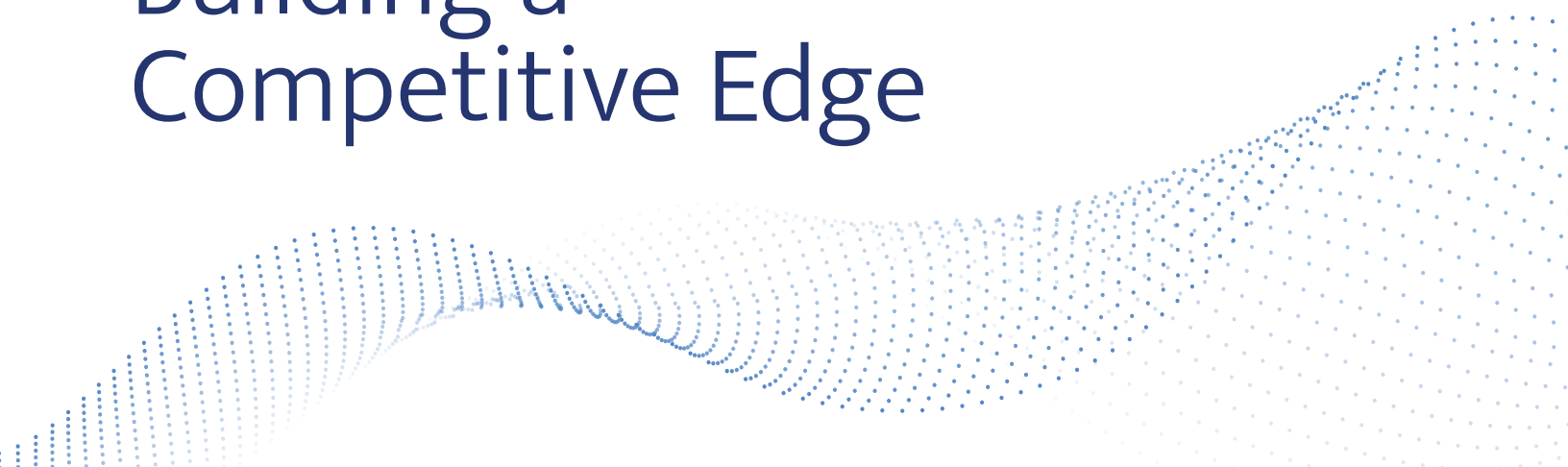# MADE WITH DATA:

How Leading Manufacturers are Building a Competitive Edge

INTRODUCTION

The rise of Industry 4.0 marks a significant turning point in the manufacturing industry. The Industrial Internet of Things (IIoT) has enabled manufacturers to generate massive amounts of data about everything from production throughput to tool longevity to machine wear and tear. With everything in a factory now connected via the internet and collecting data, manufacturers have opportunities to optimize every part of the manufacturing process, including engineering, production, and logistics. Using embedded connectivity and smart automation, this new wave of digitalization enables manufacturers to unlock new revenue streams; reduce costs; and engage with customers, employees, and suppliers like never before.

Data-driven manufacturing is the new standard, making quality data and analytics essential for success and innovation. This guide will explore how leading manufacturers leverage modern data and analytics strategies to create growth, boost profitability, and improve sustainability.

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ENGINEERING DATA AND ANALYTICS OPPORTUNITIES

Engineers have traditionally operated with limited data and limited visibility into product usage and customer feedback. Extended prototyping periods and slow testing cycles often hinder product development processes. The engineering environment is ripe for change, and the opportunity lies in leveraging data at every stage of the product lifecycle.

Advances in analytics now allow engineers to improve and accelerate design, identify problems earlier, and gain insights into customer behavior. Forward-looking manufacturing companies are incorporating analytics and optimization for quality assurance, digital twins, and 360-degree product lifecycle feedback into their operations to help engineers expedite decision-making, bring products to market faster, and develop innovative designs that resonate with customers.

QUALITY ANALYTICS

Design, manufacturability, and quality analytics can accelerate product development by identifying features that are likely to result in flaws and defects before production starts. These quality analytics require integrating data from QA, engineering, manufacturing, usage, and warranty systems to be effective. Utilizing this data, manufacturers can identify potential issues early in product development and make adjustments to prevent costly redesigns and delays, ensuring a smooth engineering process that results in high-quality products at reasonable costs.

Quality analytics and optimization benefits extend beyond faster product development and improved quality. By reducing waste and increasing efficiency, manufacturers can make products more sustainably. Sustainability is increasingly important to consumers, and manufacturers that prioritize it can gain a competitive advantage in the marketplace. Ultimately, manufacturers that leverage data and analytics to improve product quality and sustainability can boost their bottom line while positively impacting their customers and the planet.

DIGITAL TWINS

A digital twin is a virtual model of a physical product or design that can help engineers simulate and model a product's entire lifecycle. Digital twins enable engineers to predict outcomes for products in different environments, for specific use cases, or under various stress levels. Manufacturers can even use digital twins to experiment with new materials and manufacturing processes without the risk of disrupting production lines or draining resources.

Using digital twins to simulate various "what if" scenarios, engineers can collect data and test products to identify performance problems before moving to production. This way, they can adjust designs, materials, and more before investing in production or experiencing manufacturing delays, saving valuable time and resources. Digital twins enable engineers to improve product development, accelerate innovation, and optimize designs to reduce costs, enhance performance, and get products to market faster.

ENGINEERING

PRODUCT LIFECYCLE FEEDBACK

Another essential data source for engineers is 360-degree product lifecycle feedback. It provides valuable insights, like data about long-term product use, failure points, maintenance, and end-of-life, to help identify areas for improvement and optimize product designs for longevity.

This data often comes from disparate sources, including maintenance reports, machines, spare part inventory, and sales. As a whole, it can provide a comprehensive overview of the product lifecycle, allowing engineers to make more informed design choices and drive product improvements.

Product lifecycle feedback can also help engineers reduce waste, increase operational efficiency, and reduce costs. Building better products and reducing maintenance needs improves customer satisfaction, leading to better sales and more loyal customers. Leveraging product lifecycle analytics, manufacturers can drive continuous improvement and deliver products that meet and exceed customer expectations.

ENGINEERING DATA CHALLENGES

While quality analytics, digital twins, and product lifecycle feedback can be hugely advantageous to manufacturers, leveraging these tactics for engineering can be challenging.

Siloed or inaccessible data is one of the most significant obstacles. Many engineers can only access the data related to their products or departments — not data from the complete product lifecycle or other business areas. Without holistic data, engineers are basing decisions on incomplete and/or inaccurate information. This can lead to errors, delays, and increased costs. To overcome these challenges, manufacturers must break down data silos, integrate disparate data sources into a central data storage system, and give engineers real-time access to the information they need.

Another challenge is the use of legacy platforms and technologies that are not equipped to ingest and analyze the large volumes of IIoT data manufacturers create today. Outdated data platforms typically cannot process the massive amounts of data needed for quality optimization, digital twins, and 360-degree product lifecycle feedback. They often create data processing delays, errors, and inaccurate insights.

To stay current, manufacturers must invest in modern data platforms that are designed to handle large data volumes and fuel real-time analytics. Integrating different data sources and analytics processes also requires different skill sets, tools, and techniques. Manufacturers need to provide engineers with the necessary training and resources to access and navigate self-service analytics systems and effectively leverage their data to improve product development.

PRODUCTION DATA AND ANALYTICS OPPORTUNITIES

Data can offer tremendous opportunities for improving production. With the IIoT connecting machines and collecting data at every step, manufacturers can gather data from every part of their operations and get the most out of their machines, tools, and talent. They can then make more informed decisions to upgrade quality, quantity, and output speed, ultimately boosting their bottom line.

Manufacturers can further elevate the production process by analyzing throughput to increase the number of goods produced; optimizing asset usage and using dynamic digital planning and scheduling for more efficient labor, materials, and machines; and incorporating predictive maintenance to prevent machine breakdown and production disruptions. These data-driven measures make production more efficient and can reduce the adverse effects of potential labor or material shortages.

THROUGHPUT OPTIMIZATION

Throughput optimization is the process of improving the efficiency and productivity of a system by identifying and eliminating bottlenecks that impede the flow of work. Throughput optimization aims to maximize the system's output by increasing the speed and volume of the work that passes through it, making it critical for modern manufacturers. To optimize throughput for their production systems, manufacturers need to combine, access, and analyze all factory data to identify problem areas. Then, they can use those findings to streamline processes and optimize machine performance for smoother, more efficient production.

By identifying and addressing issues in real time, manufacturers can increase throughput to better meet customer demand and reduce their production cycle times, increasing productivity and minimizing downtime. Thus, manufacturers can make and ship more products without raising production costs, generating higher profits.

ASSET OPTIMIZATION

Manufacturers can significantly reduce production costs by developing analytics to optimize asset usage and create dynamic schedules and plans. When machine use is not scheduled correctly, production volume becomes uneven, leaving machines idle and creating unnecessary downtime for machines and technicians. It can also result in excess raw material inventory, which ties up capital and adds extra carrying costs.

Optimizing asset utilization based on demand and capacity requires analyzing many factory data points, including labor schedules, production cycle times, and existing material and part inventory. If manufacturers can access and integrate this data and leverage the insights, they can increase throughput, minimize employee and machine downtime, and reduce warehousing and inventory costs.

PRODUCTION

PREDICTIVE MAINTENANCE

Predictive maintenance for machinery and tools keeps machines running and producing products as efficiently as possible. By tracking usage diligently and using predictive analytics on each machine's historical data, manufacturers can predict when machines are likely to fail, when to replace tooling, and when issues are most likely to occur.

With this insight, manufacturers can take corrective action before problems occur and minimize the costs associated with machine repairs, replacement parts, and lost productivity due to downtime. Keeping close track of wear and tear on machines and tooling also reduces the likelihood of products failing quality assurance and the associated time and material costs. Ultimately, predictive maintenance results in higher machine utilization and more efficient production.

PRODUCTION DATA CHALLENGES

While more comprehensive analytics offer many production benefits, harnessing the necessary data can be challenging. Strong data engineering and integration teams are critical to creating a seamless record of all data points and data systems within a factory. Furthermore, reconciling this information with part designs, raw material inventory, and other pertinent information is essential for gaining meaningful insights. A robust modern data management system is required to efficiently collect, process, and analyze this data and generate insights that empower manufacturers to make informed decisions and maximize their production capacity.

Edge computing can help manufacturers overcome these data challenges, implement automation, and optimize operations across the factory floor. Edge computing brings computing power closer to the asset, reducing the cost and latency of moving data to the cloud to be processed, analyzed, and acted on. For example, suppose a camera or sensor monitoring an assembly line detects a product defect. An edge computing system could immediately process this information and signal the assembly line control system to halt production and remove the faulty product from the line, with little or no delay.

Edge computing facilitates real-time monitoring of machine performance, thereby reducing the risk of downtime and improving efficiency, productivity, and product quality. In contrast, manufacturers that still rely on legacy data platforms and outdated analytics technologies often cannot effectively access, collect, and use the data their factories generate.

SUPPLY CHAIN DATA AND ANALYTICS OPPORTUNITIES

Manufacturers must be agile and responsive to changing market conditions in today's fast-paced global marketplace. Supply chains are often unpredictable, so having quality data to track everything from material sourcing to product delivery can provide a significant competitive advantage.

Geopolitical factors constantly force supply chains to adapt. Factors such as tariffs, trade agreements, and political instability can rapidly impact manufacturers' ability to procure raw materials and deliver finished goods on time. By staying on top of all the factors that may impact their supply chains, manufacturers can create a more efficient and adaptable global supply chain, helping them gain a competitive edge in the marketplace.

Manufacturers need to forecast demand early enough to optimize procurement processes and source goods from the most cost-effective vendors. With growing demands for sustainability, manufacturers must also closely monitor their supply chain flow and inventory to optimize shipping paths and reduce their carbon footprint. Manufacturers that embrace modern data and analytics strategies can adapt quickly to changing market conditions, improve sustainability, and identify opportunities for optimization.

SOURCING

Effectively sourcing and purchasing raw materials based on accurate demand forecasts is essential for manufacturers seeking to minimize fixed production costs and maximize profitability. Doing so requires creating forecasting models based on financial, customer, and business data. However, demand forecasting is only a small part of optimizing a manufacturer's procurement processes.

Raw material prices are variable and fluctuate significantly based on the geopolitical landscape, natural events, seasonality, scarcity, and many other factors. Incorporating real-time third-party data into internal procurement systems can ensure procurement teams are fully informed to select the best material options and buy in optimized quantities. Pairing this external data with internal inventories and forecasts enables manufacturers to buy optimal material quantities at optimal costs, improving profitability.

SUPPLY CHAIN CERTIFICATION

Supply chain certification is increasingly important for manufacturers seeking to meet rising consumer and regulatory demands for accountability and sustainability. In order to be confident that they are using the most sustainable goods and methods available, manufacturers must track the journey required for certification from raw materials to finished goods. This requires them to have access to accurate and timely supply chain data to verify the origin and sustainability of their products and comply with regulations.

Supply chain certification helps manufacturers demonstrate that each vendor in their supply chain is providing high-quality, sustainably produced supplies. Publicizing these sustainability tracking and verification measures can help manufacturers improve their brand reputation and gain favor from consumers. In fact, **66% of US consumers** are willing to pay more for sustainable products. For manufacturers and retailers, being able to track the complete lifecycle from raw material to finished goods requires understanding and tracking sustainable certifications in each step of the process.

SUPPLY CHAIN

DIGITAL FLOW AND INVENTORY TRACKING

Manufacturers must adopt a comprehensive digital tracking system of their material and product flows and inventories to gain a complete picture of their supply chain, identify weaknesses, automate processes, and optimize performance. For supply chains to operate efficiently, each element needs to be tracked meticulously, including:

- Sources of goods

- Pace of production and assembly

- Shipping times

- Shipping frequency

- Part acquisition costs

- Import and export taxes

Doing so requires integrating data from different supply lines, factories, and retailers into a comprehensive digital tracking system for analysis and reporting.

These tracking systems are a crucial resource for manufacturers looking to save money and produce goods more efficiently. This visibility empowers manufacturers to monitor supply chain activity and adjust production volumes quickly in response to changing conditions, minimizing the impact of disruptions and improving performance.

Comprehensive data collection processes can also be valuable when navigating programs like IMMEX, which offers tax incentives to authorized companies operating manufacturing plants in Mexico. Companies participating in IMMEX can achieve massive tax savings but must provide detailed tracking of products from raw materials to finished goods.

SUPPLY CHAIN

SUPPLY CHAIN DATA CHALLENGES

Supply chains often generate siloed data from numerous internal and external sources. Data from different transportation methods, warehouses, and destinations may all have different origins. This can make it difficult for manufacturers to measure their supply chain performance comprehensively, including metrics about lead times, transportation costs, and inventory management levels, and identify improvement opportunities.

Manufacturers need access to data from all parties involved in the supply chain to ensure that the journey of all materials and goods can be certified from beginning to end. They must also integrate different data sources and tools to generate comprehensive analytics and optimize their supply chains. Creating a single golden record of supply chain data requires a robust data management system that can efficiently process an endless stream of data and serve it up for analytics and insights that empower business leaders.

DATA AND THE FUTURE OF MANUFACTURING

The future of manufacturing is promising as more manufacturers recognize the benefits of adopting data-driven strategies, supporting an ongoing focus on innovation and a desire to improve inefficient legacy processes.

By embracing Industry 4.0 technologies like the IIoT, artificial intelligence, and machine learning, manufacturers will be able to collect and analyze data from across the manufacturing process in real time to optimize engineering, production, and supply chain operations. Ultimately, this will result in better products, improved customer service, reduced waste, higher efficiency, increased sustainability, and other business benefits.

Implementing Industry 4.0 technologies and data strategies requires custom solutions built by data management experts with deep manufacturing industry expertise. Wavicle Data Solutions is a leader in helping global manufacturers access accurate data and increase visibility into their manufacturing organizations. Our experts will help you realize the value of your data and use it to build a competitive edge.

Learn more at wavicledata.com.

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DATA SOLUTIONS

Wavicle Data Solutions provides award-winning cloud data and analytics solutions that accelerate value, reduce risk, and empower our clients to make smart, data-driven decisions.

Our manufacturing data and analytics experts work with customers to create infrastructures and processes that improve visibility into every part of the manufacturing process, from product development and engineering to supply chains. Using our proprietary accelerators and frameworks to expedite data and analytics initiatives, we can help integrate disparate data sources from factories, suppliers, and customers into modern data management and analytics solutions to drive operational efficiencies and improve decision-making. Contact us today to see how we can help you improve your engineering, production, and supply chain processes with cutting-edge data and analytics solutions.