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Manufacturing to the Power of Digital

Smart Manufacturing:

An executive's guide to digitalizing manufacturing operations

Enterprise to the Power of Digital™

Introduction

Globally, the manufacturing sector is undergoing rapid transformation. On the one hand, there is a rising need for collaboration across disparate supply chains, encouraging visibility across upstream and downstream channels. On the other hand, customer expectations are changing, influenced by an increasingly consumerized world. Today, customers expect accelerated delivery, accurate fulfillment, and superior experiences without incurring unwanted costs.

> Manufacturers who are unable to live up to this promise stand to lose out on crucial business opportunities and would struggle to scale. To overcome this shortcoming, manufacturers need to leverage the power of digitalization and reimagine traditional manufacturing plants as “Smart Factories.”

The drive towards Smart Factories is perfectly encapsulated in the Industry 4.0 trend. Initially popularized by the industrial economies of Europe, Industry 4.0 is now a priority for nearly every manufacturer in the world. It refers to the widespread digitalization of operational systems, giving them networked capabilities to facilitate the seamless exchange of data. A proactive adoption of this this strategy has significant implications across the manufacturing value chain, from collecting machine data for predictive equipment maintenance to digitalized personal training, and smarter customer interactions. However, studies suggest that only 10% of manufacturing companies that are “digital champions” have achieved their Industry 4.0 goals.[1]

That’s why there is a lot of interest and investments in Smart Factory technologies, a market poised to reach $155 billion by 2025 at a 10% CAGR. Through the strategic intervention of digital innovation and the timely adoption of Smart Factory solutions, manufacturers can find one step closer themselves to 4.0 and gain from digitalization.[2]

Unraveling the Smart Factory Concept

In a Smart Manufacturing world, the next-gen technologies empower every plant, process, and stakeholder that is involved in the operations. This involvement is critical to overcoming some of the long-standing challenges plaguing the manufacturing sector:

Market forces

Fierce competition from smaller, more agile market entrants
Slow response to market changes
The risk of losing out on business opportunities

People and process gaps

Shortage of skilled talent, especially in emerging tech
Rigid processes that are difficult to scale
Lack of visibility across the supply chain

Rapid digitalization of manufacturing

Protracted timelines for digital transformation
Under-utilized automation potentials on the factory floor
Cybersecurity around as more systems become networked (hence vulnerable)

To address these issues, manufacturers must reconfigure/replace/retire traditional IT with Smart Factory-ready solutions. New model that are the norm in the Industry 4.0 era take advantage of a variety of cutting-edge technologies, integrated via smart manufacturing solutions. Some of the core areas covered here include the Internet of Things (IoT), blockchain, big data analytics, artificial intelligence (AI), machine learning, the cloud, robotic process automation, immersive technologies, and mobility solutions.

IoT is among the core technologies behind the Industry 4.0 vision. It connects physical or operational systems (like manufacturing equipment, vehicles, safety devices, to name a few) with IT capabilities. Progressive manufacturing enterprises are now eager to explore creative ways to use IoT. Recently, in 2019, Pilkington Automotive equipped a warehouse with IoT sensor-enabled smart lights.[3] The objective of this initiative is to solve a higher purpose: positively impact the environment and cut down waste. The IoT data gathered from 1300 ceiling lights across the facility helps and cut down on waste to monitor employee movements, optimize space usage, reduce energy consumption, and even make decisions in operational areas like order picking. Examples like this rely on the combination of IoT and advanced analytics.

The data acquired can be fed into an advanced analytics engine to extract insights. Previously the acumen for decision making, disciplines, assembling the same is a challenge in itself. But in a Smart Factory, analytics is augmented using sophisticated visualizations and easy-to-use dashboards, to democratize insight access for every manufacturing stakeholder.

Komatsu, the Japanese heavy equipment maker, had connected multiple next-generation devices in its production facilities to the cloud, which helps the production supervisors to monitor the shop operations in real-time. Komatsu went to acquire an American mining equipment maker Joy Global, which had connected shop ecosystem that could send 42000 data points per minute to the data center team that monitored dashboards for operational excellence.[4]

In future-ready factory floors like this one, personnel can receive real-time insights into machine wear-and-tear, and production speed. These insights can be made more accurate by implementing AI and ML techniques.

PepsiCo benefits from the power of AI using intelligent automation and IoT. At one manufacturing plant responsible for PepsiCo's Frito-Lay lineup, an ML engine determines how to manage the chips production line best. The potato wafers receive automated lasers at a particular angle; IoT sensors then detect the resulting sound. ML processes the audio and matches it with historical sound patterns to predict the correct texture. Finally, this generates actionable insights on how to configure a system for optimum texture and quality.[5]

Apart from IoT, analytics, and AI, Blockchain is another area of keen interest for manufacturers, expected to grow at an incredible 80% CAGR between now and 2025.[6] Blockchain creates a transparent, immutable, encrypted ecosystem across the manufacturing supply chain that can exchange secure and verified data. Blockchain has several promising use cases in Smart Manufacturing.[7] For instance, it enables smart contracts that help align freshly on-boarded suppliers to new terms and conditions without adding to transaction costs or timelines. At Birlasoft, we have implemented a component-level automation framework for smart contracts that makes the multiple tasks of supplier management (registration, identity management) more straightforward and more secure.

Another focus area is Robotic Process Automation, currently a mature market for manufacturers. By 2024, RPA will be worth over $5 billion globally, thanks to the high level of accuracy and efficiency it provides.[8] Siemens coupled RPA with AI-based platforms like IBM Watson and Google's natural language translation to strengthen its automation capabilities. From just 50 automated processes at the start of the project, Siemens scaled to 170 new processes in less than a year. In the end, the company automated 280,000+ additional hours of effort as a result.[9]

And all of this relies on compatibility with big data formats and mobile access, supported by a cloud-based hosting environment. Manufacturers are already adopting SCADA solutions at scale, capable of processing data in real-time, to generate timely insights. Manufacturing Execution Systems (MES) have moved to the cloud, enabling easy scalability and quick connectivity with new data sources.

Sanmina Corp. (an electronics manufacturer) is using cloud-based MES as part of its Industry 4.0 strategy. The company has on-boarded 35,000+ pieces of equipment to the cloud, and this has enabled seamless integration across 50+ factories in 50+ countries.[10]

Finally, mobility is essential for delivering insights while on the move - a game-changer for field personnel. An employee looking to service equipment at a manufacturing plant can significantly reduce their Mean Time To Repair (MTTR) by referring to the valid data while on the move.

What constitues 'Smart' in a Smart Factory?

> IoT, analytics, AI, Blockchain, mobility, 6G, cybersecurity, immersive technologies, and mobility are the key underlying technologies that are at the center of Smart Factories. While IoT, mobility, analytics, and the cloud are witnessing large-scale deployments, AI, Blockchain, 6G communications, cybersecurity, and quantum technology represent the next frontier.

Interest and investment in these areas will be critical as CXOs look at establishing themselves as Industry 4.0 pioneers.

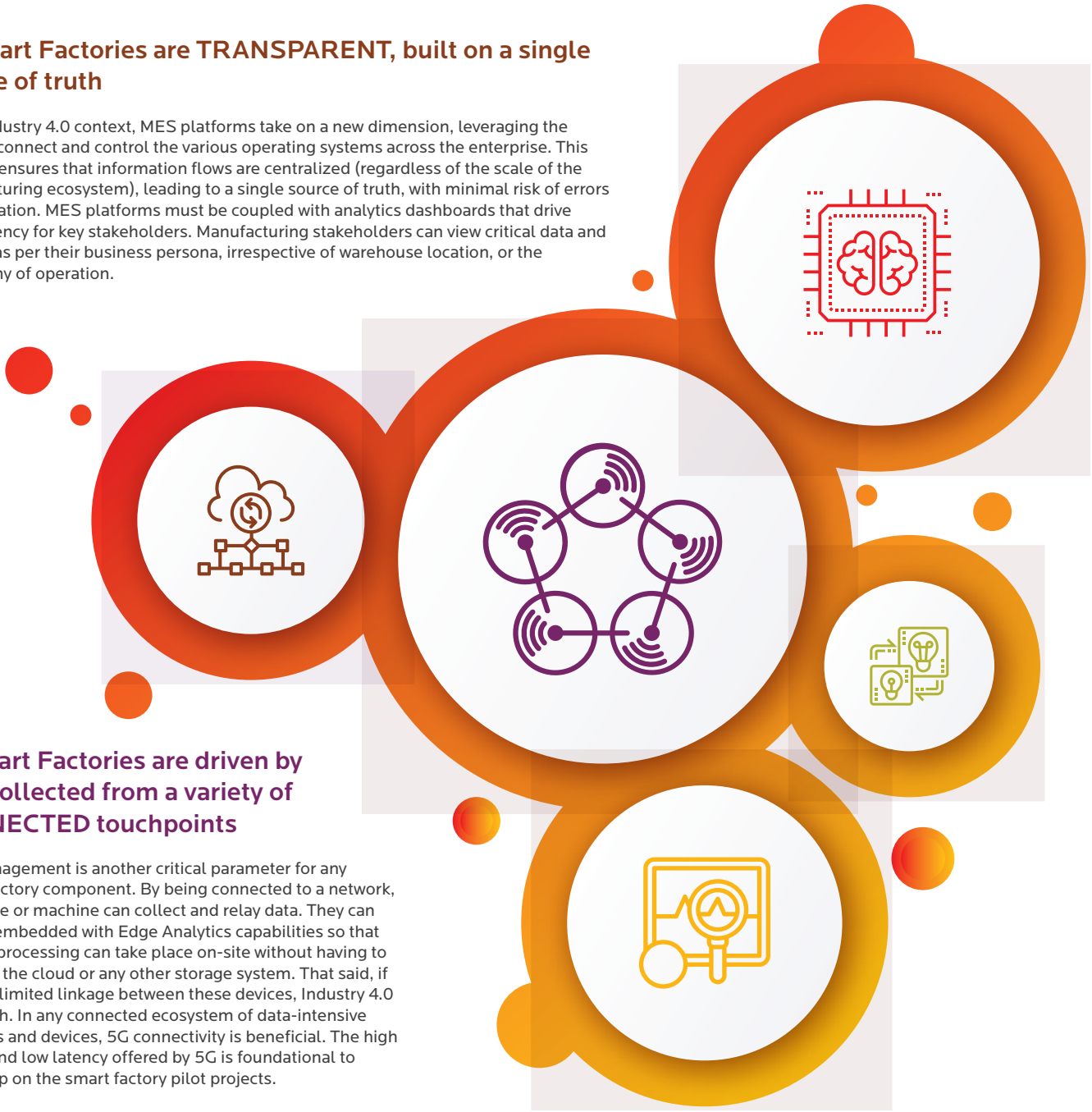
Together, these technologies will help CXOs reimagine their enterprises as TOUCHLESS, TRANSPARENT, CONNECTED, REAL-TIME, and SCALABLE

1. Smart Factories aim towards TOUCHLESS systems

AI, chatbots, and intelligent business dashboards are enabling self-service analytics. By automating the entire plant data collection process and removing human intervention in iterative tasks, factories are becoming become nearly touchless. As a result, human efforts are redirected towards more value-generating activities such as product design/conceptualization and customer management.

2. Smart Factories are TRANSPARENT, built on a single source of truth

In the Industry 4.0 context, MES platforms take on a new dimension, leveraging the cloud to connect and control the various operating systems across the enterprise. This upgrade ensures that information flows are centralized (regardless of the scale of the manufacturing ecosystem), leading to a single source of truth, with minimal risk of errors or duplication. MES platforms must be coupled with analytics dashboards that drive transparency for key stakeholders. Manufacturing stakeholders can view critical data and insights as per their business persona, irrespective of warehouse location, or the geography of operation.



3. Smart Factories are driven by data collected from a variety of CONNECTED touchpoints

Data Management is another critical parameter for any Smart Factory component. By being connected to a network, any device or machine can collect and relay data. They can even be embedded with Edge Analytics capabilities so that the data processing can take place on-site without having to plug into the cloud or any other storage system. That said, if there's a limited linkage between these devices, Industry 4.0 will perish. In any connected ecosystem of data-intensive machines and devices, 5G connectivity is beneficial. The high speeds and low latency offered by 5G is foundational to scaling up on the smart factory pilot projects.

4. Smart Factories enable actions in REAL-TIME and not just react to past events

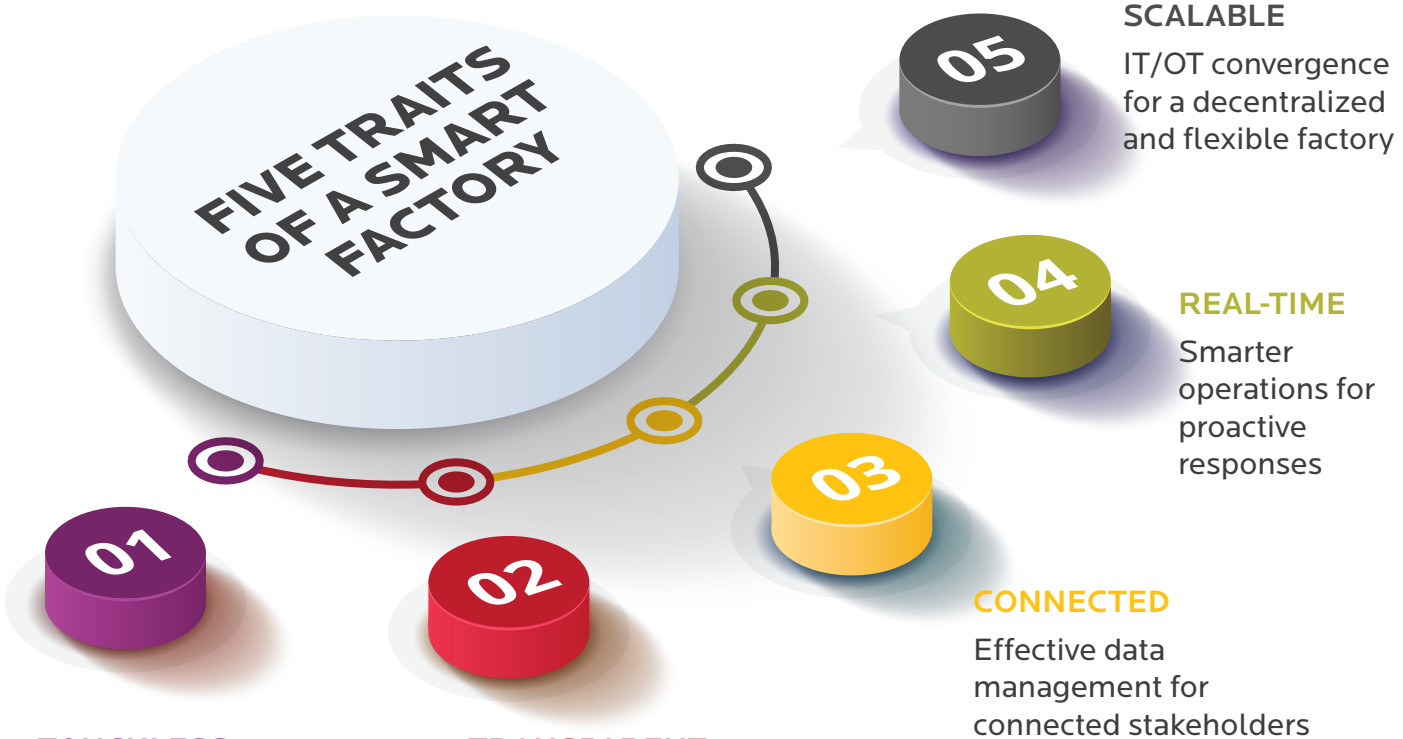
Smart manufacturing systems help enterprises monitor the factory floor in real-time, aided by notifications delivered to a stakeholder's mobile device. Automated alerts on operational events such as order arrival, inventory shortage, etc., as well as updates on when specific KPI thresholds are crossed, are pivotal for manufacturers looking to go beyond a reactive approach to operations management.

5. Smart Factories are easily SCALABLE, without retrenching existing infrastructure

The transformation would become unsustainable if not supported by easy scalability. An enterprise-specific solution deployment model (on-premise, public, hybrid, or multi-cloud) speeds up new technology implementation and time-to-market. Therefore, Smart Factories showcase increased flexibility, where central, regional, or decentralized deployments fit into the enterprise framework without causing fragmentation.

Most importantly, Smart Factories are built on the cohesive and coherent coming together of information and operational technology systems, also termed the 'IT/OT intersection'. It implies that every system on the factory floor should be networked and become a data collection node. At the basic level, this data is relayed to cloud platforms like MES to extract insights. Further, OT systems will be furnished with edge analytics capabilities so that real-time data streams are immediately processed to generate insights without needing a centralized system. This is enabled by Industrial IoT (IIoT) – predicted to become a $771.72 billion market by 2026.

That said, the converged IT/OT environment is susceptible to cyber threats, which can bring the entire smart factory operation to a halt. No wonder, every smart factory needs to have a cybersecurity shield that can prevent security breaches like denial-of-service attacks and security incidents.



TOUCHLESS
Intelligent automation for value creation

TRANSPARENT
Single source of truth for an efficient ecosystem

CONNECTED
Effective data management for connected stakeholders

REAL-TIME
Smarter operations for proactive responses

SCALABLE
IT/OT convergence for a decentralized and flexible factory

Unraveling the Smart Factory Concept

In a Smart Manufacturing world, the next-gen technologies empower every plant, process, and stakeholder that is involved in the operations. This empowerment aims to address some of the key priorities of the manufacturing sector:

Faster inventory replenishment and lesser waste

Instead of waiting for an order to come in, and then initiating the procurement cycle, Smart Factories predict demand and auto-stock supply accordingly. This optimizes the use of warehouse space and prevents the waste of products, particularly relevant for manufacturers dealing with perishable goods. We deployed an inventory management solution for a cement company to predict demands based on multiple parameters. Through accurate forecasting and automated replenishment, the company was able to save 3% in logistics costs while also reducing adverse events by 18%. To know more about how machine learning can help demand planners improve the forecast accuracy, read here.

Reduction in transportation costs

By embedding vehicles with IoT-enabled sensors, operational managers can monitor driver behavior, and shipment quality as the vehicles move through remote regions. Telematics is a vital innovation in this context, equipping vehicles with a range of data-driven systems, saving costs in terms of fuel wastage, improper driver behavior, and loss to quality. Birlasoft equipped the vehicles owned by a shipping company with diagnostic and remote monitoring capabilities. As vehicle location and driver behavior data flowed in, in real-time, the company was able to increase vehicle use by 4% along with a 12% reduction in driving incidents, positively impacting costs.

Seamless supplier collaboration

Smart Factories make it possible to explore new business models such as B2B2C. In the B2B2C model, interactions and transactions rely on multiple suppliers to be completed. Blockchain will enable smart contracts that can be auto-executed with supplier details and remain secure while ensuring transparency for everyone involved.

Smarter upskilling for personnel

It is imperative to adopt technologies that help to address the skills shortage currently faced in manufacturing. Augmented and Virtual Reality (AR and VR) should help optimize operations on the shop floor, including better upskilling/reskilling for factory workers, always-on safety monitoring, and even enhanced product design & development. At Birlasoft, we've developed AR-based solutions that support personnel with a visual workflow and voice assistance. This led to a 25% increase in productivity and 6X times reduction in picking errors in smart warehouses. To know more, read here.[11]

Improved asset utilization

One of the key benefits of IoT systems is its ability to transmit data in real time, thereby providing better visibility into manufacturing assets. Coupled with on-device Edge Analytics, manufacturing personnel can obtain real-time data that secures high-value shipments while being transported, ensures employee safety in field conditions, and streamlines product movements within warehouses. We enabled real-time tracking of hi-tech assets that are always in motion. This helped to improve asset utilization by 3%, in turn enhancing customer satisfaction and revenues.

	AI/ML	Blockchain	IoT	Automation	Immersive Tech	Mobility
Supplier collaboration	Compliance risk analysis for supplier on-boarding	Self-verification and onboarding of eligible suppliers through smart contracts	Notifications and prompts to manufacturers on vendor performance, regulatory and contract failures		Usage of Immersive tech for original-equipment demos and trials	Usage of mobile applications to assess supplier performance in areas of sustainability, CSR and sanctions info
	Slice and dice analysis of supplier spend information with respect to geography, part category and supplier type	Immunization of critical supplier credentials/qualifications from forgery	New vendor identification and automated post approval proposals	Intelligent automation led supplier selection for efficient onboarding	Usage of AR to diagnostics of equipment issues and fixing them in collaboration with suppliers	
	Legal fee reduction and improved deal cycles though ML optimization	Smart contract management for effective supplier onboarding	Leveraging IoT data for faster contracts creation and just in time contract termination notification to vendors	Automation of contract assessment for identification of deviations from standard practices		
	Determining Purchase price variance for assisted negotiations	Constant updation of suppliers in the procurement system though digital ledgers	Supplier involvement in predictive decision makings in procurement for optimizing schedules	Automation of supplier EDI configuration based on prescribed email communication from e-Commerce to plants	AR based communication environments between manufacturer and supplier for improved collaboration	
Procurement	Real time performance outputs of procurement through data visualization and effectiveness scorecards	Calculation of accurate volume discounts based on onboarded suppliers in the blockchain ecosystem	Enhanced analysis of vendor's stock usage by OEMs by having improved spend patterns study		Analysis of products/ services through an AR/VR based digital catalogue for product selection/ sourcing	
	Cash flow improvement and increase in working capital through predictive spending model	Reducing procure to pay gaps for executing supplier payments	Improved cash flow management by elimination of human error	End to end automation of AP leading to reduced cycle times and error minimization		ERP based apps to speed up the supplier invoice processing
	Automation of receipt processing through Machine learning	Tokenization of assets to integrate payment approvals with delivery	Stock monitoring delivered by vendors for optimal stock levels with the manufacturers	Automation of supplier EDI configuration based on prescribed email communication from e-Commerce to plants		ERP based apps to perform inventory, receiving, and shipping transactions
	Chatbots to facilitate and communicate product returns	Asset tracking to facilitate product returns and refunds	IoT enabled quality and stock checks for managing supply returns	Rule-based RPA system to filter out sub optimal quality spare parts for returns	Usage of AR with blockchain to manage returns in case of counterfeit product supply	

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	AI/ML	Blockchain	IoT	Automation	Immersive Tech	Mobility
Supply and Demand planning	Machine learning techniques to predict market demand	Cryptographic tagging to prevent counterfeit and pirated goods	IoT and Big Data driving demand sensing with point of sales data leading to minimum forecast errors and better ROIs	Automation of demand plan refinement to maintain the right inventory levels	Usage of immersive tech by shop floor engineers to connect with their suppliers for enhancing supply chain planning activities	
	Anticipation of back orders/phantom demand through predictive modelling to improve CSAT scores	Reduction of constraint and increasing transparency in the planning process by reducing intermediary in supply chain	Real-time inventory status leads to an accurate order schedule and better consumption planning			
Smart logistics	Inventory floor-space optimization using machine learning models.	Asset tracking to improve inventory visibility across supply chain	Leveraging IoT data for inventory optimizations for having optimal inventory on hand and improved fill rates	Safety stock calculation automation to square off demand variability/Back order automation	Smart glasses-based warehouse picking for error free inventory management	Usage of app to perform inventory transactions by accessing master data from ERP systems
	Autonomous robots for warehouse operations		IOT usage for automatic navigation, optimization, product accuracy and fork lift truck usage and health monitoring	Generation of service reminders on warehouse equipment using Automation	Smart glasses-based warehouse picking for efficient workforce	Usage of Mobile WMS for prioritizing replenishment, stocking, transferring
	Classification algorithms to detect fraudulent orders	Establishing transparency in the order delivery process through asset tagging		Work order management process automation for revenue growth		Application to import, manage & ship orders from multiple selling channels
	Predictive models to improve order fulfillment and prevent delays	Tracking assets that are in transit to ensure end to end real-time visibility across distribution channel	Smart packaging solutions for product authentication, tracking logs, and product reorder automation		AR based packaging for improved customer engagement	Usage of GPS applications for monitoring vehicle and asset movement
	Cognitive automation to perform rule-based tasks	Automatic digital invoicing and payments upon proof of delivery	Truck surveillance and monitoring Assets and delivery track and trace	Manufacturer Freight Forwarder collaboration	Usage of AR based devices for optimized cargo loading leading to a accelerated freight loading process	Usage of ELD apps for tracking hours of service for transporters

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	AI/ML	Blockchain	IoT	Automation	Immersive Tech	Mobility
Manufacturing Operations and Maintenance	Machine learning model to improve accuracy on lead time	Usage of smart contacts for scheduling maintenance and ordering spare parts in-line with service level agreements (SLAs)	Production flow monitoring and condition-based alerts	Supply chain planning - production planning alignment	Improved workforce decision making on the assembly shop floor through AR based smart glasses	Usage of mobile dashboards communication and tracking of daily production plans
	Predictive maintenance for fault detection improving OEE		Predictive Maintenance leading to huge cost savings and ROIs Remote equipment monitoring	Data consolidation through automation to facilitate real-time asset monitoring for improved service levels and shorter cycle times	Improved workforce decision making on the assembly shop floor through AR based smart glasses	Usage of mobile dashboards communication and tracking of daily production plans
Quality Control	Minimizing product recalls though computer vision technology	Usage of blockchain as Immutable, shared record to store all necessary quality checks before dispatch	Monitoring critical and perishable items for preventing pilferage and loss	Rule-based RPA system to improve QC and cut down on wastage	AR based overlays to compare the actual assembly part with the image of the part provided by supplier for any quality deviations	Usage of QC inspection checklist apps for executing production quality assurance
	Anomaly detection in the emission process to prevent hazards		Workers safety on manufacturing premises by alarms and alerts		Immersive training modules for simulation-based exercises	

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Accelerating Your Journey Towards Smart Manufacturing: The Way Forward

To implement Smart Manufacturing solutions, CXOs must follow a carefully calibrated roadmap. The stepping stone to this journey begins with a thorough assessment of the "as-is" landscape, getting to the root of the challenges, and outlining a robust execution strategy comprising best-fit digital tools. To ensure the highest possibility of being first-time right, manufacturers can partner with technology veterans with battle-tested expertise in Industry 4.0 transformation. Briefly, the transformation roadmap looks as follows:

Start with why

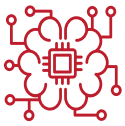
Map out your business priorities, short to long term strategy with the digital transformation goals your firm needs.

Move on to assessment

Break down your "as-is" value chain across supply & procurement, on-floor operations, inventory management, and logistics & distribution, in terms of critical dimensions.

Time to benchmark

Compare the various dimensions with the benchmark data to assess the digital transformation maturity index of your value chain.



Zero in on a "smart" answer

Align challenges/opportunities to industry use cases, mapping out the digital tools needed to generate value (for example, IoT, advanced analytics, AI, Blockchain, etc.). While you're at this step, you need to shortlist the right set of vendors that bring to life the various use cases your company needs.

"Scale up" with mini-smart factories

Extend the scope of your successful smart factory experiments to a broader scale and continuously monitor the outcomes with the benchmarked data/metrics.

Build the "digital culture"

Assess the company culture to identify transformation stakeholders, understand the appetite for digitalization, and figure out change management needs.

Following these six foundational steps, manufacturers can look forward to a smart landscape that's geared for sustained productivity, greater scalability, improved efficiency, and optimal asset utilization.

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Birlasoft combines the power of domain, enterprise and digital technologies to reimagine business processes for customers and their ecosystem. Its consultative and design thinking approach makes societies more productive by helping customers run businesses. As part of the multibillion-dollar diversified The CK Birla Group, Birlasoft withits 10,000 engineers, is committed to continuing our 157-year heritage of building sustainable communities.