

Forging the future

Navigating the New Era of Industrial Manufacturing

Disruptive Trends Radar 2024 - 2025

Evolution of Technology Trends in the Industrial Manufacturing Industry



The future success of manufacturing organizations will rely not just on **adopting new technologies and trends, but on how smoothly they bring them together.**

The post-pandemic landscape has brought a clear surge in digital investments within the manufacturing industry, spanning across sectors such as Industrial, Automotive, Aerospace and Defense (A&D), Process, and Engineering and Construction (E&C). The key areas of focus include:

- **Improved customer experience and commercial excellence:** Establishing Direct-to-Customer relationships and reducing reliance on intermediaries have become critical goals across sectors. Customer experience solutions including eCommerce for Equipment, Services, and Software, are essential for driving cross-selling opportunities and enhancing brand loyalty. This approach requires agile Configure-Price-Quote (CPQ) solutions, especially for managing complex quotes that enable faster responses and higher win rates. In the automotive sector, the shift towards direct customer engagement across sales and service is transformative. Real-time and dynamic pricing models are increasingly important for maintaining competitiveness.

- **AI and data and analytics:** As organizations strive to become more data-driven, there's a shift in focus from merely reducing technical debt (by streamlining pipelines, data organization, and consumption) to creating data products with functional value and agility for critical business functions like Supply Chain, Finance, and Manufacturing. A purposeful AI strategy—encompassing Artificial Intelligence (AI), Machine Learning (ML), and Generative AI (Gen AI)—has become a cornerstone of this evolving data strategy.
- **Integrated supply chain and digital factory modernization:** There is a heightened focus on improved sales, inventory and operations planning functions across industry segments to address key gaps in both inbound and outbound supply chain performance. Integrated digital factory modernization initiatives, aimed at enhancing throughput from existing factory lines, are also gaining momentum. Efforts to automate factory operations, such as transitioning from Dark to Semi-Dark Factory initiatives and incorporating Augmented and Virtual Reality (ARVR) for worker engagement, training, and

productivity, are critical for achieving better predictability and higher output.

- **Connected platforms for aftermarket expansion:** Every customer is rapidly increasing the connected nature of the equipment and services they sell to capitalize on Annual Recurring Revenue (ARR) opportunities. Across sectors, high-margin aftermarket opportunities are at the forefront of these platform-focused strategies.

The future success of manufacturing organizations will depend not only on the adoption of these technologies and trends but, more importantly, on their seamless convergence. Only by integrating these diverse initiatives can companies drive real, sustained growth in a digitally transformed world.

Rajesh Sundaram
EVP, Chief Business Officer, Manufacturing

Transforming Manufacturing: Embracing Modernization and Smart Engineering



A holistic approach **combining technology, training, and worker well-being** drives sustained gains.

In the rapidly evolving landscape of industrial manufacturing, innovation and current technology trends are driving strategic priorities and technological advancements. The industry continues to transform, emphasizing speed and efficiency in today's fast-paced world, and AI plays a pivotal role across the entire value chain.

Our research concludes that manufacturers increasingly favor Servitization As-a-Service and Direct-to-Consumer (D2C) models. Their goal is to capture lifetime customer value and meet emerging demands better in the longer term. Beyond mere product sales, manufacturers now offer bundled products, software, and service subscriptions. This gradual shift is transforming the aftermarket into the core market. The ongoing servitization blurs the lines between product sales and warranty, fueled by product subsidies.

To remain competitive, manufacturers are turning to manufacturing modernization. Implementing modernization at multiple levels enhances visibility and updates network and cybersecurity foundations. New PLCs (programmable logic controllers), scalers, and

MES (manufacturing execution systems) are directly integrated for command and control on the shop floor.

The rise of AI, sensor economy, robotics, digitalization, Industry 4.0, and digital twins underscores the critical need for smart engineering in manufacturing. Customers demand customization, complexity, and speed. Intelligent machines now operate autonomously, adjusting processes via digital instructions. The future lies in integrated production lines with real-time data from sensors and internet connectivity. This shift from manual to smart, adaptive engineering processes highlights the importance of advanced technologies, positioning us at the forefront of manufacturing innovation and excellence.

A larger number of manufacturers focus on improving worker productivity. A holistic approach combining technology, training, and worker well-being drives sustained gains. The focus on productivity influences financial success, operational sustainability, and organizational competitiveness.

Many industrial manufacturers grapple with legacy applications. Modernizing systems is paramount for enhancing operational efficiency. Notably, substantial

investments are directed toward migrating to cloud-based and secure systems, bolstering efficiency and operational agility. These transformative efforts position manufacturers as industry leaders, poised to thrive in a competitive market.

We at LTIMindtree, foresee the future of industrial manufacturing shaped by digitization, modernization, smart engineering, worker productivity, and core modernization.

Naushad Khambhawala,
VP, Delivery Head - Manufacturing

The Journey of Creating the Manufacturing Radar



LTIMindtree Crystal Manufacturing Radar Report empowers industries to make faster and smarter decisions based on existing and emerging technology trends in the manufacturing domain.

“The best way to predict the future is to create it.” – Alan Kay

Innovation and proactivity go hand in hand in the world of manufacturing. By embracing this mindset, we can anticipate and drive changes, turning visionary ideas into tangible realities that define the collective industrial future. LTIMindtree Crystal Manufacturing Radar Report empowers industries to make faster and smarter decisions based on existing and emerging technology trends in the manufacturing domain.

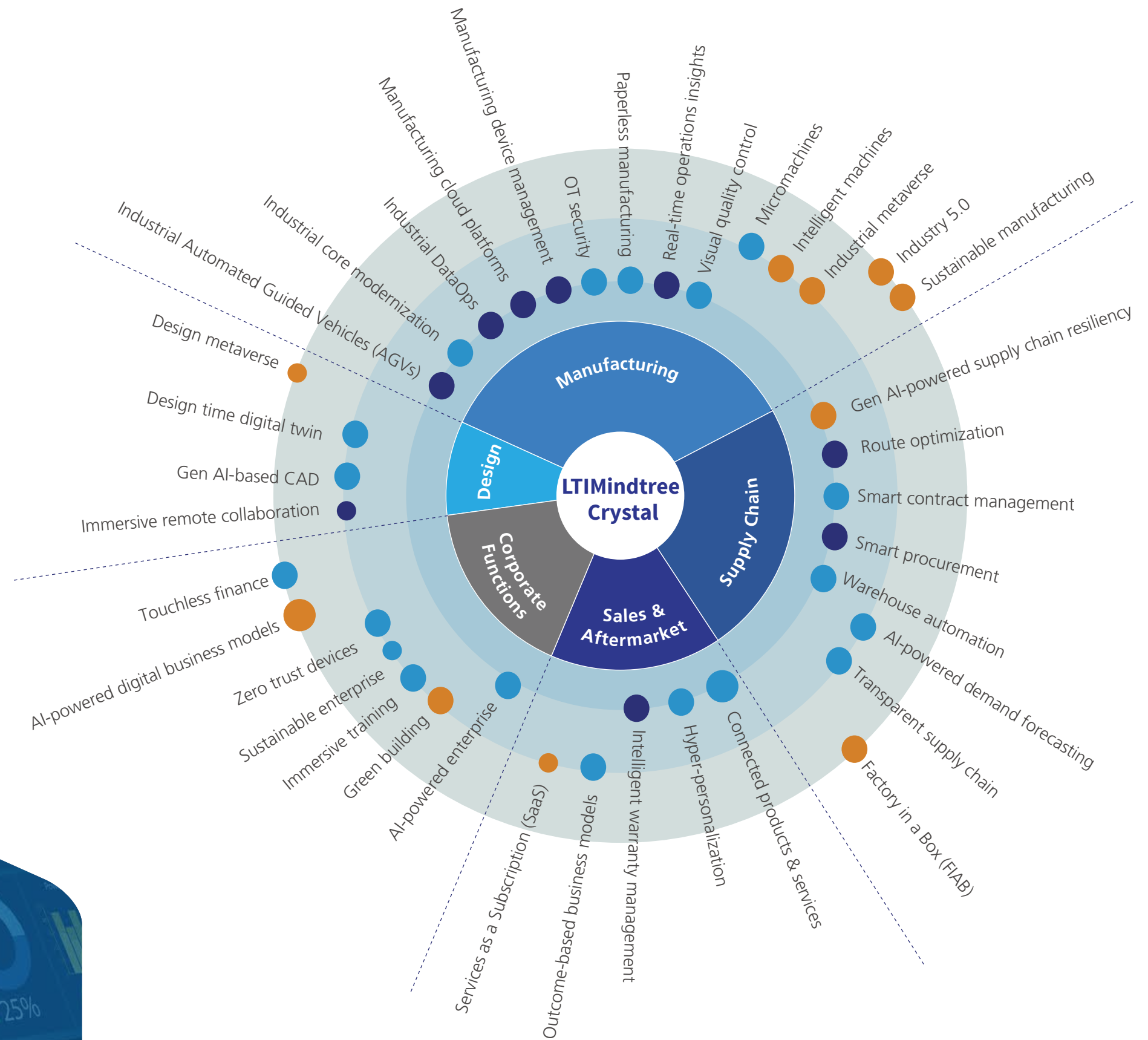
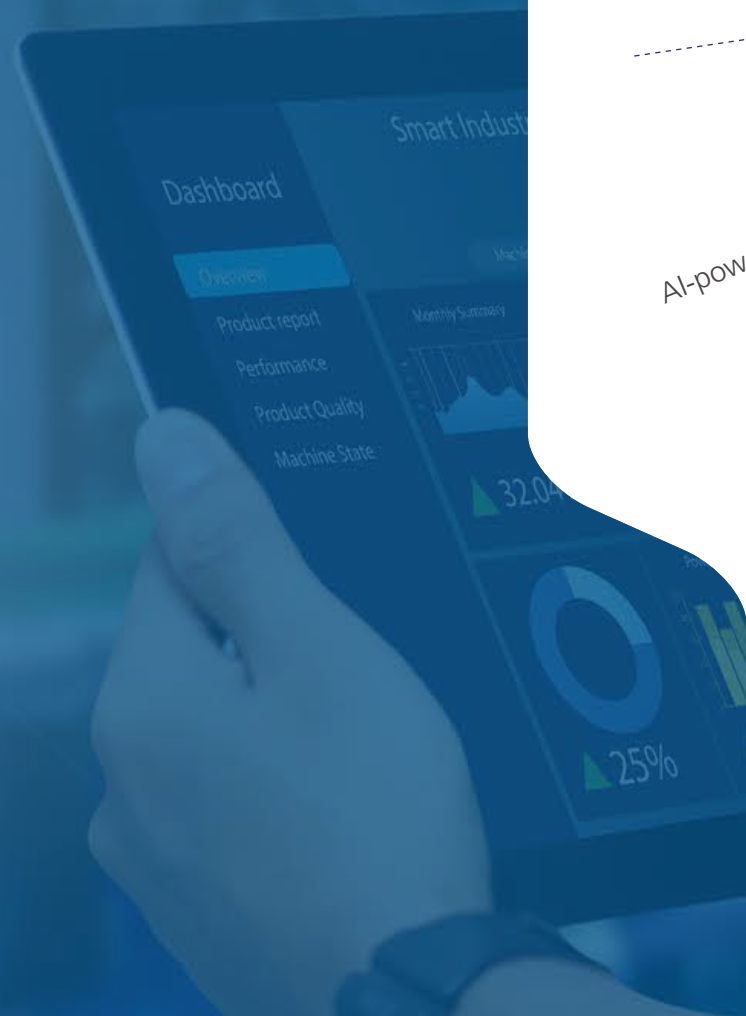
To craft a comprehensive manufacturing radar, we initiated with an in-depth grasp of the industrial domain's needs, carefully defining the scope, segmentation, and rating parameters to align with stakeholder expectations. The pivotal phase entailed identifying pertinent technology trends which was subjected to a stringent vetting process. Their real-world case studies underpinned the accuracy and pertinence of our analysis, illustrating how innovations like LTIMindtree's smart manufacturing are transforming the sector by boosting efficiency, customer satisfaction, and sustainability.



Our structured methodology captures the essence of being systematic and reflects our unwavering commitment to innovation and proactiveness. This commitment drives us to stay at the forefront of technological evolution, ensuring that our report is reliable and relevant to the ever-changing needs of the manufacturing industry.

Indranil Mitra,
Vice President, Global Technology Office

Industrial Manufacturing Disruptive Trends Radar



Radar Ratings and Definition

Horizon

Horizon refers to the timeframe between the inception of a new technology trend and its adoption by the mainstream

Horizon 1 (0-1 Year)

Trend will be industrialized in less than 1 year

Horizon 2 (1-3 Years)

Trend will be industrialized within 1 to 3 years

Horizon 3 (3+ Years)

Trend will take more than 3 years to reach industrialization state

Market Potential (USD)

The likelihood of the technology trend to generate value across multiple functions



Low



High



Very High

Adoption Phase

Adoption maturity of the technology trend in the market

Emerging ●

Trend is at its initial stages of adoption, with innovators and early adopters exploring its potential.

Improving ●

Trend adoption is increasing with proven potential to improve efficiency and effectiveness.

Mature ●

Trend has achieved widespread acceptance and usage among the general population or targeted audience

A large industrial robot arm, primarily orange and black, is shown in a factory setting. The background is a blue-tinted image of a factory floor with various equipment and structures. A large, semi-transparent blue circle is overlaid on the right side of the image, containing the title text.

Key Trends Industrial Manufacturing

Key Trends Design

Gen AI-based Computer-aided Design (CAD)

Engineers and designers, constrained by time, resources, and energy, often resort to incremental design improvements, resulting in over-engineered components and limited innovation. Generative design, an AI-driven CAD capability, revolutionizes design by eliminating traditional limitations, enabling rapid exploration of options, and autonomously creating optimal, manufacture-ready designs, thus accelerating product innovation.

McKinsey & Company reports that generative design has significantly reduced part costs by 6%-20%, part weight by 10%-50%, and development time by 30%-50% across various industries. By leveraging AI, advanced simulation, and cloud computing, generative design speeds up the generation of numerous design alternatives based on specified constraints.

This technology presents numerous opportunities for a high ROI, enabling production for low-volume, short-run, and custom components. It uses additive manufacturing and computer numerical control (CNC) methods. Additionally, generative design can inspire new shapes for high-volume components. These components can be reverse engineered for conventional manufacturing, as a leading German Industrial Manufacturer demonstrated.

Design-time digital twin

Digital twins in industrial manufacturing enhance design stages by enabling process simulation and analysis. This leads to optimized product designs, faster development, and reduced costs. Digital twins accelerate design, testing, and production through AI-backed insights and identify process failures in pre-production for better risk assessment. They improve production line reliability, all while increasing efficiency and reducing maintenance costs.

According to IoT Analytics, currently, 29% of manufacturers have fully or partially implemented digital twin strategies, with 63% developing them. These digital twins, crucial for new product development, simulate designs pre-construction, reducing costly prototypes and enabling extensive testing. Integrated with CAE and CAD software, they enhance simulations like fluid dynamics and mechanical performance, streamlining the design process.

Key Trends

Manufacturing

Operational Technology (OT) security

OT boosts automation, streamlines processes, and facilitates smooth departmental operations. However, it also brings security risks, serving as a potential entry point for cyberattacks. Increased device connectivity raises the risk factor, and breaches in OT infrastructure can severely affect human lives due to the specific nature of manufacturing environments.

According to Splunk's State of Security 2023 research, 49% of surveyed organizations experienced data breaches in the past two years, up from 39% previously. Manufacturers are now deploying OT security capabilities across their ecosystems. Manufacturing resilience is essential, and OT security is its backbone. Implementing robust OT security measures and adopting a proactive approach enables manufacturing companies to safeguard operations, mitigate cyber risks, and maintain continuity despite potential disruptions.

Industrial DataOps

In manufacturing, data often remains siloed and disconnected, leading to inefficiencies. Frost and Sullivan highlight the exponential data generation in the industrial landscape, with 328 million terabytes created daily and projected 181 zettabytes annually by 2025. DataOps is emerging as a vital discipline for effective data management, enhancing data literacy, and maximizing value. Adopting DataOps allows organizations to harness the transformative potential of data better, moving towards sustainable, efficient, and safe operations.

The shift from application-centric to platform-centric technology stacks marks a significant evolution, enabling companies to redesign operational frameworks. This transformation leverages connected, intelligent infrastructure through industrial DataOps and AI advancements, driving digital maturity and progressive industrial operations.

Key Trends

Supply Chain

Gen AI-powered supply chain resiliency

Gen AI-driven supply chains offer a wide range of potential applications in planning, manufacturing, and delivering industrial goods. This technology provides an opportunity to speed up the transition from design to market significantly. It can make manufacturing processes more sustainable and resilient while enhancing overall equipment effectiveness (OEE), a crucial metric in the manufacturing industry.

A recent Gartner survey of 127 supply chain leaders revealed that Chief Supply Chain Officers (CSCOs) will allocate 5.8% of their budget to generative AI in 2024. According to a joint study by E&Y and HFS, nearly 85% of enterprises expect Gen AI to be pivotal in their supply chain strategies by 2030. Additionally, 80% of respondents view Gen AI as a transformative tool capable of revolutionizing their supply chains. This highlights a significant move towards low-human-touch, autonomous networks.

Warehouse automation

Warehouse automation addresses key challenges in supply chain management, including inefficiency, high labor costs, and safety risks, and is evolving rapidly. Advanced warehouse management systems (WMS) can be integrated with warehouse control systems (WCS) to streamline inventory tracking and real-time coordination of automated equipment. Physical automation, using technologies like AGVs and robotics, reduces manual labor, speeds up operations, and improves accuracy. It helps manufacturers enhance productivity, save costs, improve safety, and utilize spaces better, contributing to fewer errors and increased customer satisfaction.

Looking ahead, AI, machine learning, IoT, and cobots will further enhance automation capabilities, promoting sustainability and operational efficiency. According to McKinsey-2023, investment in warehouse automation is expected to reach over 25% of capital spending, underscoring its critical role in the future of industrial manufacturing.

Key Trends

Sales & Aftermarket

Hyper-personalization

Personalization is crucial for meeting customer needs, but hyper-personalization elevates this by utilizing real-time data and AI for highly customized products. This approach enables businesses to deliver exceptional customer experiences, offering precisely what customers want, when and where they want it.

Integrating hyper-personalization into production enhances efficiency by aligning output with customer specifications, reducing overproduction and excess inventory. Manufacturers gain insights into production timelines, optimizing schedules, and using predictive analytics for smart forecasting to minimize waste and downtime. Deloitte notes that 80% of customers prefer personalized experiences. By leveraging predictive analytics, machine learning, and real-time optimization, manufacturers can offer tailored products and experiences. Embracing digital transformation focused on customization at scale is key to success in Industry 4.0.

Connected products and services

Connected products and services enhance efficiency, improve production quality, enable real-time monitoring and control, and support intelligent decision-making processes. Previously, companies focused on horizontal innovation within the value chain. However, with the advent of smart connected products, industrial manufacturers are now innovating vertically.

Leading manufacturers are adopting an ecosystem-driven approach to create smart, connected products. This fosters data sharing, accelerates speed-to-market, reduces costs, and sparks innovation. According to EY, connected ecosystems can boost revenue growth and earnings by over 13%. Manufacturing is one of the top growing industries worldwide, where more than 125.6 million devices will be connected via IoT in 2024.

Key Trends

Corporate Functions

AI-powered enterprise

Knowledge management is essential for business growth in manufacturing. It centralizes access to tools, processes, and materials, enhancing efficiency and problem-solving. An AI-powered enterprise reduces solution search time, boosting productivity. Comprehensive resources like videos, guides, and manuals streamline onboarding and mitigate knowledge loss, especially from retirements. This leads to better decision-making, informed by experienced professionals, benefiting employees, leaders, and stakeholders alike.

According to the Technology Services Industry Association, over 70% of companies predict that implementing effective knowledge management can boost productivity by over 20%. AI-powered enterprise solutions will revolutionize industrial manufacturing by capturing and transferring valuable knowledge from experienced staff to the next generation. These solutions streamline efficiency and productivity through advanced applications, including quick result classification and comprehensive text-based troubleshooting instructions. This will enhance information retrieval and problem-solving capabilities.

Touchless finance

In industrial manufacturing, touchless finance solves the common challenges of manual back-office workflows, such as human errors, high costs, and inefficiencies. A Gartner survey indicates that 55% of finance executives aim for a touchless financial close by 2025, making this a strategic priority for staying competitive. Leveraging machine-learning algorithms within the cloud can automate repetitive financial tasks, ensuring accurate general ledger (GL) classifications, timely supplier payments, and enhanced audit trails.

This saves cost and time, increases stakeholder confidence, and builds a reputation for reliability. With predictive analytics that correct data errors in real time, operations become more efficient.



About LTIMindtree Crystal

LTIMindtree Crystal brings technologies trends to cross-industry enterprises. It presents exciting opportunities in terms of foresight to future-ready businesses keen to make faster and smarter decisions on existing and emerging technology trends. The LTIMindtree Crystal is an output of rigorous research by our team of next-gen technology experts and meticulously rated by our Technology Council across a set of parameters.

We hope you enjoyed reading the **Manufacturing Technology Trends Radar Report**.

Please reach out to crystal@ltimindtree.com for any queries.



Getting to the
future, faster.
Together.

LTIMindtree is a global technology consulting and digital solutions company that enables enterprises across industries to reimagine business models, accelerate innovation, and maximize growth by harnessing digital technologies. As a digital transformation partner to more than 700 clients, LTIMindtree brings extensive domain and technology expertise to help drive superior competitive differentiation, customer experiences, and business outcomes in a converging world. Powered by 84,000+ talented and entrepreneurial professionals across more than 30 countries, LTIMindtree — a Larsen & Toubro Group company — solves the most complex business challenges and delivers transformation at scale.

For more information, please visit www.ltimindtree.com.