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INDUSTRY 4.0 ENABLING TOMMOROW'S SMART FACTORIES

An article on how manufacturing industries can work on building the factory of tomorrow using Industry 4.0

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Industry 4.0 first saw adoption by a few enterprises in the early part of the decade, starting in 2011. General Electric (GE) and Siemens, both high-end engineering enterprises, were some of the early adopters of IoT within their manufacturing and engineering operations by developing smart sensors and connected solutions to track the efficiency of the equipment and machinery in their plants. Data from these sensors were analysed on in-house software and analytics platforms – these platforms were later connected across servers and the cloud. This was the start of the IoT journey for these firms. These firms then embedded their industrial equipment, such as electric generators for power generation companies, with smart sensors to monitor and improve uptime, predict failures/faults, and lower usage costs–KPIs customers sought to improve constantly. The data from these sensors were collected over the cloud and analysed on in-house IoT platforms. Both these enterprises initially utilised IoT solutions internally and then as end-to-end smart engineering solutions, covering sensors, devices, smart factories, connectivity, platforms, and analytics. At every step of the journey, these early adopters of IoT accelerated the utilisation of smart tools and platforms to move up the value chain from simple equipment and factory monitoring to end-to-end deep analytics of the manufacturing lifecycle – a necessity to remain competitive and to deliver the required KPIs to their customers.

INDUSTRY 4.0 – CORE TECHNOLOGIES

Industry 4.0 is characterised by smart factories or tomorrow's plants revolutionising manufacturing. Nine core technologies are transforming the smart factories in the new paradigm. These technologies are:

- Big Data and Analytics
- Autonomous Robots
- Simulation
- Horizontal and Vertical System Integration
- Industrial Internet of Things (IIoT)
- Cybersecurity
- The Cloud
- Additive Manufacturing
- Augmented Reality

AUTOMATION AND INDUSTRY 4.0

Automation is one of the emerging technologies increasingly utilised by the industrial sector to improve product quality and efficiency and reduce operating costs. Automation is the bridge between humans and machines – leading to the development of smart plants and factories. Smart plants are made up of hyper-connected production processes – these machines and processes communicate through Machine to Machine (M2M) technologies. The M2M technologies rely on automation platforms to collect and analyse different data related to inputs, manufacturing, operations, and production outputs.

Automation creates a connected manufacturing ecosystem that enables connectivity across machines in factories through wireless connectivity and sensors – the connectivity technologies enable monitoring

and visualisation of the entire production process and drive assisted decision-making or semi-autonomous decisions.

Wireless connectivity across machines and remote applications and the increased usage of sensors is expected to be bolstered with the full rollout of 5G services for industrial purposes. This would enable greater automation, allowing for real-time communication between systems, and facilitate disparate systems to "move" closer (virtually) to the point of production and manufacturing by utilising Edge Computing.

IMPLEMENTATION OF INDUSTRY 4.0 – KEY TOOLS AND APPLICATIONS

While nine main pillars of Industry 4.0 exist, several software tools and applications are essential to the implementation and operations of Industry 4.0. These tools enable the entire smart manufacturing lifecycle from design and development to scheduling and decision-making. The essential software tools that enable the whole operation processes of smart manufacturing include:

- **Simulator Tools:** Simulator Tools include the applications that manufacturers and product designers utilise in the smart manufacturing ecosystem. Simulators are used in the product design in the R&D / Design stage and in the planning stage to map how production would be carried out based on the product specifications. The availability of a range of tools enables designers and manufacturers to develop hyper-personalised products for a wide range of consumers. Moreover, the ability to develop several prototypes and carry out numerous test simulations without building the actual product enables the manufacturers to seek customer feedback while developing the product specifications continuously.
- **APS Software:** The demands of manufacturing have a corresponding effect on the demands of operations and scheduling "smartly" in Industry 4.0. For this purpose, manufacturers utilise Advanced Planning and Scheduling software (APS) to streamline operations and production schedules. Advanced Planning and Scheduling (APS) offers digital solutions to manage production planning and shop floor scheduling. Using advanced algorithms to balance demand and capacity and generate achievable production schedules, Advanced Planning and Scheduling (APS) software results in shorter lead times to meet customer demands and easier, more rapid responses to unexpected production changes.

The two primary components of advanced planning and scheduling (APS) – strategic planning and detailed scheduling – help manufacturers by:

- Anticipating manufacturing resource needs
- Orchestrating efficient use of material people and machines
- Delivering valuable customer service and higher profitability

Advanced planning and scheduling (aps) can be utilised for any length of production scheduling across:

- Long-term strategic planning covering months and years
- Medium-term tactical planning with a horizon of a few weeks
- Detailed sequencing and scheduling

Advanced planning and scheduling (APS) software can be utilised as a standalone system to manage planning and scheduling and can also be integrated with enterprise resource planning (ERP), manufacturing execution system (MES), and other software solutions.

- **IoT Applications:** IoT applications enable manufacturers to utilise dedicated software to monitor production processes, perform

predictive maintenance, and boost ROI / productivity. IoT applications utilise several technologies encompassing software, sensors, machinery, and connectivity. By bringing all these technologies on a single dashboard, IoT applications can monitor and manage manufacturing sub-processes. IoT applications can connect devices and applications across the board (including ERP and CRM), integrate data from several sensors and devices, utilise AR (augmented reality) simulation, analyse data, and monitor machinery and tools. Each process is remotely monitored by the IoT application, with data constantly streaming into the platform 24/7.

• **AIIoT (Artificial Intelligence in the Internet of Things):** AIIoT is redefining and reforming every industry process in the manufacturing sector. AI paves the way for intelligent task execution with real-time analysis, and by integrating with IoT, AIIoT enables machine monitoring, data collection, and storage to the cloud while delivering decision making and stimulating the machines/devices to respond. Overall, AIIoT enables interoperability of devices (chipsets), software (programs and operating systems), and platforms (IoT, ERP, and CRM) – this interoperability is enabled with the implementation of APIs for AI and IoT devices, software, and platforms.

OPTIMISING MANUFACTURING PERFORMANCE

Industry 4.0 has begun, and it signals the start of a new way of planning and operations of manufacturing processes. Adopting IoT software, data-driven analytics, and connectivity is crucial for manufacturers and product designers to stay competitive in the new, highly competitive landscape. Industry 4.0 can improve revenue growth and business operations and transform the supply chain, products, and customer expectations. The use of portable devices and sensors, robotics, and analytics enable real-time improvements in products, from creating tests and prototypes to integrating connectivity, seeking customer feedback, developing personalised products, and integrating several platforms for constantly monitoring the production lifecycle.

Customers are going beyond increasing revenue and optimising costs - customers are seeking an elevated level of experience and sustainability and looking to improve key KPIs that exist in the manufacturing process constantly – some of these KPIs include - asset availability, factory performance, and overall equipment effectiveness. Customers now seek to not only track data but also provide insights into performance and recommendations for improvements - these requirements are now being addressed through all the integrated technologies of smart factory initiatives.