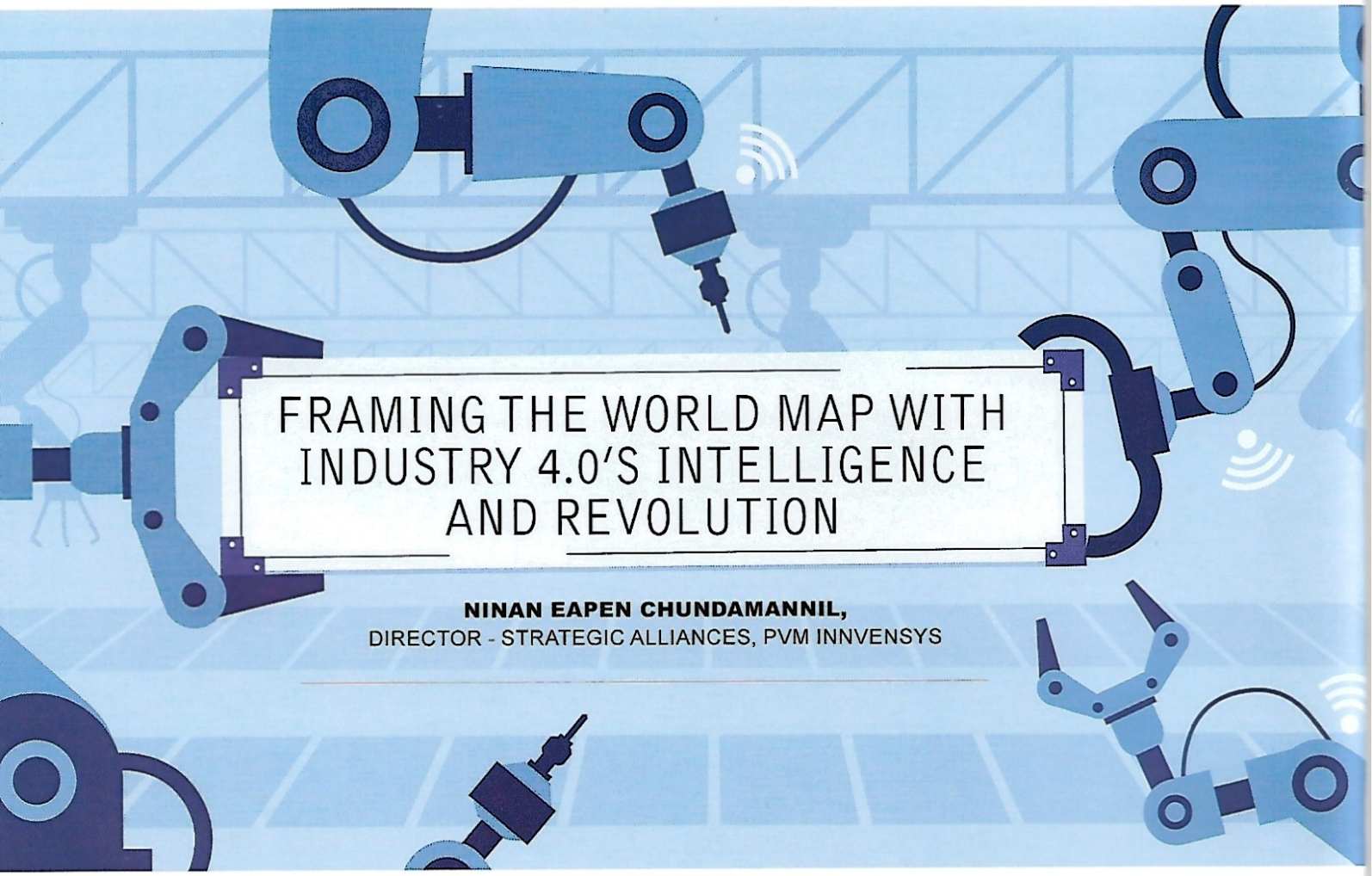

FRAMING THE WORLD MAP WITH INDUSTRY 4.0'S INTELLIGENCE AND REVOLUTION

NINAN EAPEN CHUNDAMANNIL,
DIRECTOR - STRATEGIC ALLIANCES, PVM INNVENSYS

The buzzwords around Industry 4.0, comprising terms like Smart Factory, IoT, Digital Twins, Smart Manufacturing, Flexible Production, Smart Logistics Chain, and a host of others, have emerged in the Indian manufacturing space for the past few years. While some seem to refer to logical needs, and a few are the latest advances from other, adjacent industries, it is difficult to understand all that Industry 4.0 encompasses and promises to deliver.

The Modern Industrial Age: The 4.0, incidentally, refers to what experts are unanimously saying – that the world is currently in the 4th stage of the modern industrial revolution. The First Industrial Revolution came with mechanical production using steam / water-powered machines well over 200 years ago; the Second saw large scale production factories, with electric powered machines and division of labour and early modern management thinking; and the Third was the stage after the second world war, with modern machines with electronic control systems, IT control systems on the factory floor and ability to achieve massive scales and lower per-unit costs. Manufacturing units worldwide are at this 3rd stage, with controllable electronic machines with measurable output, the human-machine interface at all machines, and the general ability to integrate enterprise-wide software like ERP systems. These have given a lot of benefits to the manufacturing and production processes in the Indian manufacturing landscape as well.

Modern management & Process thinking: Technological advancements and improved ability to integrate internal departments and external suppliers and customers have increased manufacturing ability with Industry 4.0. Some of the technical and managerial thoughts that help these are:

Interoperability: Bring together people, processes, suppliers, and customers by interlinking all machines, objects, and people involved in the factory routine. Centralised monitoring, automated processes, dashboard views, data-

based decisions, and standards-based approaches/hardware and open-source platforms/software bring the benefits of efficiency, process improvements, productivity, and reliability & reduction of errors to the Smart Factory.

Virtualization: The ability to create a 'virtual' / digital twin or a 3D model of a machine or object allows an operator to monitor the equipment's real-time status for analysis, quality of output, and maintenance. Machine or asset data can also be 'virtually' kept at a shared location and data shared by multiple users in the cloud.

Decentralisation: Firms could have investments spread across wherever they are needed – in a production line, in a factory, at a location, or in a country – so that efficiencies can be brought down the wire to the line/location. Virtualization, edge compute, cloud-based backend and connected technologies allow these sorts of components to be envisaged.

Real-time: The ability to have real-time data allows Industry 4.0 systems to monitor individual objects /machines /processes, analyse the data generated, and aid in decentralised decisions at the 'edge.' This improves the speed of decision making, takes advantage of efficient inventory levels, responds quickly to market trends and has faster production & logistics times.

Service orientation & Modularity: Factories based on Industry 4.0 move away from a mass-production mentality to tailor-made, individualised batch-runs. Real-time capability, significant data insights into market trends, interoperable systems, and interlinked supply-chain systems offer a better service orientation to individual customers. Modularity offers the ability to flexibly adapt to changing requirements and industry needs by specialising groups of processes or groups of people or assets. More minor splits of these teams/groups allow specialisation, expertise development, automation, robotic usage, and specialised software platforms in manufacturing.

Industry 4.0 Technological Systems: Using principles like the above and implementing improved technologies like 4G/5G, IoT, Artificial Intelligence, Machine Learning, Big Data analysis, Low-cost sensors, Robotics, and process like ERP systems, connected supply chains, etc., have allowed newer systems to be implemented in industrial environments:

Embedded systems: Software-controlled embedded systems, Standardised communications, and data networking with better electronics, communication systems & microsystems.

Simulated reality: Digital twins monitoring live machines, Virtual /augmented reality, Ambient Intelligence and Simulation.

High performance & Edge computing: Analysis of the Big Data being collected, Usage of Artificial Intelligence, Computing at the edge to take faster & decentralised decisions.

Human-machine interaction: Language /media / interaction technologies, Bio-analogous information processing, Service robotics.

Software engineering: Standards-based approach to developing platforms, Processes & assets brought together in a seamless interface, ability to monitor from centralised dashboards.

Reliability: Components and systems that - Monitor machines, Predict failure incidents and Pre-empt downtimes, with planned maintenance/interventions.

These systems are now being implemented to bring in efficiency, cost-effectiveness, and improvements in quality using the new and flexible production infrastructures under Industry 4.0.

The path forward: The road ahead is for machines, service robots, and other systems to deal with complex tasks autonomously – transitioning from ICT-based control mechanisms to autonomously acting components & systems. Disruptive technologies like artificial intelligence, omnipresent communication networks, cloud computing, and smart devices have enabled companies to embark on factory digitization. Implementing these new technologies and well-designed systems have enabled them to integrate and optimise their industries to take advantage of their manufacturing-supplier-customer ecosystems. Cyber-physical-production systems (CPPS) made up of intelligent machines, logistics systems, and production facilities allow peerless ICT-based integration for vertically integrated and networked manufacturing.

Smart Factories in India: All these technological advancements and process improvements have come together to make Industry 4.0 possible. Innovative Factory technologies like Internet of Things (IoT), Additive manufacturing, Digitalization and integration of data and workflows, Remote monitoring, Multi-disciplinary engineering, and automation of controls through machine learning and Predictive analytics are possible even for the smallest of Indian manufacturing firms as well.

Each manufacturing firm would participate in some part of the benefits of these new technologies and process systems. Some may want to get started by digitising work processes and getting factory floor machines and systems integrated. Larger firms could see the benefit in robotics, vision systems, automated decision systems, and integrated systems. In contrast, firms with very large ecosystems could see benefits in supplier and customer networks being integrated.

Govt. of India initiative: The Government of India is also encouraging the manufacturing firms to move to Industry 4.0 under its SAMARTH Udyog Bharat 4.0 and the Make In India program.

Every senior executive in the Manufacturing Ecosystem should understand the possibilities and scope of Industry 4.0 in their area of operation and explore how best they can participate in the next 4th Industrial Revolution.