

Industry 4.0 is here now and has accelerated due to the pandemic. Today, companies are laying the foundation for connectivity and a unified IT/OT digital platform. Now, there are newer technologies emerging, besides 4G/5G, to help Industry 4.0 work across demanding environments

One such technology is Wirepas. It is said to be world's first and only non-cellular 5G connectivity technology for enterprise IoT (Internet of Things)—Wirepas Private 5G. You can connect millions of devices even in the toughest, most demanding environments. It allows coverage anywhere, with a free global dedicated spectrum at 1.9GHz. This, at the fraction of the cost of cellular.

Wirepas partner case was when the design department of a car manufacturer needed to locate cars or component prototypes in a hurry. Stuck with an end-of-life barcode-based inventory system, this was the problem facing one world-leading German automotive brand. It used Wirepas to solve the problem.

The Industry IoT Consortium (IIC) has a mission to deliver transformative business value to the industry,

organizations, and society by accelerating adoption of a trustworthy IoT.

Stephen Mellor, CTO, IIC, said that you can't necessarily have a unified IT/OT platform! The average age of an industrial installation is 19 years. Some installations don't even use 2G, let alone 5G! Moreover, they often have a plethora of domain-specific connectivity technologies, tightly integrated and optimized to solve domain-specific connectivity needs. The IIoT (Industrial IoT) systems typically include the integration of brownfield technologies to preserve legacy investments, and greenfield technologies to spur innovation.

He added: "We have to define a small set of connectivity core standards. Domain-specific connectivity technologies then need a gateway to just one of the connectivity core standards, to participate in an information exchange with the rest of the IIoT ecosystem."



WE HAVE TO DEFINE A SMALL SET OF CONNECTIVITY CORE STANDARDS. DOMAIN-SPECIFIC CONNECTIVITY TECHNOLOGIES THEN NEED A GATEWAY TO JUST ONE OF THE CONNECTIVITY CORE STANDARDS, TO PARTICIPATE IN AN INFORMATION EXCHANGE WITH THE REST OF THE IIOT ECOSYSTEM.

MULTIPLE FRAMEWORKS

With Industry 4.0 well entrenched, let us look at some of the current activities. Vedanta Ltd, a subsidiary of Vedanta Resources Ltd, is one of the world's leading oil and gas, and metals company, with significant operations in oil and gas, zinc, lead, silver, copper, iron ore, steel, and aluminium, and power across India, South Africa and Namibia. In February 2022, Vedanta and Hon Hai Technology Group (Foxconn) signed an MoU for manufacturing semiconductors in India.

Vineet Jaiswal, Deputy CEO, Centre of Excellence, Vedanta, said they have multiple metal and mining business footprints. Vedanta has a unified business transformation blueprint. It created the VI4.0 (Vedanta Industry 4.0) framework. This framework works as reference and guiding document for all the digital transformation activity across the group businesses.

For seamless connectivity and help create digital thread across the value chain, VI4.0 recommends protocols like 5G, LoraWAN, Wi-Fi, Wirepas, besides optical fibre. At Hindustan Zinc, they created world class Wi-Fi network in underground mines covering 30 km. It has partners like Cisco SD-WAN for IT/OT integration of multiple units, OSI PI as the enterprise historian platform for OT data and analytics, and Azure ML platform for data analytics, etc.

The digital thread across the mining value chain has helped in visibility of underground vehicles and tracking, for seamless execution of operation activities, optimal utilization of assets, safety of employees, real-time monitoring of interactions between man and machine to avoid any accidents, thus making the mine safer.

Data is another key enabler for this transformation. Vedanta has defined SOPs as to how should they collect, transfer, and consume data (at edge, fog or cloud). Different IIoT sensor technologies like Edge-based satellite oil fields, multiple start-up products/solutions and other business proprietary platform with API interfaces are leveraged to get visibility to treasure of data and based on use cases implemented to bring the value to businesses.

Vedanta-wide unified Azure data lake platform, DISHA, has empowered key stakeholders like CEOs to get key insights on business performance and strategic inputs, as well as the operational leaders by powering them with alerts on predictive maintenance of assets and equipment. All these efforts are not only helping sweat

the assets judiciously, but also helping utilization of natural resources like ore, water, etc., optimally enabling the efforts towards sustainability.

Rajesh Gharpure, EVP and Global Head, Industry 4.0, L&T Infotech (LTI), said OT and IT integration is the cornerstone of all Industry 4.0 use cases, whether smart manufacturing, connected products, or smart spaces. It enables the cross-functional analytics and contextualization of the operations performance with the financial matrix. To unify IT and OT, LTI leverages the Industry X.0 Canvas (IXC) framework with assessment templates, playbooks, and a library of use cases.

He said: "We leverage the visibility layer of the IXC framework, which is rich in IT-OT collaboration scenarios and cross-functional analytics. We have open protocol connectors and custom-built connectors enabled by cyber security framework to collect data from disparate systems, including legacy systems. Our expertise in device engineering and sensorization optimization enables us to unleash data from non-networked siloed OT layer. We capitalize our industrial data model and catalogue to build these cross-functional scenarios."

Maximl offers the first full-stack collaboration platform for deskless workers powered by intelligent field automation. Pankaj Pawan, Co-founder and CEO, Maximl, added that the IT/OT convergence represents the integration of manufacturing systems (such as MES, SCADA, PLCs, etc.) controlling physical events and processes with back-end hardware and software for conveying and processing information.

Traditionally, OT systems have been very sophisticated but were not always connected to the network. They generally operated in isolation and often communicated using multiple niche protocols, resulting in data blind spots in the existing processes.

As we see ever-increasing cloud adoption, the factory's assets and processes are becoming part of a single, centralized network. IIoT is a simple example of this convergence. Unified IT/OT systems enable increased connectivity, resulting in tremendous amount of data, helping manufacturers identify hidden data blind spots in their processes. "We are moving into a world of real-time visibility and an improved understanding of the manufacturing processes. We are helping manufacturers ensure they are ready for changes that come around with this convergence for their workforce."



VEDANTA HAS A UNIFIED BUSINESS TRANSFORMATION BLUEPRINT. IT CREATED THE VI4.0 (VEDANTA INDUSTRY 4.0) FRAMEWORK. THIS FRAMEWORK WORKS AS REFERENCE AND GUIDING DOCUMENT FOR ALL THE DIGITAL TRANSFORMATION ACTIVITY ACROSS THE GROUP BUSINESSES.

— **Vineet Jaiswal**, Deputy CEO, Centre of Excellence, Vedanta

Maximl's Connected Worker Platform bridges this gap of connectivity and collaboration by augmenting the capabilities of the frontline workforce. Maximl seamlessly connects across various systems directly to the on-field workers and relays real-time data from and to the system. The platform connects IoT devices, sensors, machines, and humans in the entire ecosystem, offering a true sense of Industry 4.0. The design takes a human-first approach to improve the workforce's productivity, quality, and safety.

With the Connected Worker Platform, complex SOPs and text-heavy process knowledge can be converted into a measurable, simple digital micro-instruction delivered through an interactive and instructive way on the handheld device of the worker performing any complex operation. The worker can then follow, record and escalate deviations directly, enabling the team to take immediate actions, increasing productivity, compliance, safety, and quality of work. Integration of the workforce is an integral part of creating a smart connected factory, as envisioned in Industry 4.0!

Anuj Bhalla, Digital and Cloud Transformation Leader, President, and SBU Head, APJI Enterprise, Tech Mahindra, added that Tech Mahindra's Industry 4.0 solution is built across the Product-Production-Performance value chain with Digital Thread and Digital Twin as fundamental blocks. Digital Thread solution creates a connected and unified platform across IT/OT layers of our customer and their extended enterprise including suppliers, connected products, and after-market entities. On the other hand, Digital Twins, as a concept, is the quintessential physical asset where a seamless integration between a physical and digital asset occurs.

"We help customers establish a common-data model to gather the massive data generated and leverage analytics to gain critical insights. Further, our industrial cloud offering consolidates and migrates the existing IT/OT applications to the cloud. Our Multi-Access-Edge-Compute provides wireless and secure digital solutions to support customers' network requirements."

Speciale Invest is an early-stage investor focusing on tech-driven/deep-tech ventures. Vishesh Rajaram, Founder and Managing Partner of Speciale Invest, said IT and OT were traditionally separate worlds. Industry 4.0 has enabled the marriage of both, and hence, equipped the industries to solve multiple use cases. Industry 4.0 is powered by the convergence of AI, cloud computing, access to Internet, and the capacity to collect and utilize massive data sets.

Today, adopting Industry 4.0 is a non-negotiable! Traditionally manufacturing industries have suffered from lack of data collection and data sharing, both horizontally (across various departments in a plant) and vertically (at machine level, plant level, etc.). Connected devices powered by IoT allow for data to be exchanged seamlessly among various stakeholders. This collected data can be further used to optimize machine operations, plan predictive maintenance, decrease machine downtime, improve workflows, train workers, and overall, deliver better products quicker and cheaper.

As investors, they have made attempts to understand the pain points in industrial settings. These can range from tooling to procurement and delivery of components to manufacturing operations and training and safety of the workforce.

They look for technologies that can help improve processes and mitigate risks for each of these pain points. The bridging of hardware or software by IIoT tools have had significant impact on managing industrial operations. Data is the bedrock of all these activities.

Shuja Mirza, Director, Solutions Engineering NetApp India & SAARC, noted they are a data-centric organisation with in-depth experience in delivering data services across hybrid cloud environments. These data-intensive services and processes are at the core of Industry 4.0 initiatives. These services and processes are better served with a robust data fabric. As an example, Digital Twins in Industry 4.0 are the formal representation of assets, processes, and systems, which can provide data to orchestrate and optimize manufacturing plants. In such cases, data fabric enables this digitization and brings alive the Digital Twin. At the core of its operations, NetApp make it easier for enterprises to adopt hybrid cloud deployments and accelerate initiatives like Industry 4.0.

Rituparna Mandal, GM, MediaTek India said they have been at the forefront of technology. This drive has made us the frontrunner in 5G solutions. In terms of connectivity and enabling the entire unified IT/OT digital platform, 5G is the future. The transformational connectivity will power almost every device under the sun. We have laid the foundation for 5G to drive Industry 4.0 use cases.

MediaTek's Dimensity family of 5G chips is powering 5G smartphones across demographics. It is also enabling unprecedented connectivity through 5G broadband and Wi-Fi 6 services. Under Industry 4.0, innovations such as IoT, AI/ML and similar new-age technologies will play a major role in creating a more connected and equitable ecosystem. MediaTek is awaiting upcoming industrial and technology revolutions.

REDUCING EQUIPMENT DOWNTIME AND MINIMIZING HUMAN ERRORS

Next, we need to see how companies are now able to reduce the equipment downtime and minimize human errors to decrease production expenses and improve quality and safety.

Vedanta's Vineet Jaiswal said: "We have taken multiple steps to help better utilize our assets to improve the bottom line by aligning to our Vedanta wide AO (Asset Optimization) and V4I.0 framework. The AO framework is focused on 'foundational elements' like strategy,

organization, standards to 'maintenance focus' on shutdown, condition monitoring, material management etc., to 'reliability enhancement focus' areas like defect elimination, process optimization, operate for reliability to finally 'improvement processes' like digitalization, innovation, Lean 6 Sigma, etc."

V4I.0 lists down technology catalogue, which can be used to better understand the health of the equipment, and in many cases enable the AO framework. Analysis of telemetry data collected from mining equipment helps in condition based monitoring and predictive maintenance.

THESE ARE SOME OF THE KEY ENABLERS...

Detailed shutdown planning

- Executing granular planning with scientific methodologies. We have moved our approvals online with improved validation systems for faster operations and convenience.
- Also enabled higher visibility and tracking of manpower, procurement, and scheduling to increase our responsiveness to shutdowns and outages.

Seamless shutdown execution

- Real-time data capture: Immediate data capture on field and sharing through mobile app
- Richer information collection: Easy collection of inspection evidence collected through pictures, notes and document pdfs
- Dynamic decision making: Live S-Curve and critical path identification
- Collecting data from sensors installed on assets on cloud and analysing it real-time through dashboards.

Effective post shutdown management

- Effective record management: Information collected digitally and stored effectively for future use
- Easy insight extraction: Trend analysis on data stored in standardized format
- Improved accountability: Concept of Reviewer and Signatory for transparent operations.

Rituparna Mandal, MediaTek, added that they create innovative chips that power huge ecosystem of devices. During designing process, the focus is always on creating solutions that reduce downtime and minimize errors, while lowering production expenses and enhancing quality. For instance, 5G is a huge focus area. MediaTek



OUR EXPERTISE IN DEVICE ENGINEERING AND SENSORIZATION OPTIMIZATION ENABLES US TO UNLEASH DATA FROM NON-NETWORKED SILOED OT LAYER. WE CAPITALIZE OUR INDUSTRIAL DATA MODEL AND CATALOGUE TO BUILD THESE CROSS-FUNCTIONAL SCENARIOS.

— **Rajesh Gharpure**, EVP and Global Head, Industry 4.0, L&T Infotech

Dimensity 5G series platform offers smartphones and OEMs combination of connectivity, multimedia, AI and imaging innovations.

Under 5G offerings, it has created Dimensity 5G Open Resource Architecture or DORA platform, which helps OEMs reduce downtime, creating more customized experiences. The closer-to-metal access on Dimensity chipsets allows brands to hyper-personalize smartphone features like AI, multimedia and camera, while improving quality and minimizing downtime significantly.

Anuj Bhalla said that at Tech Mahindra, they have leveraged automation, AI and analytics to reduce human errors. While automation reduces human errors, for the activities which mandate human intervention, we aid them with computer vision, video analytics, and AR-VR solutions. They have supported customers with condition-based monitoring and predictive maintenance solutions. Edge and cloud-based AI algorithms monitor the equipment parameters and suggest corrective actions.

Additionally, as a part of the Quality Analytics offering, TechM sensorized and monitored the critical-to-quality parameters and safety parameters. Tech Mahindra's algorithms identify the deviations in parameters, improve quality and safety and reduce the scrap and rework.

DECREASE TOOLING COSTS AND LEAD TIME

Next, we need to check out the activities of players for decreasing the tooling costs and lead time.

Rajesh Gharpure said LTI develops software tools that help businesses track and manage tools for their periodic calibration and maintenance cycles. Regression analysis-based ML models predict tool conditions in real-time, helps

increase remaining useful life of the tool and perform coordinated tool changeover, further enhancing productivity. Integrating these software tools with plant-wide tracking solutions helps businesses locate and collect out-of-life tools thwarting their usage on the shop floor. On-time tool calibration for high-value tools helps save significant cost by avoiding scrap due to tool breakages or quality out runs due to out-of-specification tooling.

Anuj Bhalla, TechM, said as a part of engineering offerings, they help customers design flexible and modular tooling. Modular tools reduce the design and configuration timelines.

Stephen Mellor, IIC, said IIoT enables this in two ways. First, by instrumenting equipment, we can predict when a machine needs maintenance. That will reduce downtime and decrease production expenses and improve quality and safety.

The second one is more difficult. No amount of IIoT will completely eradicate human error, for the simple reason that we are dealing with humans. We can reduce the amount of mechanical work, and even intellectual work, by using various techniques in AI. With proper instrumentation, we can display information in a meaningful way to human operators, and therefore, reduce errors.

WHAT ABOUT MAINTENANCE?

Rajesh Gharpure, LTI, added that condition-based maintenance and failure prediction are the two common and critical uses cases that LTI has implemented for customers. Periodic maintenance may not detect potential failures. While mean time between failures (MTBF) can be as low as one per year, the costs of such losses can be very high.

Therefore, we can establish connectivity to acquire real-time data from the shop floor systems and equipment sensor data, e.g., vibration sensors for remote monitoring, and leverage technologies like computer vision and AI/ML to generate insights for failure prediction and quality conformance. LTI has further integrated with assets and quality management systems for several customers to trigger the required actions, such as creating automated maintenance work orders or lot rejection, once an anomaly is detected.

Pankaj Pawan at Maximi said whether planned or unplanned, equipment downtime is a complex and prolonged task for any manufacturing facility. As downtime directly affects the productivity of the floor, these tasks require a high level of compliance. About 70% of factory failures are still caused by human-centric processes. These could be related to inadequate procedures, management oversight, inadequate training, or pure human error. It is helping clients augment their workforce capabilities to transform the way they work.

For e.g., the SOPs of these maintenance processes are often complex, and often available to the maintenance team in text-heavy procedural guides. Due to this complexity and knowledge ambiguity, the workforce has

low compliance with standards, with dependency on tribal knowledge. Collaboration and reporting are spreadsheet and paper-based, leading to poor wrench time. Over-dependence on paper and spreadsheets also leads to creation of data blind spots.

Maximi's Connected Worker Platform enables the organization to break down the complex SOPs into microwork instructions. These work instructions are delivered to the worker digitally, eliminating the dependency on technical expert knowledge and simplifying the process. The platform connects with existing ERP/IoT systems, creating a connected experience for the workforce. This enables clients to standardize the way of working, improves procedural compliance, identifies real-time deviations in quality, and enhances the productivity and safety of the operations.

Sunil Cavale, Speciale Invest, said in large setups involved in manufacturing and assembly of multiple product lines, changing tools and dies are essential. However, these are often time-consuming processes. Production line becomes non-functional during this period.

Using data captured by sensors mounted on industrial equipment, organizations are able to better plan and manage their processes. AI models are able to predict the





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— Pankaj Pawan, Co-founder and CEO, Maximi

most optimized workflows to manage various operations for multiple product lines. This allows for predictive maintenance, process time studies, cycle studies, tooling and die change patterns amongst others, leading to optimal functioning of the plant.

For improving safety, Sunil Cavale said worker safety is of great importance today. Collecting and monitoring data about workers enabled organizations to better monitor workers' overall health and safety. By monitoring KPIs, such as number of injuries, near-misses, vehicle incidents, worker leaves, deviation from standard procedures, damage to property, etc., better safety measures are being enforced. IoT sensors and devices are slowly taking over the task.

SIMPLER PROCESS INSTRUCTIONS

We have also seen that organizations are developing shortening of the changeovers, and also creating simpler process instructions to reduce training time.

Stephen Mellor, IIC, said that to shorten changeover time, two techniques can be used. At the high level, using predictive maintenance enables scheduling the machine downtime, and therefore, operators too. Fewer changeovers mean less changeover time.

The second is better presentation of information in real-time. Rather than paper logs, we can provide exact detail of what has happened and the current state. This is referred to as 'digitization' and 'digitalization'. The former means to transition from analog to digital information, and to make information available and accessible in digital format. The latter means to build on digitization, leverage digitized information in processes, and standardize digital work. Automating processes also reduces the training

time. However, putting more work onto machines implies that people are doing higher-level tasks, and that may require training.

Rajesh Gharpure, LTI, said changeovers between production lots are quite complex and time-consuming, depending on the nature of work performed during the machining cycle. It is vital to ensure the correct manufacturing workflow routing and machine specifications are in place, before the production of the new product or the new variant begins. LTI leverages scheduling and routing optimization software for generating the most optimum workflow for the planned changeover.

LTI also leverages Digital Work Instruction, one of its smart manufacturing accelerators, for enabling rapid and successful changeovers. The digital instructions are based on the best practices. They give out step-by-step processes and timelines for each task and completion verification criteria. This eliminates manual errors and helps in effective production planning. In some cases, LTI has also utilized A/R for operator training on changeovers procedures.

Pankaj Pawan, Maximi, felt the convergence of IT/OT allows hardware to communicate with software and allows different software systems to communicate. Having real-time information allows manufacturers to make decisions based on predictive analytics. With the IoT, manufacturers can know when machines may need maintenance or repair.

Maximi enables plug-n-play integrations with these systems and helps our client achieve back-office automation. The platform automatically assigns the work order based on the technician's skill, and they get notified in real-time. It also sends the interactive procedure to be

followed for maintenance activity, all necessary drawings, safety precautions, and digital checklists to comply during the maintenance activity. If they need any help from experts, they can instantly get connected and get their queries resolved.

Workers can now complete the task much faster, adhering to the best quality and safety standards. This significantly impacts the lead time and the quality of work. In our journey of digitizing our client's workforce, we have seen a huge reduction in lead time and even reduced production costs.

TechM offers video analytics to analyze operator's actions and suggest ways to reduce changeover time, and AI-based production planning and scheduling to eliminate the changeovers. They leverage on its metaverse capability to help customers display simpler process instructions in the AR device. Guided, step-by-step instructions are displayed in the user view. They can view product CAD and videos to clarify their doubts. VR-based assessment modules identify mistakes and fine-tune them.

IMPROVING DELIVERY TIMING

Companies are also working toward meeting complex customer requirements and improving delivery timing.

Rajesh Gharpure said LTI has a proven track record of solving customers' unique and complex business needs with the best-fit tailored solution, ensuring quicker value realization. It approaches customers' requirements through digital lenses of transformation. First, domain experts from IXC practice engage with customers and evaluate digital maturity of the manufacturing value chain.

Then, along with the business consultants, they work with different business verticals of customer organizations to develop a roadmap for their digitization journey. Solution frameworks put the outcomes at the forefront and tie them directly to customers' KPIs, which helps decode the complex requirements into proper implementation of a successful roadmap. The agile delivery methodologies and strong governance, coupled with risk and change management approach, empowers LTI to deliver commitments on time.

Stephen Mellor, ICC, said they are doing everything they can! The two main ideas here are scale and interoperability. Imagine a project implementing predictive maintenance. Once implemented, you need

to deploy in every factory you own as rapidly as possible so that the gains can be more widespread. It's less work to deploy the second installation than the first, so the return on investment is higher. But, for scale 'at scale', you need interoperability! That means, plug-and-play solutions, often supported by standards. As a business, you need to demand this from suppliers.

Shuja Mirza added that NetApp follows a consultative approach to problem solving. It takes the cloud-led, data-centric software solutions approach with customers and takes pride in being specialists in these areas. Complexity is broken down when the focus is on the desired business outcomes, making the journey simpler and faster (thereby, improving delivery times) through automation and ease of deployment.

Pankaj Pawan, Maximi, added that if you can democratize the use of technology and give a consumer-like user experience in the hands of the frontline workers, we can unlock the next wave of improvements in productivity, safety, and quality KPIs across the entire organization. The only way to do this at scale is by building a technology that is agile enough to model the process knowledge and heterogeneity and make it accessible through technology.

"We have understood the ever-increasing importance of agility. We have started to move towards the adoption of mobile-first cloud-based solutions to provide continuous operations and deliver ever-changing procedures and guidelines. With Maximi, one can go to Google Play Store or Apple Store, download the possible app, and access guided maintenance procedures, digital checklists, instead of relying on thick paper binders and manuals. You can be up and running within days.

Anuj Bhalla, TechM, added: "We have strong assessment frameworks with respect to Industry 4.0, data maturity and technology. We utilize these to map complex customer requirements and develop a future-ready architecture. We implement use cases with good ROI and invest back to create a light-house manufacturing facility."

To improve the delivery timelines, TechM has developed tools and accelerators. Some accelerators help in migrating to the cloud faster, and some help in consolidating multiple MES (Manufacturing Execution System)/PLM (Product Lifecycle Management) systems in a much faster manner. The team has variety of skill sets, including consulting, PLM, factory IT, OT, network and security, etc.



WE HAVE STRONG ASSESSMENT FRAMEWORKS WITH RESPECT TO INDUSTRY 4.0, DATA MATURITY AND TECHNOLOGY. WE UTILIZE THESE TO MAP COMPLEX CUSTOMER REQUIREMENTS AND DEVELOP A FUTURE-READY ARCHITECTURE.

— **Anuj Bhalla**, Digital and Cloud Transformation Leader, President, and SBU Head, APJI Enterprise, Tech Mahindra

Maximi provides a platform to create connected procedures easily. With the no-code capability, it becomes easier for business users to create work instructions, procedure practices for maintenance, auditing, quality, and training. The platform also provides plug-n-play integrations with IoT devices and other enterprise systems such as ERP, reducing the time to realize RoI and creating a seamless and integrated environment for their workforce.

Shuja Mirza, NetApp, said ease of use and automation solutions allow NetApp customers to rapidly deploy a service, whether it is within the four walls of their data center or in the cloud. With automation built into the platforms, including support for containerized deployment of modern apps, they can reduce lead time by 3x to 5x depending on the use case.

LTI is a customer-centric services company. It has a proven track record of solving customers' unique and complex business needs with the best-fit tailored solution, ensuring quicker value realization for our customers. Domain experts from IXC practice engage with customers and evaluate the digital maturity of the manufacturing value chain.

Vineet Jaiswal, Vedanta, added that they are going 100% ecommerce for all sales and marketing channels across BUs. To compliment/enable faster time to serve, we are also implementing 100% online buying. All buying is to be done through EOI and auctions for price discovery. We have invested significantly in supply chain over the years, and we are further building on the same concept to bring better visibility on delivery for our customers.

Governance of the same is enabled through our data platform, DISHA which provides insides on performance and gives timely alerts on deviation to commitments.

These insights are used to track progress, identify issues and bottlenecks proactively. This results in better planning, mitigation and closing the decision loop faster. "We are also engaging startups through Spark program and implementing group wide digital transformation program through project Pratham.

EXAMPLES GALORE

As of now, there are several examples of Industry 4.0 deployments. Rajesh Gharpure, LTI, said they worked with a leading multinational power management company to define digital transformation roadmap for Factory of the Future, powered by Industry 4.0. LTI conducted value discovery workshops with all the stakeholders to define the various digital interventions across different functions. The solution was powered by an IIoT platform to enable machine connectivity, business KPI visualization, and analytics for Insights. The solution was rolled out to 45+ sites globally, helping achieve a 15% reduction in manual effort at workstations, a 25-30% reduction in unplanned downtime through predictive maintenance, a 15% improvement in OEE, and a significant reduction in inventory cost with improved visibility of parts consumption.

It is also engaged in a large-scale global transformation program with one of the world's leading global elevator manufacturing companies. The broad objective of the program is to personalize the customer experience and redefine the service model. LTI addressed the need through the connected elevator solution, which leverages IoT, Cloud, and AR.

A single-pane glass view enables real-time monitoring of the entire elevator portfolio with dashboards aligned to different personas (OEM, facility head, end customers),

predicts failures, sends service notification to field personnel, and provides remote troubleshooting through AR. Today, there are 200,000+ elevators across the USA, China, EMEA and APAC, onboarded on this platform. The solution reduced downtime of the elevators by 15% and field calls cost reduction by 10%. The connected Elevator solution helped the client manifest “Product as a service model”.

Vedanta is involved in several use cases. In advanced process control enabling smart manufacturing, there is transition to automated adaptive control from manual control to unlock significant value through minimizing variability and driving efficiencies. It's like our best operator working 24x7.

Key outcomes include reduced variability, improved efficiency, improved throughput, and quality, and operation at global optima setpoints. Further coupled with AI/ML techniques like self-learning – retune model to adapt with process changes over time and intelligent soft sensors for real time measurement using regression models to replace less frequent lab values. We have realized 1-5% gain in throughput, efficiency, and cost reduction through implementations in zinc, O&G, and aluminium processing units, etc.

In Smart pot relining through sensorization, the Smart Pot project has helped to reduce production loss duration from 9.5 days to 8.1 days. Due to automated processes with online portals and logbooks, it eliminated possibility of data manipulation, and saved 83% of man hours previously consumed. With centralized access and automated analysis, it provides real-time visibility of reports. This results in better planning, outcomes, continuous tracking and supports audit compliance efforts.

Vedanta also has examples from coal-blend optimization, where AI/ML-based digital coal-blend optimizer and predictive model, was integrated with SAP and Historian. Simulation tool was built to aid commercial in sourcing, and OCR to auto populate data from documents received from the vendor. This can be integrated with burden mix for predicting the burden mix.

It is also involved in safety training through extended reality, drone-based overhead lines monitoring, predictive maintenance, and condition monitoring leading through real-time vibration monitoring system.

Stephen Mellor, IIC, talked about two projects that are underway. One is a solution around gait analysis. This

project was initiated in Japan because their citizenry is relatively older. Being able to monitor a senior citizen's gait can help identify health issues and, of course, falls.

The second is a project around boats. It's a form of asset tracking, but has to include history and certification of captains, meaning that it's more than just the asset that's being tracked. We can see how this can be extended into multiple areas.

Shuja Mirza, NetApp added that industrial IoT has vastly improved efficiency, scalability, cost, and time savings for customers. Some of the popular use cases for Industry 4.0 where NetApp technologies are being leveraged include: condition monitoring – storing, processing time series data, inventory optimisation – RFID data, fed into real-time decision support systems and supply chain management systems, and integrated data flows enabled across on-premise and cloud environments, and quality assurance – X-rays and various forms of image scanning stored on NetApp systems, made available for analysis and taking corrective actions for quality assurance purposes.

Pankaj Pawan said Maximl is an enterprise SaaS company empowering the deskless workforce to improve safety, quality, and productivity at the workplace. With India's first no-code Connected Worker Platform, it helps clients implement continuous improvement and achieve standardization by connecting the last-mile operations. Maximl has deployed its solutions at 100+ global sites with 18 enterprise customers across India, SEA, Latin America, and Europe, including Indian Oil, Reliance, Bharat Petroleum, Vedanta, and Tata Steel.

It deployed the solution in one of the largest refineries in eastern India. Turnarounds are complex to manage. They include over 10,000 maintenance activities and require high co-ordination among several departments to ensure timely completion with safety and reliability. Maximl deployed the platform, which helped them with real-time progress updates, established a single source of truth, eliminated all paper-based checklists with digital procedures, automated reporting, and manual escalations. For over 70% of the issues, the team could resolve them remotely without physical meetings. Field engineers could reduce the non-productive time spent on manual report preparation through one-click automated reporting.

With the no-code authoring capability of Maximl's Connected Worker Platform, the client, an Oil & Gas sector



IT AND OT WERE TRADITIONALLY SEPARATE WORLDS. INDUSTRY 4.0 HAS ENABLED THE MARRIAGE OF BOTH, AND HENCE, EQUIPPED THE INDUSTRIES TO SOLVE MULTIPLE USE CASES. INDUSTRY 4.0 IS POWERED BY THE CONVERGENCE OF AI, CLOUD COMPUTING, ACCESS TO INTERNET, AND THE CAPACITY TO COLLECT AND UTILIZE MASSIVE DATA SETS.

— **Vishesh Rajaram**, Founder and Managing Partner of Speciale Invest

leader, created a digital blueprint of asset reliability practices of over 130 assets. These templates are now being used every day by the workforce on their mobile phone to access digital checklists, watch interactive content and connect them with experts remotely, if required.

Touching upon Examples of recent Industry 4.0 deployments, Vishesh Rajaram, Speciale Invest, said they used IoT sensors on a glove to collect data when workers are carrying out tasks such as welding, painting, etc. This allows supervisors to monitor workers, while providing them immediate feedback.

Each robot on a factory floor has a different communication standard. System integrators find it difficult today to get these robots to talk to each other. This results in delays in optimizing the warehouse automation process. Often, the integration process is hard-coded meaning that replacing a single robot involves the entire communication backend to be reworked on. Teams are working on a software platform that connects robots in a plant to communicate and exchange data seamlessly with each other, thus increasing interoperability and significantly reducing the time taken by system integrators.

Anuj Bhalla, TechM, said that a leading motor company could unleash new revenue stream, higher operational efficiency. They teamed up with the customer to design an industry 4.0 platform that could monitor the health of motor remotely. The solution gave real-time feedback about motors' health parameters like vibration, temperature etc. We developed the hardware and firmware which was easy to install and use, and power efficient. The motor parameters were transmitted to a cloud backend, which helped gain insights into the motor performance. The

solution significantly reduced the downtime, avoiding revenue loss due to motor failure.

There was another IoT-led paint quality optimization for a heavy commercial truck major. A global manufacturer of commercial vehicles, based in the USA, faced challenges in terms of reducing DPU (defects per unit), while painting trucks. They needed cost-effective solution and decided to partner with Tech Mahindra. Through domain and technical expertise, TechM offered an IoT-based platform to detect painting quality and build reports.

He added: "We used Thingworx base solution to build mashup screens, generate reports, and build analytics to detect painting quality. Data from various IT systems with OT was integrated to the Thingworx platform. Alerts, events, and subscriptions were configured as per user's requirement. There was 25-30% reduction in paint rework, and paint warranty cost, reduction of offline truck inventory, and improvement in plant productivity.

Rituparna Mandal, MediaTek, added all solutions are created with the aim of powering Industry 4.0 and technology revolution. Some recent deployments include MT7921 Wi-Fi 6 chipset powering ASUS Republic of Gamers (ROG) and The Ultimate Force (TUF) new gaming notebooks, along with the world's first Wi-Fi 6E enabled 8K TV, in collaboration with Samsung. The flagship Samsung 8K QLED Y21, powered by MediaTek's MT7921AU, delivers fastest connectivity experiences through its cutting-edge Wi-Fi 6E capabilities.

Industry 4.0 has definitely emerged strongly for automation and data exchange in manufacturing technologies, including cyber-physical systems, IoT, cloud computing and cognitive computing, thereby creating the smart factory.