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5 MANUFACTURING TRENDS YOU'VE (PROBABLY) THOUGHT ABOUT

AND THE DIGITAL IMPLICATIONS YOU MAY HAVE MISSED

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INTRODUCTION

It is 8 AM in an automobile factory in Chennai, India

A warning light comes on robot number 7 on the assembly line of FactoryNext corp. This sets off a chain of events.

An SMS alert goes to the floor supervisor and the on-duty engineer with the identification of the robot, the error code, and a link.

The duty engineer springs into action. He picks up his tablet, opens the link and reviews the error on his way to the robot's station.

He opens the maintenance app and brings his tablet close to the robotic control panel. The processed sensor metrics are transmitted to the tablet.

The app runs a 3-D simulation and quickly opens the internal circuit system of the controller. It highlights the faulty part in red.

He taps on the instruction manual and opens a set of instructions with embedded maintenance videos.

It looks like the defective part will need to be replaced. He clicks on the part replacement option and sees that the part is unavailable on-site.

The inventory app, which is connected to the part manufacturer, shows the replacement from the OEM will take two weeks to be delivered. This would lead to significant downtime for the plant.

The engineer instead looks for the part in the 3D printing inventory. He locates the correct model number and issues a command to the in-house 3D printer to print the part.

In 60 minutes, the part is printed, and now the repair can begin. The engineer must stop the assembly line for 6 hours to start the repair process.

He does this by using a manual override on the control tablet. As soon as the supervisor approves the manual override, the cloud-connected application issues appropriate notifications to the Pune and Hyderabad facilities.

They ramp up production to make up for the deficit in the Chennai plant. The warehouse near Bhopal and the logistics partners in all three plant locations are sent notifications regarding the change in production.

Such a smart factory enabling a hyperconnected ecosystem is not the distant future but a rapidly approaching reality. The convergence of existing automation plans, and the introduction of new technologies is driving this future of manufacturing in the form of Industry 4.0. It is a fulfilment of an industry-wide vision to harness the promise of automation to do things faster, more cost-effectively, with greater productivity than ever before that is at the heart of Industry 4.0 and smart manufacturing.

SMART MANUFACTURING THROUGH THE ECOSYSTEM ENABLER'S LENS

While definitions vary, MESA International, a well-known, not-for-profit organisation of manufacturers, producers, industry leaders, and solution providers which is involved in knowledge diffusion, best practice training, and advocacy, uses the following definition

"Smart manufacturing is the intelligent, real-time orchestration and synchronisation of business, physical and digital processes within factories and across the entire value chain. Resources and processes are automated, integrated, monitored and continuously evaluated based on all available information as close to real-time as possible."

While this definition is apt, the enterprise reality is that Smart manufacturing means different things to different people. For manufacturing customers, it is about getting more intelligent products that can self-inspect issues and receive automatic upgrades and security fixes. For shopfloor workers, it is about increased productivity, improved safety, and reduced downtime. For manufacturing leaders, it is about greater efficiency, reduced costs, and greater customer satisfaction.

At Tata Communications, we view smart manufacturing as an enabler to realise the full potential of technologies by increasing business resilience, improving customer experience, driving efficiency, and ensuring safety across the manufacturing value chain.

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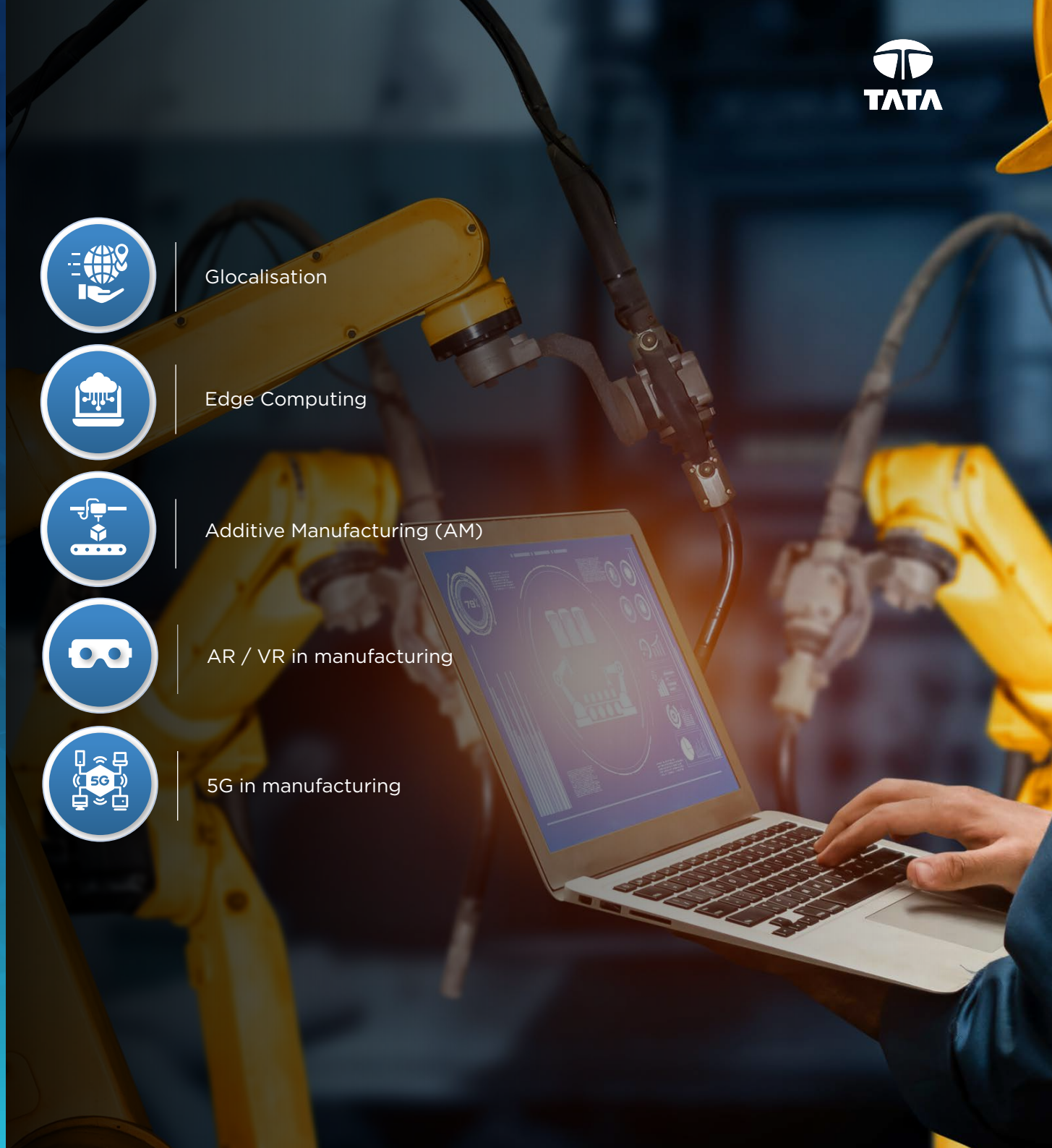
THE SMART MANUFACTURING DILEMMA

Like every new technology cycle, there is a large gap between vision and implementation. Enterprises that are too ambitious can invest heavily across a vast landscape without delivering significant improvements in business outcomes; enterprises that do too little may lose out on the upside promised by these technologies. To succeed, manufacturers need to align the business outcomes they seek with a sharply focused approach to strategic investments while implementing them effectively.

We have handpicked five trends reshaping manufacturing and identified key recommendations for you to realise the benefits from each.

Let's take a closer look at each of these



I. GLOCALISATION

While the need for localised variations of goods has been felt since early days of industrial revolution, it remained a distant dream for decades. Technological limitations and cost implications have for the most part of the century dissuaded manufacturers from pursuing that dream. However, with the advancements in technology over the last decade, glocalisation is not just achievable but also imperative for manufacturers.

Glocalisation creates a need for connecting factories, warehouses, and office locations worldwide through a global, performant network. In addition, enabling multiple production facilities to work in tandem requires designing a cloud-first, internet-first architecture. In many manufacturing organisations, digital infrastructure and connectivity tend to grow organically based on local considerations and needs. This often leads to a fragmented digital architecture that is inflexible, costly, complex to manage and lacks visibility and control. We recommend Manufacturers reassess their network and cloud preparedness by looking at them holistically across geographies and locations

Key technology enablers:

Technology area	Key considerations
A global, performant and secure network that can connect factories, warehouses, and office locations across the globe.	• Consistent user experience across locations • Enabling agile policy changes to create a consistent security posture globally • Interoperable network for both existing and new multi-vendor infrastructure • Seamless migration to public cloud and ensuring secure access to apps on public cloud
Enable secure multi-cloud connectivity to enable multiple locations to access essential production-related information and applications	• Moving workload and data from one cloud to another and connecting users to the clouds while ensuring performance • Setting up individual connections to different clouds and among clouds is costly and complex • Orchestrating and managing multiple cloud environments requires a single platform to ensure an optimised environment and cost-efficiency

II. EDGE COMPUTING

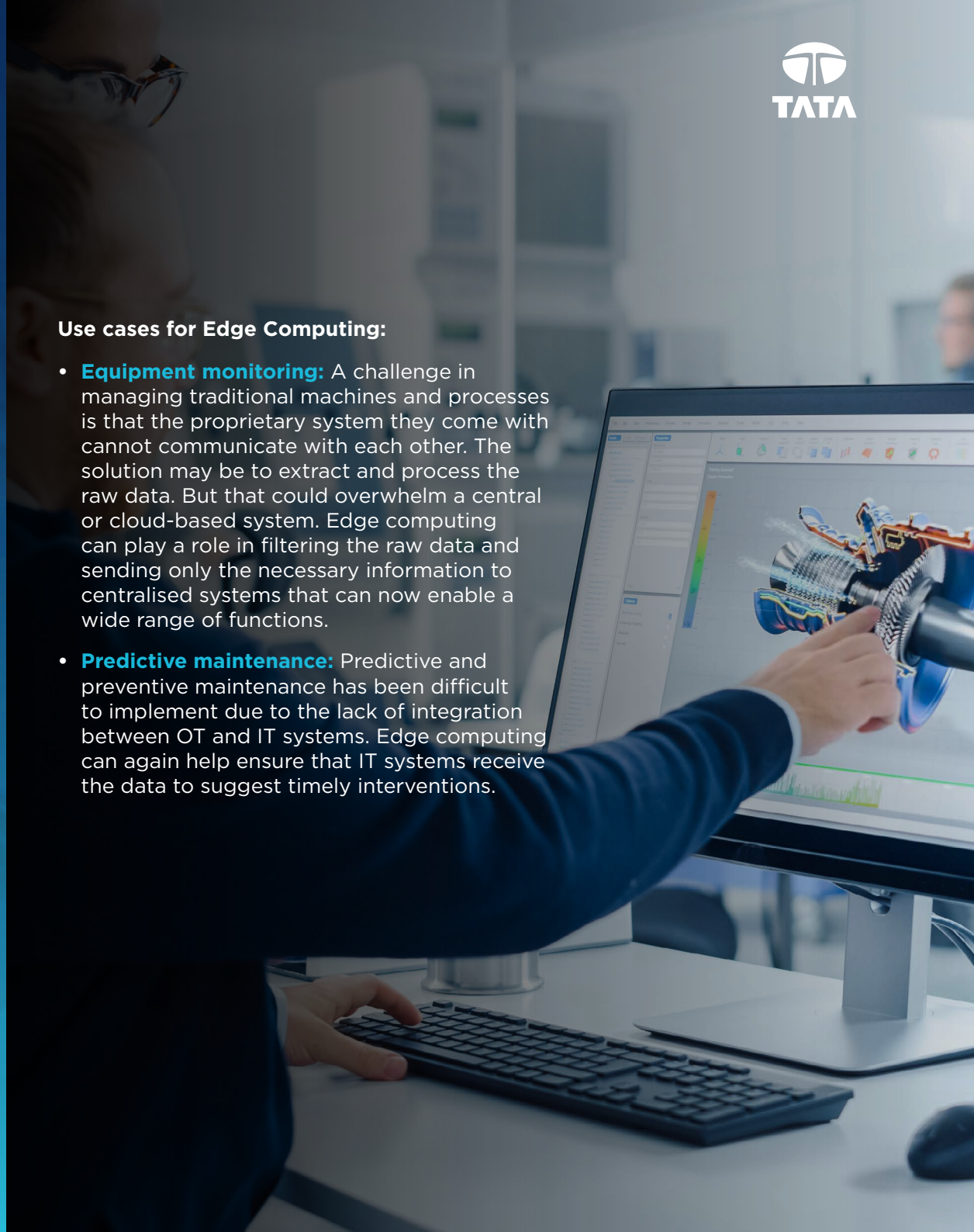
Edge computing enables manufacturers to power production efficiency by taking computing intelligence right to the shop floor. By pairing standardised, hardened edge computing hardware with OT-focused applications, legacy protocols and sensor reading can be turned into data streams that can be used by cloud-based analytics and monitoring systems.

To gain the promised benefits of edge computing is premised on a computing architecture with low latency and high reliability and the conversion of shopfloor equipment into smart devices in extreme industrial conditions. While manufacturers have implemented increased levels of automation and self-monitoring systems, shopfloor networks have not evolved at the same pace. Implementing new networking solutions on the shop floor have ripple effects that can impact the larger enterprise.

The first step towards adopting edge computing in an industrial context is a strategic review of the enterprise network to align the larger organisation's connectivity needs to those of the shop floor. Ultimately, a multi-level change across technology and management processes may need to be instituted to fully integrate edge computing capability into the organisation.

Use cases for Edge Computing:

- **Equipment monitoring:** A challenge in managing traditional machines and processes is that the proprietary system they come with cannot communicate with each other. The solution may be to extract and process the raw data. But that could overwhelm a central or cloud-based system. Edge computing can play a role in filtering the raw data and sending only the necessary information to centralised systems that can now enable a wide range of functions.
- **Predictive maintenance:** Predictive and preventive maintenance has been difficult to implement due to the lack of integration between OT and IT systems. Edge computing can again help ensure that IT systems receive the data to suggest timely interventions.



II. EDGE COMPUTING

Key technology enablers:

Technology area	Key considerations
Private 5G networks that can seamlessly connect smart devices on the shopfloor	• Building a low-latency, high-bandwidth, highly reliable IoT-enabled network connecting industrial computing platforms to technology analytics and control services. • Enabling data storage and backup on the cloud for vast amounts of data generated.
Wi-Fi 6 as an IoT gateway integration	• Scalable coverage with a smaller device footprint • Management of traffic flows, routing policy, network security and compliance • Improvement in range and battery life
Mobility solutions that can create connect devices	• Integrating eSIMs to existing equipment, including sensors, equipment, and controls to computing devices
Secure Cloud solutions	• Managing integration of app-specific clouds from different service providers • Seamless backup and DR solutions that can ensure business continuity in the event of industrial disruption
A new vision for **Security** that incorporates a transformed landscape	• Securing data flows from an increased number of data processing locations • The proliferation of attack surfaces due to the increase in the number of connected devices • Industrial systems must be enabled with the same levels of security controls found in IT systems.

III. ADDITIVE MANUFACTURING (AM)

The promise of Additive Manufacturing (AM), better known as 3-D printing, is to unleash design creativity to create precise geometric shapes at a lower cost outside the traditional manufacturing paradigm. By eliminating the need for conventional manufacturing approaches like moulds and presses and minimising waste, AM is a paradigm shift in
the manufacturing industry.

But the potential of AM is often tempered with the lack of a ready digital ecosystem to manage AM operations efficiently. For example, many AM processes are still manual – a CAD module is designed for 3-D printing and is then transferred to the printer on a USB drive. While this may work in a lab, it is not useful in production scenarios of even limited scale.

Enterprises looking to operationalise AM need to create a digital infrastructure that allows seamless transfer of data from the design studio to the printers, wherever they may be located. This requires cloud solutions that can be accessed by 3-D printers at a factory or a remote location and a global, high bandwidth network that can be accessed via multiple access points and robust security to protect valuable IP.

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Use cases for Additive Manufacturing

While AM cannot compete with mass production, it can be a valuable complementary technology across a range of use cases like:

Rapid prototyping: Creating and perfecting new products or components is often a trial-and-error process. The key to success is the ability to evaluate different options quickly. The traditional methods involved creating individual moulds for each new variation before fabricating the same. This is a time-consuming process. With AM, creators can quickly print out multiple variations of an object to accelerate the product development process.

Small batch manufacturing: AM can deliver real cost benefits when manufacturing less than 10,000 units. The elimination of production line changes, low wastage, and reduced power consumption offer a cost-effect solution when manufacturing a limited number of products.

Printing of high-value components: In many industries like aerospace and automotive, the need for specific high-end components can be met quickly and cost-effectively through AM.

Creating legacy spare parts: Many industrial machines worldwide may no longer be actively supported by manufacturers as they are of advanced age but still relevant in their function. When spare part availability is non-existent, AM offers both suppliers and customers the option to custom print the desired component cost-effectively.

AM has seen significant success in the Aerospace and Automotive industries, where the need for lightweight, reliable, complex components plays a massive role in product performance.

III. ADDITIVE MANUFACTURING (AM)

Key technology enablers:

Technology area	Key considerations
Secure multi-cloud solutions	• High-performance cloud to store and deploy design information and measure product quality in real-time • Managing and orchestrating multiple use case-specific cloud solution providers • Enabling seamless collaboration between geographically separated teams
Security solutions that are created for the AM paradigm	• The need for a comprehensive approach to security is needed both on the cloud and at the device level to protect company IP other proprietary information • Prevent illegal printing of contraband on company printers • Preventing malicious actors from executing changes to design that may result in recalls, fines and damage to property or humans

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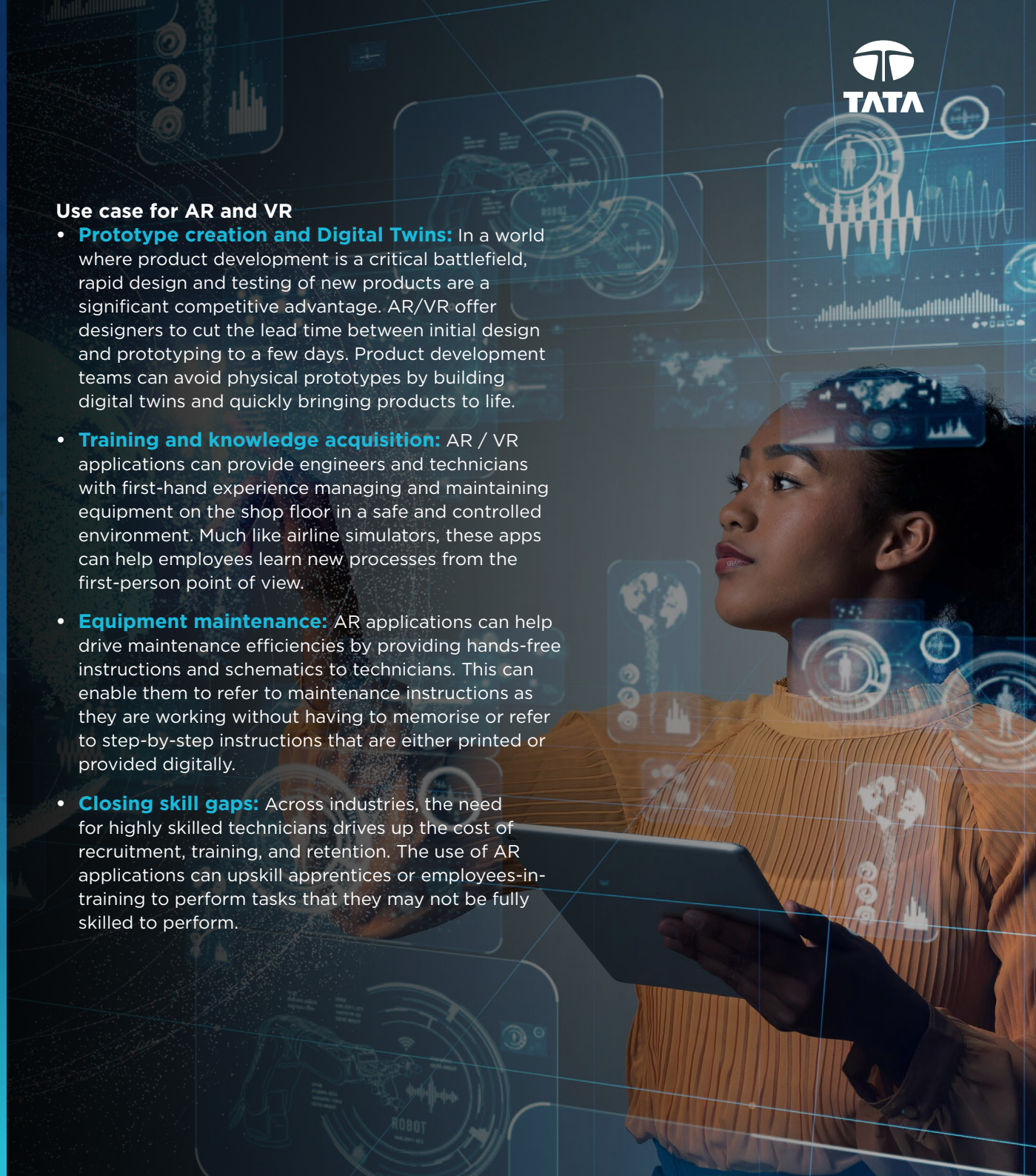
IV. AUGMENTED REALITY (AR) / VIRTUAL REALITY (VR)

AR and VR have integrated the visual and data streams into a seamless experience. AR and VR offer rich media interactions that can transform workers' productivity and skill levels. But integrating AR and VR in the industrial context requires a new set of digital tools ranging from high bandwidth wireless networks that connect devices to hybrid cloud solutions. These new digital solutions also must be placed in a new security context that recognises the added dimensions of cyber risk that come with distributing proprietary information on wireless devices.

Use case for AR and VR

- **Prototype creation and Digital Twins:** In a world where product development is a critical battlefield, rapid design and testing of new products are a significant competitive advantage. AR/VR offer designers to cut the lead time between initial design and prototyping to a few days. Product development teams can avoid physical prototypes by building digital twins and quickly bringing products to life.
- **Training and knowledge acquisition:** AR / VR applications can provide engineers and technicians with first-hand experience managing and maintaining equipment on the shop floor in a safe and controlled environment. Much like airline simulators, these apps can help employees learn new processes from the first-person point of view.
- **Equipment maintenance:** AR applications can help drive maintenance efficiencies by providing hands-free instructions and schematics to technicians. This can enable them to refer to maintenance instructions as they are working without having to memorise or refer to step-by-step instructions that are either printed or provided digitally.
- **Closing skill gaps:** Across industries, the need for highly skilled technicians drives up the cost of recruitment, training, and retention. The use of AR applications can upskill apprentices or employees-in-training to perform tasks that they may not be fully skilled to perform.



IV. AUGMENTED REALITY (AR) / VIRTUAL REALITY (VR)

Key technology enablers:

Technology area	Key considerations
Agile multi-cloud solutions that can power proprietary and industry-standard AR / VR solutions across the globe	• The need for agile, robust cloud solutions that can manage both the high computing requirements of AR / VR apps and the need for rapid scale. • Cloud architecture that can seamlessly integrate specialised AR / VR-Clouds • Ability to integrate multiple technologies from maps, data streams and imaging services to deliver a complete AR / VR experience
Secure Network and Mobility that can bring the AR / VR experience to life, even in remote locations	• The availability of high-bandwidth, low-latency, and secure wireless connectivity • Reliability of network to ensure disruption-free operations • Connected devices and eSIM-device integration that can interact with and be controlled through AR / VR devices

V. 5G CONNECTIVITY

5G heralds a world where everything is connected. By offering a data rate and reliability comparable to wired connections, 5G promises to be the new nervous system that can make the promise of Industry 4.0 a reality. But implementing 5G is more than a network project. It is about harnessing 5G to connect Man, Machine and Material for comprehensive visibility, cohesion, cost efficiency and improved production efficiency.

Manufacturers are advised to take the 'enterprise first view' that looks at harnessing 5G to unlock new ways or processes to achieve business goals. The start point is the evaluation of an integrated platform that can connect devices and sensors to analytical and control tools by abstracting in the underlying connectivity complexities. This has to be followed by connectivity embedded at the chip level that will lower the barriers to Industry 4.0 use cases.

Finally, this new digital landscape requires real-time monitoring of cyber threats beyond the traditional IT security landscape and includes edge devices such as equipment on the shopfloor and connected delivery trucks.

Use case for 5G

- **Process automation:** Imaging a smart factory where robots, devices, sensors are all working in concert, auto-correcting to run autonomously. Such a factory would not only be highly efficient but will also be free of human error and risk of injury to workers. 5G connectivity will be a core component of such a factory as it will provide the foundation on which such autonomous systems can interact seamlessly with each other.
- **Advanced robotics and cobots:** Robots that collaborate with humans are increasingly prevalent in shopfloors and warehouses. When robots are needed to move inside a defined space, they will need constant monitoring and real-time instruction to avoid collisions. The introduction of 5G will ensure that such collaborative robots (or cobots) can perform more complex and higher-value tasks with minimal disruption.
- **Cloud-managed machines:** Traditionally, factory automation was dependent on programmable logic controllers (PLCs) that were integrated with or near machines. PLCs were hard-wired into the network to ensure reliable performance under extreme conditions. With 5G, this function can be cloud-enabled, massive re-engineering the cost profile of such controllers.
- **Remote management of production systems:** A key benefit of a 5G-enabled factory is that operators do not have to be near production assets like robots and other machinery. Instead, they can remotely monitor them from a remote location or a centre of excellence. This ensures that highly skilled personnel are available to monitor, manage, and, if required, troubleshoot shopfloor equipment. Not only does this ensure access to skilled resources, but it also ensures that such resources can be pooled to provide expert assistance to multiple sites within an enterprise.

Beyond the above use cases, 5G is at the heart of many other key innovations that have been discussed in this whitepaper, including the use of AR/VR and edge computing.

V. 5G CONNECTIVITY

Key technology enablers:

Technology area	Key considerations
Using 5G as the primary SD-WAN Link	• Deploying SD-WAN using 5G as the underly in addition to private network, MPLS, DIA and broadband access • 5G and SD-WAN enables high speeds and low-latency access to remote geographic areas with limited connectivity options
Reimagined security for a quantum leap in the number of network nodes	• Managing a vast number of connected devices that create an increase in the attack surface • A new security architecture that delivers security at the edge instead of from the centre • Managing security for connected legacy devices without native security control • Zero-trust security
5G-ready enterprise networks	• Integration of 5G private network into the enterprise network architecture • Deploying 5G in a multi-vendor network environment • The need for private 5G networks that can enable specific use-case based on the needs of each location • Creating enterprise-wide standards that will enable seamless connectivity between locations • The case for network consolidation to drive cost benefits and smoother 5G deployment
Easy to deploy eSIM (embedded SIM) solution	• eSIM-chip integration to lower the barrier for 5G roll-out • Zero-touch device activation for ease of deployment • Managing eSIM profile variation based on device profiles

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HOW CAN TATA COMMUNICATIONS HELP?

What are common themes in a Smart Manufacturing ecosystem?

Transformation Levers:

- Hyper-connectivity
- IIoT
- Rapid processing
- Autonomy
- Real-time data analysis
- Intelligence

Business Outcomes:

- Greater efficiencies
- Smarter decision making
- Resource effectiveness
- Transformation of employee experience
- Optimising energy consumption

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Each of the above themes needs a complete reimagining of the traditional technology backbone in a manufacturing enterprise. Tata Communications suggests the below:

- **Lay an agile digital foundation:**

  Manufacturing enterprises have traditionally prioritised stability over agility. As the reliability of smart manufacturing technologies improves, this needs to be re-examined as the adoption of agile technologies like cloud, SD-WAN and IIoT / IoT are essential to harvesting the benefits of smart manufacturing in a connected world.

- **Analyse data and predict processes:**

  The factory of the future is a data-rich ecosystem. Harnessing this data to improve outcomes continually will be a crucial driver of the returns from Smart manufacturing initiatives. This data also has valuable predictive capabilities. From optimising production runs to eliminating downtime through predictive maintenance, data analysis can deliver a range of competitive advantages to smart manufacturers.

- **Creating digital models across the value chain:**

  From product prototypes to new building construction, technology allows manufacturers to build digital models first. These 'digital twins' can help designers and engineers to measure new ideas against desired performance standards before creating physical outputs. This helps save time and resources and ensures that manufacturers can stand behind their product quality and performance like never before.

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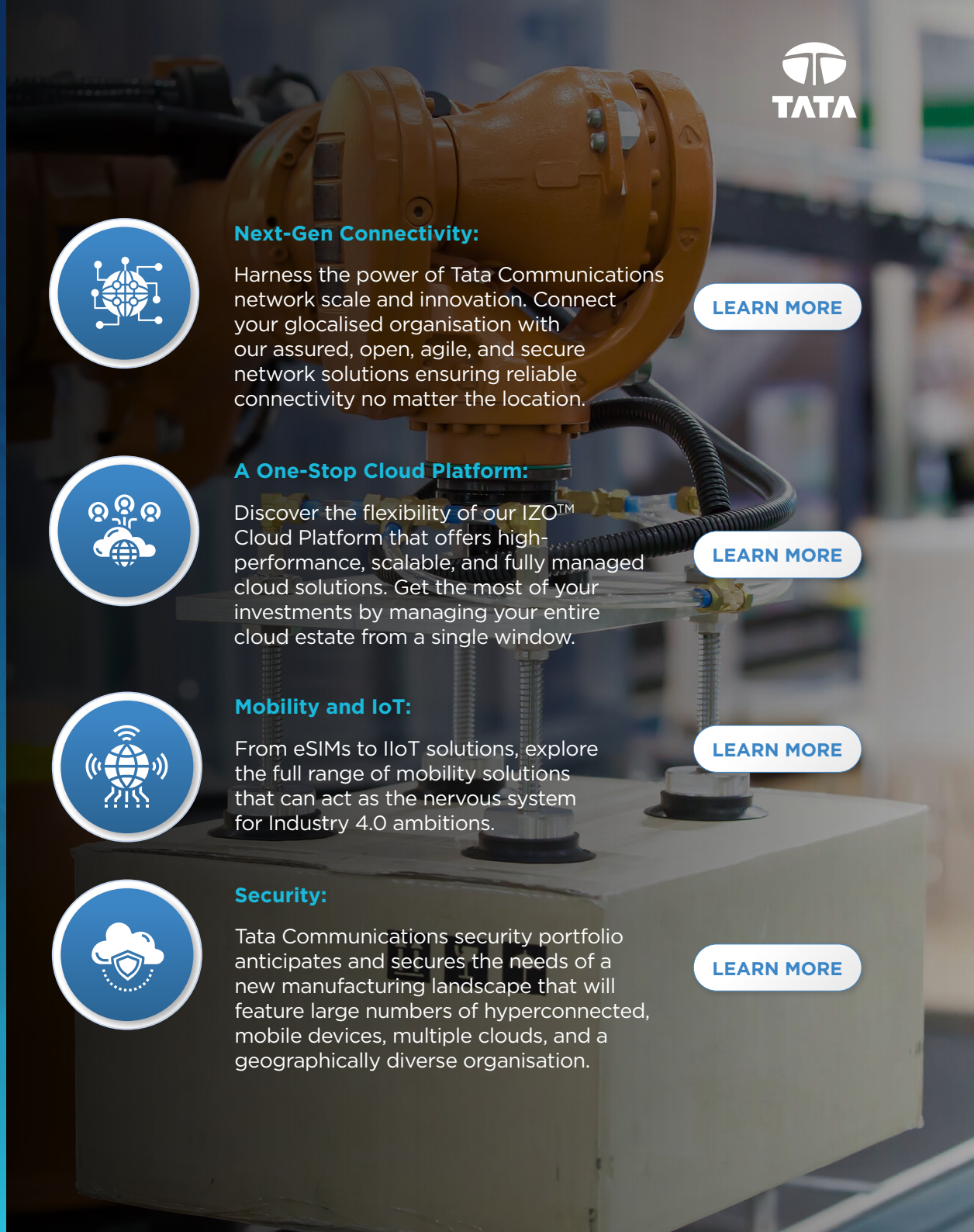
TATA COMMUNICATIONS PORTFOLIO THAT CAN ENABLE THE SMART MANUFACTURING DIGITAL ECOSYSTEM

Click here to learn more about how Tata Communications can help you in your smart manufacturing initiatives.



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Next-Gen Connectivity:

Harness the power of Tata Communications network scale and innovation. Connect your glocalised organisation with our assured, open, agile, and secure network solutions ensuring reliable connectivity no matter the location.

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A One-Stop Cloud Platform:

Discover the flexibility of our IZO™ Cloud Platform that offers high-performance, scalable, and fully managed cloud solutions. Get the most of your investments by managing your entire cloud estate from a single window.

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Mobility and IoT:

From eSIMs to IIoT solutions, explore the full range of mobility solutions that can act as the nervous system for Industry 4.0 ambitions.

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Security:

Tata Communications security portfolio anticipates and secures the needs of a new manufacturing landscape that will feature large numbers of hyperconnected, mobile devices, multiple clouds, and a geographically diverse organisation.

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About Tata Communications

Tata Communications is a leading Digital Ecosystem Enabler that powers today's fast-growing digital economy.

The company's customers represent 300 of the Fortune 500 whose digital transformation journeys are enabled by its portfolio of integrated, globally managed services that deliver local customer experiences. Through its network, cloud, mobility, Internet of Things (IoT), collaboration and security services, Tata Communications carries around 30% of the world's internet routes, and connects businesses to 60% of the world's cloud giants and 4 out of 5 mobile subscribers.

The company's capabilities are underpinned by its global network, which is the world's largest wholly owned subsea fibre backbone and a Tier-1 IP network.

Tata Communications Limited is listed on the Bombay Stock Exchange and the National Stock Exchange of India, and it serves customers in more than 200 countries and territories worldwide through its technology capabilities and partnerships.

For more information, visit us at www.tatacommunications.com

Contact us