



Immersive

Outlook

Driving human-centric transformation

December 2024





Contents

01

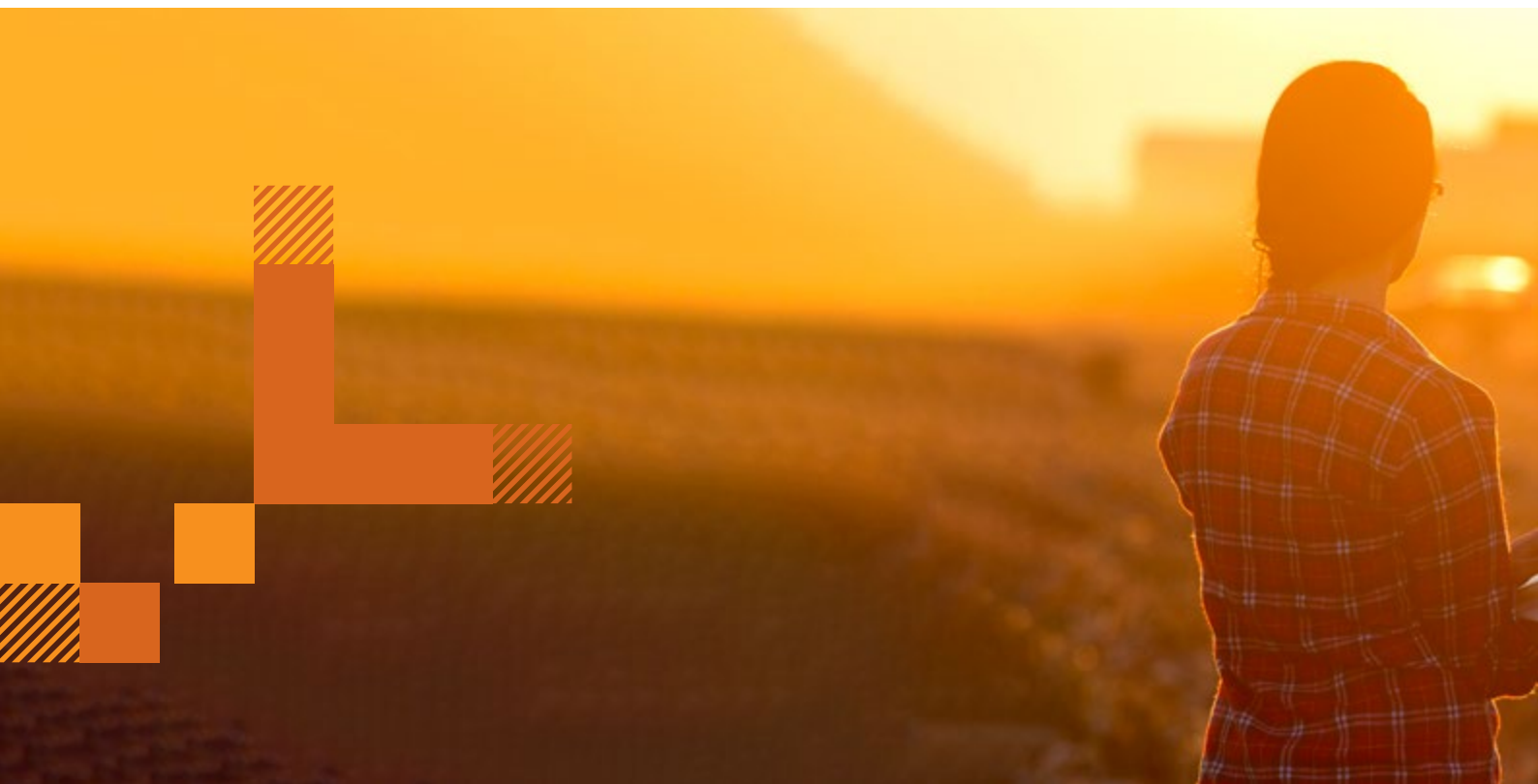
Foreword

Driving the Fifth Industrial Revolution **04**

02

Three imperatives to drive human-centricity in the manufacturing landscape

The Fifth Industrial Revolution places humans at the centre of operational and production processes. **Sudipta Ghosh, Ankur Basu** and **Ajay Deshmukh** highlight three imperatives to drive the workforce-first approach of Industry 5.0. **06**





03

‘Marrying people and technology can solve current manufacturing challenges of scale, speed and quality’

The manufacturing sector has lost its salience to attract people over the years. To change that, the need of the hour is to embrace technologies such as the internet of things [IoT] and bring in human-centric development, says **B. Thiagarajan**, Managing Director of Blue Star Ltd. in a conversation with **Sudipta Ghosh**, Data and Analytics and Industrial Products Leader, PwC India. **12**

04

Managing and measuring change on the manufacturing shop floor

Transforming the shop floor is central to the Fifth Industrial Revolution to increase operational efficiency, enhance sustainability and improve workforce safety. **Ankur Basu** and **Ajay Deshmukh** outline how robust change management strategies can drive this transformation. **18**



Foreword

Driving the Fifth Industrial Revolution

Our recently released report **‘Decoding the Fifth Industrial Revolution: Marching towards a resilient, sustainable and human-centric future’** stated at the outset that 93% of senior executives across six industries would like to be known for their sustainability initiatives, and yet achieve 2x to 3x profitable growth over the next three to five years. As the way forward, this edition of Immersive Outlook focuses on ‘how’ that can be achieved through the harmonious partnership between humans and nature, a workforce-first approach and futuristic transformation of the manufacturing shop floor – with sustainability as the sticky glue to bind them all together.

With COP29 having just concluded, underscoring the importance of sustainability as the fulcrum for the Fifth Industrial Revolution is befitting, given that the principles of Industry 5.0 align well with the goals of COP29. Both are directed at promoting efficient resource utilisation, reducing waste and minimising environmental impact through innovation. In addition, Industry 5.0 ensures that there is no trade-off between technological efficiency and human health and safety. Thus, the synergy between COP29’s sustainability goals and Industry 5.0’s technological advancements to create safer work environments offers a promising pathway towards a more sustainable and resilient future.

A few nations have already shown the way. Japan, for instance, took the lead way back in 2016 with its Society 5.0 concept that blurred the lines between cyberspace and physical space using technology – big data, AI, robotics – to build digital twins.¹ Society 5.0 is aimed at enhancing the quality of an individual’s life and in turn create a human-centric, smart society.² An offshoot of this concept, Industry 5.0 proposes a far more enhanced role for humans with resilience at its core – enabled by technology to work in sustainable and safe spaces.

If Industry 4.0 was about automation and efficiency, sparking the fear of job loss, Industry 5.0 is more about human creativity and cobots, alleviating the primary fear of job loss and in its place emphasising the need for high-value jobs that require human involvement.

1 UNESCO, Japan pushing ahead with Society 5.0 to overcome chronic social challenges

2 Ibid.



This edition of Immersive Outlook, accordingly, focuses on the need for this paradigm shift with humans and nature as the mutual beneficiaries.

The first article, **‘Three imperatives to drive human-centricity in the manufacturing landscape’**, shows how companies can drive the workforce-first approach of Industry 5.0 by making the transition from smart to cognitive technology, empowering the workforce through upskilling, and taking initiatives to improve workforce safety. These imperatives are substantiated by use cases that highlight the impact of combining advanced analytics models with human ingenuity.

The manufacturing sector’s need to embrace technologies such as the internet of things (IoT) and bring in human-centric development is highlighted by **B. Thiagarajan**, Managing Director of Blue Star Ltd., in our video interview with him on **‘Marrying people and technology can solve current manufacturing challenges of scale, speed and quality’**. According to Thiagarajan, this marriage is of utmost importance for the simple reason that there are growing aspirations of the labour force.

Last but by no means the least, the final article, **‘Managing and measuring change on the manufacturing shop floor’**, deals with the dynamics of the manufacturing shop floor, the meeting ground of design innovation and engineering on the one hand, and the production processes on the other. Despite changes ushered in by industrial revolutions, companies are at times faced with a significant challenge: the shop floor remains a siloed space. With the Fifth Industrial Revolution, shop floors

around the world are set to transform, combining digital twins with AI and GenAI to develop promising solutions to bridge some of the gaps that arise in a traditional shop floor setting.

Our report **‘Decoding the Fifth Industrial Revolution: Marching towards a resilient, sustainable and human-centric future’**, which surveyed 180 senior manufacturing executives, indicated how companies clearly acknowledge the need to prioritise employee development and engagement. It also underlined that more than 95% of the respondents in the cement and industrial goods sectors are prioritising investments in real-time inventory tracking to optimise inventory levels, reduce stockouts and minimise excess inventory. Customers too are ready to pay a premium for innovative products and services.

With these findings as the starting point, this edition of Immersive Outlook goes a step forward to show that while Industry 4.0 is transformative, it does not fully align with the urgent needs of our time. Industry 5.0, with its emphasis on the harmonious integration of advanced technologies with human and environmental considerations, is a more suitable model for addressing the current sustainability challenges.

We hope you enjoy reading this edition of Immersive Outlook and gain relevant insights to build a sustainable future for the planet.

**Raghav Narsalay and
Vishnupriya Sengupta**



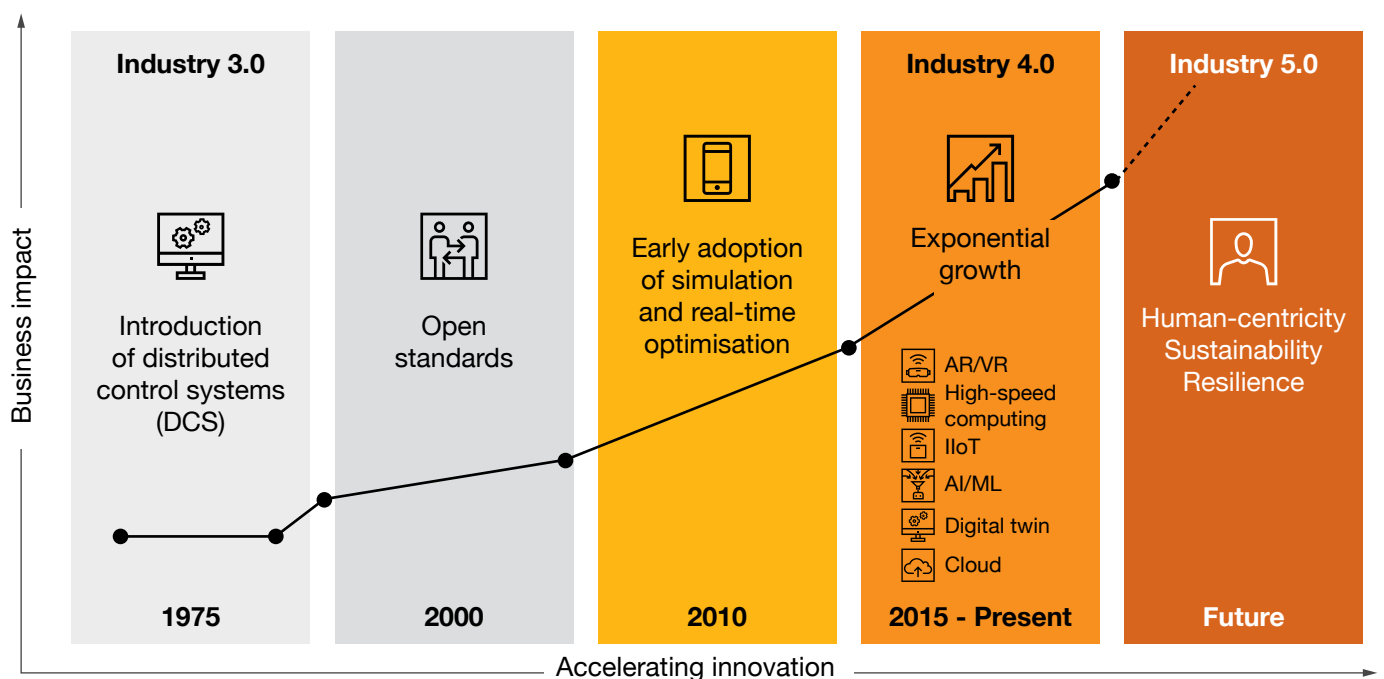
Three imperatives to drive human-centricity in the manufacturing landscape

The Fifth Industrial Revolution places humans at the centre of operational and production processes. **Sudipta Ghosh**, **Ankur Basu** and **Ajay Deshmukh** highlight three imperatives to drive the workforce-first approach of Industry 5.0.

From industrial value to holistic value

Technological advancements and innovations in recent years have revolutionised the manufacturing landscape, ushering in a new era of industrial growth. This trajectory owes much to the advent of industrial digitisation, which marks significant shifts in manufacturing and production methods.

Figure 1: The industrial revolutions



Source: PwC analysis



A human-centric approach in Industry 5.0 places human needs, safety and interests at the heart of the production process. Instead of focusing on what humans can do with new technology, Industry 5.0 asks what technology can do for humans?¹ Instead of the workforce adapting their skills to evolving technology, the Fifth Industrial Revolution aims at using technology to adapt production processes to the needs of a diverse workforce.² This is aligned with the imperative for companies to adapt to shifting workforce dynamics to enhance capabilities that can generate value-driven opportunities.

The recent PwC India research on Industry 5.0, **Decoding the Fifth Industrial Revolution**,³ indicates that companies clearly acknowledge the need to prioritise employee development and engagement, and have gradually begun to perceive them through the lens of investment which yields holistic returns, rather than the lens of cost which erodes revenue. Three core imperatives can help Industry 5.0 to realise its human-centric promise:

- move from smart to cognitive technology
- empower the workforce to be Industry 5.0-ready
- improve workforce wellness.

1) Move from smart to cognitive technology

Unlike 'smart' technology that focuses on specific tasks with predefined intelligence, cognitive technology replicates more advanced cognitive functions associated with human intelligence. 'Smart' virtual assistants, for instance, can perform tasks based on pre-programmed commands; interaction is limited to these specific commands that rely on predefined scripts. Cognitive AI assistants, on their part, go beyond executing commands. Designed to comprehend context and intent, they can perform complex tasks; interaction is natural as they are able to respond to nuanced language and interpret emotions.

For instance, a smart predictive maintenance system could alert a technician that a machine's vibration levels are higher than normal, indicating a possible bearing failure. The technician would then be required to schedule a check-up. A cognitive predictive maintenance system is equipped to do more. For one, the technician would receive an alert on both the possible failure of the bearing, and an estimate of when that can happen. Such a system would also suggest the optimal time for maintenance based on production schedules,

order replacement parts in advance, and offer instructions or video tutorials on how to perform the maintenance, based on the specific context of the detected issue.

This transition from smart to cognitive technology in predictive maintenance illustrates how manufacturing processes are becoming more pre-emptive and efficient. This shift showcases how the world is moving towards more sophisticated technologies that not only perform tasks but also understand and adapt to complex human needs and contexts.

With human-machine collaboration at the forefront, the technologies including human-centred artificial intelligence (HCAI)⁴ are designed to augment rather than replace human capabilities to create more adaptive and responsive systems. Employees on their part are also open to embracing new technologies and benefiting from them.

And yet, the inability to provide secure access to GenAI and similar such technologies to enhance workforce productivity is a challenge for many executives across industries such as chemicals (77%), textiles and clothing (57%), cement (53%) and automotive (30%).⁵



1 European Commission, Industry 5.0

2 Ibid.

3 PwC, Decoding the Fifth Industrial Revolution

4 Shneiderman, B. Human-centered artificial intelligence: Reliable, safe & trustworthy. Int. J. Hum. Comput. Interact. 2020, 36, 495–504

5 PwC, Decoding the Fifth Industrial Revolution



Clothes manufacturers, for example, are trying to explore GenAI for rapid prototyping and acceleration of the design process. However, challenges remain. Ensuring the safety of proprietary designs that GenAI models need access to, implementing strong authorisation mechanisms to control who has access to modify the GenAI tools, and training the workforce on potential security risks are areas that still need to be addressed.

2) Empower the workforce to be Industry 5.0-ready

With human-machine synchronisation, the workforce will need to be upskilled to bridge the gap between their current skill sets and those required for the next level of industrialisation. Creative problem solving, digital proficiency, emotional intelligence and data literacy will gain prominence. Industry 5.0 therefore envisions continuous learning and skill development for employees while offering flexible work environments.

With this in mind, organisations are using GenAI to customise training programmes to suit individual employees' needs and career goals. Manufacturing companies are exploring the use of GenAI to simulate factory settings and train shop floor workers on complex machinery in a risk-free environment.

Moreover, with robots taking over repetitive tasks and those demanding heavy physical labour, the Fifth Industrial Revolution can render workplaces safer for

workers while also democratising opportunities for one and all in the working environment.⁶ Digitalising industrial processes will also enable remote work, allowing those living in distant regions to enter the labour market.⁷ Workers too would be motivated to acquire new skills with a strong emphasis on quality and consistency in their work.

Companies are also identifying opportunities to strengthen and empower their workforce. As per our survey, 79% of business leaders want to upskill at least 50% of their workforce to work with advanced digital technologies and machines in the next one to two years, and 28% of the organisations say they have scaled up customised skilling mechanisms using technologies such as augmented reality (AR), virtual reality (VR) and GenAI to make training enjoyable and accessible to the workforce at any time.⁸

3) Improve workforce wellness

Enhancing worker well-being and resilience is a key tenet of Industry 5.0. The workforce is now seeking comprehensive measures that prioritise their well-being and safety. This has prompted companies to deploy digital solutions to improve the physical and mental health conditions of their workforce.

A case in point is that of an automobile manufacturer that has employed VR-based training for its assembly line workers and reported significant injury reduction. In another manufacturing company, safety measures for workers are

taught through AR and VR. For instance, when a worker climbs a transmission line tower, the worker wears a mixed-reality headset. Using multiple sensors, advanced optics and holographic processing that melds seamlessly with its environment, these holograms display information, blend with the real world, or even simulate a virtual world and show the worker how to go about the task safely.

When designing digitised workplaces, it is important to factor in ethical considerations and ensure that the tools and technology do not undermine the dignity of the worker⁹ or breach their privacy while harnessing the collective intelligence of man and machine. Therefore, the three imperatives are key to the human-centric vision that is at the core of Industry 5.0.

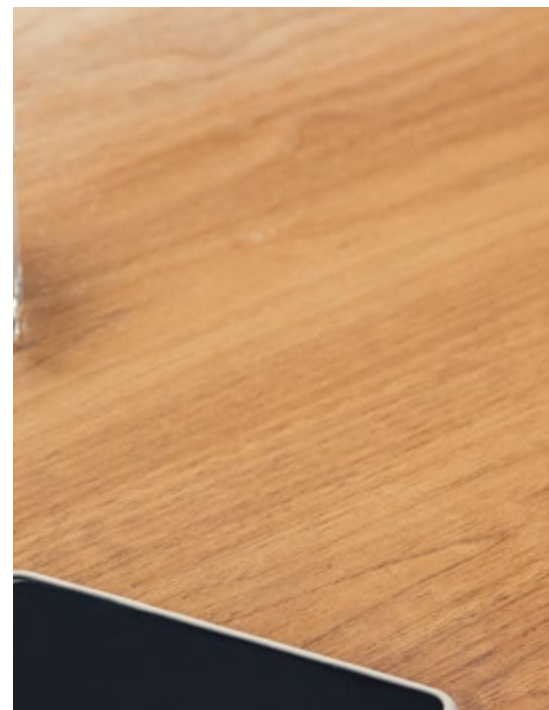
A potential use case involving a manufacturing plant demonstrates how these principles can be put into practice to boost productivity and resilience while ensuring continuous learning and employee satisfaction.

6 European Commission, Industry 5.0

7 Ibid.

8 PwC, Decoding the Fifth Industrial Revolution

9 European Commission, Industry 5.0





Use case: Unleashing human ingenuity using next-gen plant analytics

While Industry 5.0 encompasses a range of technologies, one particularly promising solution combines advanced analytics models – trained on historical plant issues and troubleshooting techniques – with enhanced knowledge-sharing and personalised human capital development plans.

As-is state

The current systems based on the Industry 4.0 approach rely on a collaborative mechanism called the 'Integrated Process Operations Framework' which is responsible for the transmission of production-related insights from the plant level to the boardroom, where strategic decisions are made. This integrated process operations framework consists of three major components:

1. An overarching operating envelope detailing various process parameters and their operating limits. This operating envelope further includes

instructions, shift monitoring tools, and a shift reporting tool, often referred to as Handover, Takeover or HOTO.

2. Alarm analysis and a rationalisation tool model equipped with real-time monitoring of online process parameters with corresponding operating limits pre-fed into the system for highlighting any deviation – untoward or otherwise.
3. A mobility platform providing enhanced system connectivity for on-ground activities and real-time support.

Post completion of every shift activity, every single action that was conducted and every incident that took place during the shift are recorded in a digital shift logbook for keeping records. This logbook, when implemented as a database of all plant-related incidents and activities, can be augmented with advanced analytical tools to generate a wealth of information.

To-be state

While the plant is equipped with standard operating procedures (SOPs), the way it is run is largely

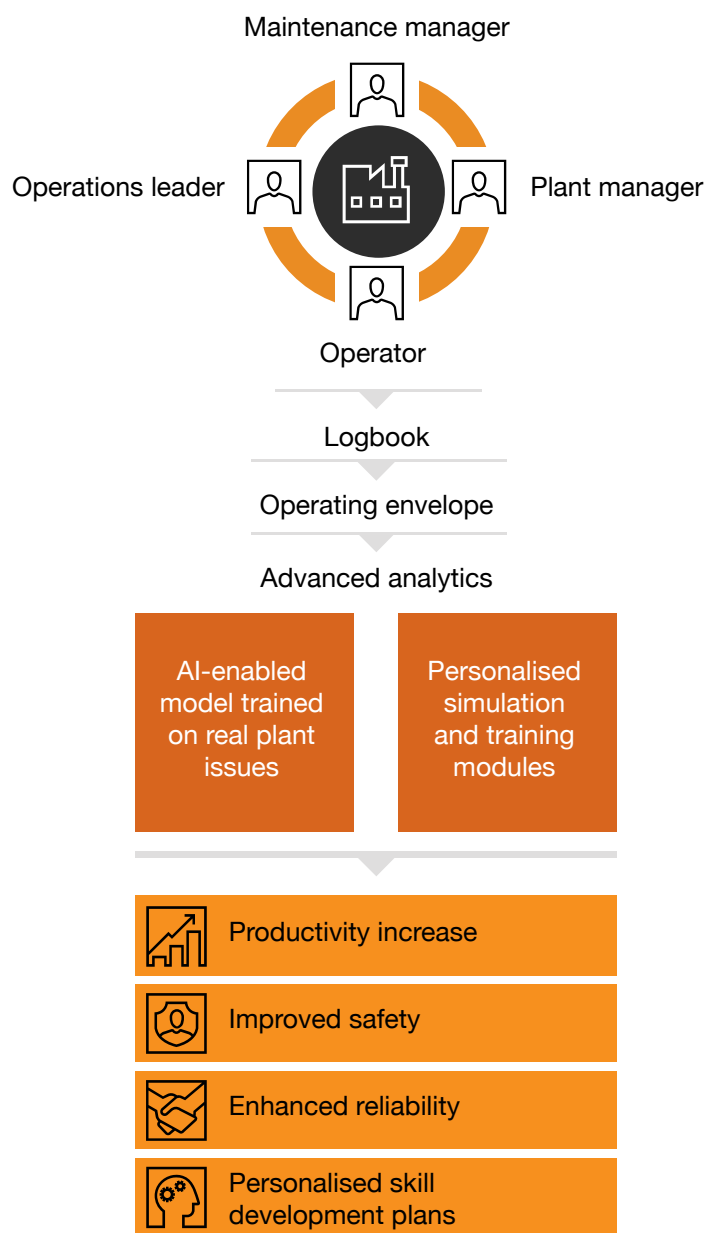
dependent on human input and decision making, informed by the expertise of running the plant in a safe, reliable and timely manner that comes with years of experience. This indicates that human skill and experience are critical in determining how smoothly the plant would operate. Combining human expertise with modern analytics tools can lead to the generation of value on multiple fronts for an organisation.

- **Man-machine collaboration for enhanced reliability:** The digital logbooks which hold large amounts of plant data can be used in combination with natural language processing (NLP) and specialised AI/ML models equipped to learn and assimilate years of plant data to derive insights. Such a tool will not only highlight issues that can hamper smooth operations but also suggest the best mitigation measure based on historical records. This would also enable younger, less experienced executives to make better decisions with increased confidence and reliability in high-stress situations.

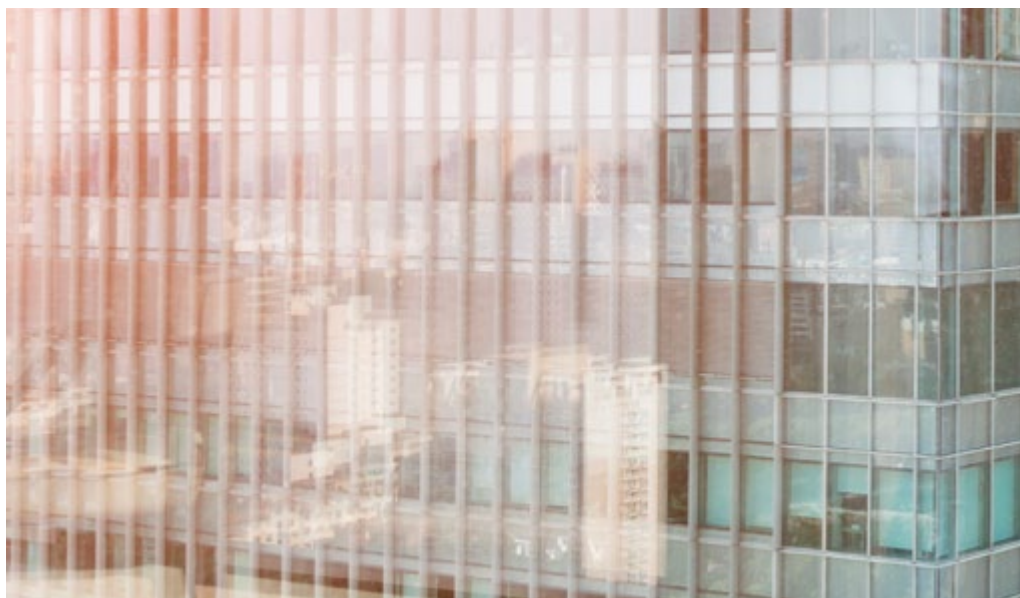


- Performance analysis for better productivity:** Once prepared, this tool can also be used for performance analysis and benchmarking of various shift in-charges and their level of competence based on their handling of plant issues from a historical data standpoint. The insights generated could also help the management pinpoint that productivity differences in different shifts are a result of differences in competence level, which are built by handling abnormal situations that may arise. Once candidates who underperform with respect to a chosen benchmark are identified, specialised training could be arranged for such individuals.
- Personalised skill development:** The use case can also be employed to drastically improve employee learning and development by creating personalised training modules. Using the insights generated, the employee can leverage digital twins and simulations to practice and perform troubleshooting activities in a simulated environment without disrupting normal plant operations. The simulations may be created in order to replicate abnormal situations that have been identified in the logbook. Assessment of the individual could be conducted by benchmarking the steps the learner takes vis-à-vis the SOPs and best practices which were also highlighted in the logbook analysis.

Figure 2: Moving from the as-is to the to-be state



Source: PwC analysis





Looking ahead

Companies are slowly recognising the need for business model reinvention to build human-centric value proposition-based products, services and experiences. They are focusing on building operating models to provide opportunities for upskilling and reskilling employees and to create an environment that encourages learning, experimentation and innovation.

However, businesses are still struggling to scale up in areas such as digital twinning and human-machine collaboration. Certain challenges need to be addressed to accelerate the adoption of Industry 5.0. These include:

- The workforce perceives machines/robots and digital technologies as threats to their jobs and incomes.

- Organisations lack substantive training to maximise value from human-machine collaboration or offer poor on-the-job virtual training.
- Organisations are unable to track and understand workforce aspirations towards leveraging emerging technologies.
- Companies are unable to provide secure access to GenAI and similar such technologies to enhance workforce productivity, sustainability and efficiency.
- Poorly executed inclusion and diversity policies are often demotivating.

It is evident then that multiple actions will be required on the part of both the employer and the employee. While employees need to place their trust in

technology, companies need to take initiatives to empower them to trust technology. The good news is that companies are investing in capabilities that are central to the vision of Industry 5.0. Forward-thinking companies looking to stay ahead of the curve emphasise that their immediate priorities include listening to continuous feedback and scaling up this ability so that they can provide employees with meaningful work to boost their job satisfaction, alongside smart and engaging skilling initiatives.¹⁰

Also contributing to this article were **Vishnupriya Sengupta, Ruchika Uniyal, Arnab Chakraborty and Mohit Prasad.**



‘Marrying people and technology can solve current manufacturing challenges of scale, speed and quality’

The manufacturing sector has lost its salience to attract people over the years. To change that, the need of the hour is to embrace technologies such as the internet of things (IoT) and bring in human-centric development, says **B. Thiagarajan**, Managing Director of Blue Star Ltd. in a conversation with **Sudipta Ghosh**, Data and Analytics and Industrial Products Leader, PwC India.



Sudipta Ghosh (L) with B. Thiagarajan



Excerpts from the interview

Sudipta Ghosh: Hello and welcome to this edition of *Immersive Outlook*. My name is Sudipta Ghosh, I'm a partner at PwC India and today we will be talking about Industry 5.0, which introduces the perspective of resilience, sustainability and human-centric solutions, particularly for the manufacturing sector. Joining me today is Mr B. Thiagarajan, the MD of Blue Star Ltd., who has over four decades of industry experience across multiple organisations. We always knew that efficiency and automation were going to be critical for manufacturers, but we now see organisations looking at ways to make their applications more sustainable and resilient as well, while trying to ensure symbiotic interactivity between humans and machines. While we aspire to make manufacturing 24% or 25% of the GDP's share, today the percentage is around 16% or 17%. To meet this goal, we possibly have to grow at double the rate of what our economy is growing at right now. And that is a great ambition to have. In that context, it would be great to understand your thoughts from an industrial and organisational perspective. What kind of growth do you see in your sector and in the overall manufacturing sector, specifically in the Indian context?

B. Thiagarajan: It's such a pleasure interacting with you, Sudipta. The story is the same across various sectors. It is India's decade. Driven by many things that are happening around, there is a huge aspiration for growth in every industry that I

look into. Take, for example, the consumer durables and electronics [segment], in which we are talking about becoming the fourth largest in the world in the next five years, at a record INR 5 lakh crore revenue. The sector that I belong to, the air conditioning industry, will more than double by 2030 and become the largest in the world by 2040, overtaking China. So this is the moment when manufacturing needs to meet scale. In that context, Industry 5.0 is indeed an interesting approach.

Sudipta Ghosh: When you talk of this growth, there will probably be a huge amount of focus on the consumers of our products. We are seeing the expectations of our consumers change, as they now look for greener products. We are already seeing this shift in many of the export sectors as India becomes a manufacturing hub. What are organisations doing to improve customer centricity, taking into account their changing needs and expectations, particularly in the light of environmental factors?

B. Thiagarajan: The very first thing to keep in mind is cost leadership. You [a manufacturer] are trying to become a manufacturing leader in the country and create your own component ecosystem without any dependence on imports. Therefore, the nature of manufacturing itself is changing with capacities being created, but scale is yet to happen, and you are trying to make quite a few products for the first time. So there is a cost issue. You had been used to imports and now suddenly, you are making products which are competitive from the consumer point of view. It is key to deliver a product at a price which

the customer can afford, only then can scale happen. So customer centricity begins with that. The second aspect is connected with the lifecycle cost [of a product] as against the initial purchase. In quite a few categories, it is about the product's power consumption and the carbon footprint. Manufacturers need to keep in mind factors like the reusability and recyclability of a product and the e-waste it may generate. So, you need to look at the cost and sustainability of the product while ensuring that it creates a lower carbon footprint. Most importantly, in a connected world, if an advanced technology is being leveraged elsewhere, it should be implemented here as well. So, we are in exciting times. It is indeed very challenging but we cannot escape these dimensions.

Sudipta Ghosh: While efficiency and cost optimisation can always be achieved through conventional means by working on different levers, now we see cost efficiency being increasingly linked to sustainability. For example, if I try to have a conversion process that can reduce my energy consumption or my scope 1 emission, it solves my twin purposes of reducing my energy consumption cost and making my product look greener. I can use that as a differentiator in the market. While this idea is at a conceptual level, I would like to get a perspective on its practical implementation from you. Are you sensing that sustainability has moved away from being a 'nice-to-have' feature to something that can add to the competitiveness of a product from the perspective of customer positioning or cost advantage?

B. Thiagarajan: I come from the school of thought that unless and until there is a business case, no one is going to embrace sustainability, especially in a growing country like India with billions of consumers. Whether it is meant for a B2B or B2C model, you have to make a sound business case as to why marketeers, manufacturers and service providers must embrace sustainability. Take air conditioners, for example. There may be an energy labelling programme legislated for various purposes, but if I have to sell more, I need to demonstrate that my product consumes less energy. Let us say we are selling to a B2B customer, for whom the power consumption at an IT data centre adds up to a huge cost. Therefore, it is important that the product that is manufactured be highly energy efficient. Green shifts aren't restricted to manufacturing, they must begin at the R&D and conceptualisation stage. Manufacturers must ask themselves: How can I design a product and create a value proposition around higher energy efficiency? How can I ensure recyclability and how, through recyclability, can I offer a benefit to the consumer [like recyclable packaging]?

Traditional manufacturing is about research and development, prototyping, setting up a manufacturing unit. The efficiency of that manufacturing unit will be decided at the manufacturing engineering stage. I think we are at a crossroads. For the first time, we will be looking at scale. We are used to manufacturing units that churn out half a million units in a particular time period and now we are looking at units that can produce 3 million, 5 million or 10 million units in the same window. That itself is new and that

kind of scale cannot be achieved unless you make manufacturing very efficient from all angles, be it through the equipment you use, the productivity, the power consumption or the material flow. It is a completely different science, according to me.



Sudipta Ghosh (left); B. Thiagarajan (right)

Sudipta Ghosh: We are seeing a lot of focus on creating a digital replica of the supply chain or creating a digital twin of a product, so as to simulate the production process and identify bottlenecks and choke points. The simulation also helps manufacturers find ways to build more redundancies into the supply chain so that operations can be future proof and business continuity is ensured. When it comes to your organisation or the overall industry, do you see any shifts in thought processes, in moving away from focusing solely on efficiency to also looking at business continuity and resilience?

B. Thiagarajan: Most CEOs, including myself, would list supply chain concerns as the number one challenge. If I'm losing sleep, it will be over this particular issue. These concerns arise from (a) the Make in India imperative and (b) the geopolitical risks involved with over-dependence on vendors across the globe or in a few countries. Your whole growth strategy can be impacted if a particular component stops being available. It may not have substantial value but it can stop production. There are multiple things that are happening. First, you have to customise your product for the country and its residents.



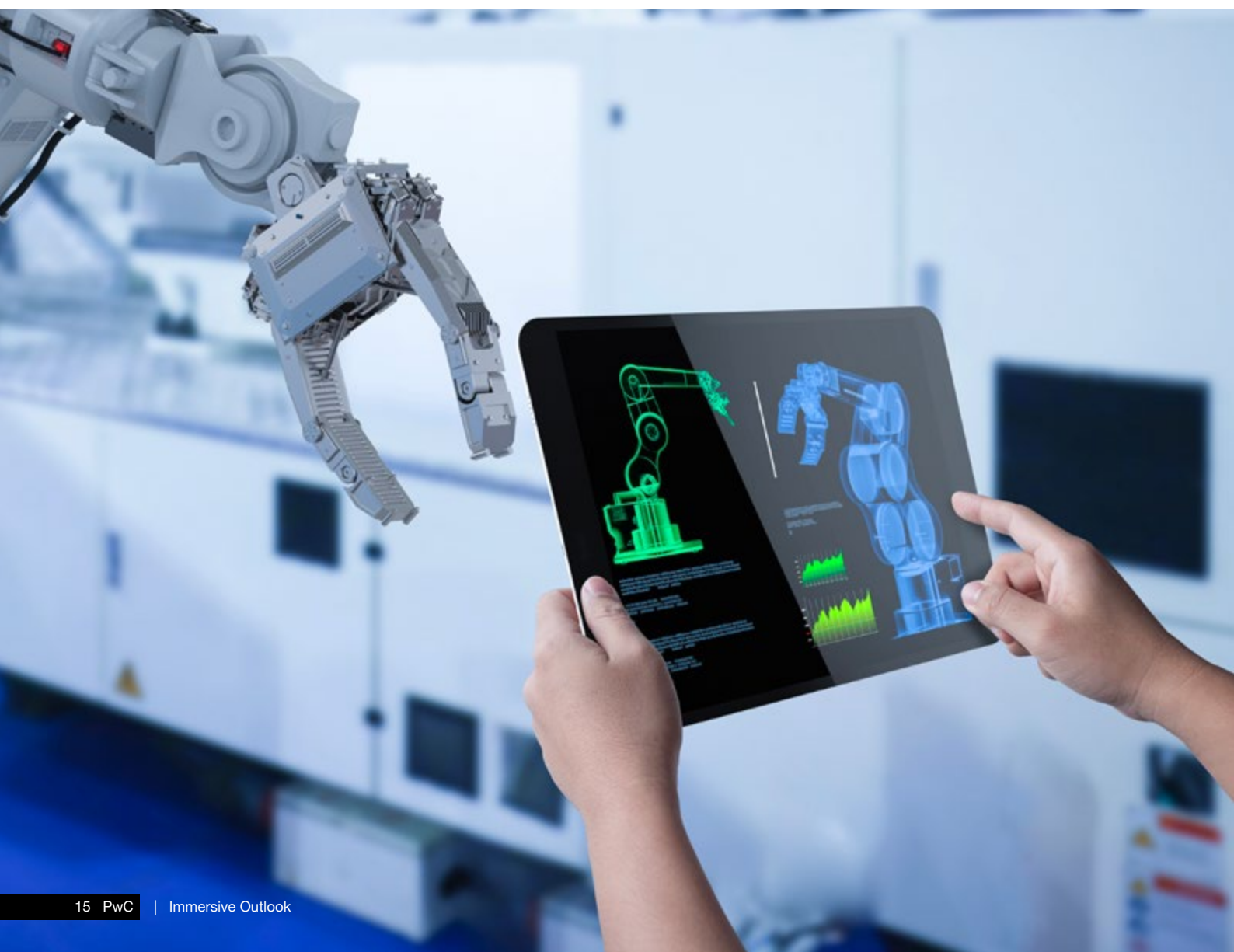


Second, in a few categories like air conditioners, you have to design the product according to climatic zones. Third, you have to keep in mind that you are attempting a new level of scale for the first time and fourth, you may not have sufficient time to conduct testing or sufficient capacity in R&D to look at multiple vendors. The vendor ecosystem is just developing within the country. We were deluding ourselves that the COVID-19 pandemic had taught us a lesson. That was momentary. It was only a trigger. Going forward, the manufacturing story will need to look at the supply chain in a completely different manner. And it is something which is making us lose sleep.

Sudipta Ghosh: Shifting gears a little bit, one of the promises of Industry 5.0 is a huge focus on human capacity. There has been a long debate on whether an algorithm is going to replace a human being, but we have seen that it is never really one versus the other. It has always been one with the other. So how can a human being work collaboratively with an algorithm, a bot or a machine in a symbiotic manner and make an application better or more productive? I would like to understand your perspective on how people are taking in such technological advancements [that promise human-machine

interaction]. Is the symbiotic relationship between human and machine actually happening on the shop floor or is there a possibility of that in the future?

B. Thiagarajan: I am very happy that you are thinking this way. In a manner of speaking, Industry 4.0 created a perception that it is not people-friendly or, specifically, labour-friendly. In a country where employment has been a challenge, manufacturing was supposed to be the solution. I hold the view that we forgot manufacturing somewhere.





We woke up and found the world to be completely different, with the emergence of scale, smart technologies, sustainability, etc. As I keep saying, it is like the Rip Van Winkle story. If you wake up and try to move at a great speed to catch up with the world, the world is not going to wait. If our aspiration is to be a part of the global supply chain, we have to run faster. Not only is it growing at double the speed of India's GDP, but we also have much more to do in order to get into and succeed in the global supply chain ecosystem. I think it will happen. In that context, the conflict has been this: how can you leave out human beings? In several forums, there is talk of artificial intelligence and machine learning and these [technologies] are coming

across as concerns. However, the policymakers are clear that we should not forget people, so it [adoption of human-centric technology] will happen.

In my view, the fact that Industry 5.0 takes into account human centricity, apart from sustainability and resilience, is a laudable thing. Frankly, I never expected that to be brought in. And it is of utmost importance for the simple reason that there are growing aspirations of the labour force. On the one end, we are struggling to create the required capacity and skills. I hold the view that the manufacturing sector has lost its salience to attract people over the years. The services, IT, sales and marketing, and finance sectors attract talent and the



manufacturing sector does not. In order to change that, we must embrace technologies such as the internet of things [IoT] and bring in human-centric development. Now, I think it is possible and that this is the right time to do it, for the simple reason that by marrying technology with people, we will be able to solve the current challenges we have got. The important one being [the need to achieve] scale. [By continuing] in the old way, you will never be able to achieve the scale you aspire to. You can improve the quality [of products] and the speed at which you introduce new products by marrying these two [humans and technology]. And the challenge will be, how will you upskill and ensure people learn fast without seeing it [change management] as a formidable challenge?



Sudipta Ghosh

Sudipta Ghosh: When it comes to reskilling and upskilling, which trends do you see shaping up (a) in terms of facilitating more seamless interactions and (b) in terms of adopting some of the solutions being built in the organisation?

B. Thiagarajan: I am passionate about the subject. Firstly, organisations must look into ways of imparting skilling through technology. The second part is geotagging people as they migrate, and trying to locate and certify them. The third part is looking at how their jobs on the shop floor can become much more creative and interesting from boring and repetitive. I think it [the shift] is beginning to happen, but there is a long way to go.

Sudipta Ghosh: To summarise, is there anything else that you would want to talk about in terms of what you are seeing from an industry perspective? Any closing thoughts or suggestions that you may have?

B. Thiagarajan: Sustainability is the most talked-about point and it will always be there, because of regulatory requirements. I think we have to keep in mind the UN SDGs [Sustainable Development Goals]. For example, manufacturing was considered a masculine job, but we need to look at encouraging inclusion by bringing in women into manufacturing jobs. With technology, that is possible. Women have a huge role to play in the manufacturing growth story. Meanwhile, traditional thinking is another aspect that needs our attention. There are exceptions in India but in most cases, we are not taught to think big. And that is impacting [growth]. Scale is important, as are smart technologies, sustainability and speed.



B. Thiagarajan

B. Thiagarajan: Thank you. It was a pleasure interacting with you. I compliment PricewaterhouseCoopers for identifying these challenges and coming up with [solutions on] Industry 5.0. All the best to you. Thank you very much.



Managing and measuring change on the manufacturing shop floor



Transforming the shop floor is central to the Fifth Industrial Revolution to increase operational efficiency, enhance sustainability and improve workforce safety. **Ankur Basu** and **Ajay Deshmukh** outline how robust change management strategies can drive this transformation.

Shop floor dynamics in the manufacturing space

For nearly a decade, Ravi has been working on the shop floor of a manufacturing plant which produces metal components for the automotive industry. While the plant has functioned smoothly, it faces challenges such as equipment breakdown, production inefficiencies and safety risks for workers who operate heavy machinery.

Fast forward to 2024 – the shop floor has undergone digital transformation. The company has integrated cutting-edge technologies such as digital twins, artificial intelligence (AI) and generative AI (GenAI) to enhance productivity and safety which has resulted in a highly efficient, sustainable and safe workplace. The workflow for Ravi is now seamless, with advanced technologies which enhance productivity and ensure the highest quality standards.

When it comes to manufacturing, shop floor is the meeting ground of design innovation and engineering on the one hand, and the production processes on the other. It serves as a crucible to assess the theoretical elements of design and engineering against real-world constraints and opportunities. However, despite the changes ushered in by industrial revolutions, companies are, at times, faced with a significant challenge – the shop floor remains a siloed space, disconnected from innovations led by the design and engineering teams, and insights from the marketing and sales functions.

Often, this disconnect results in inefficiencies and the products manufactured do not necessarily cater to market demands and client requirements, resulting in wasted resources. In such instances, efficient production gains priority over innovative and functional products, leading to compromises in product quality.

Further, lack of effective communication and a limited feedback loop could result in missed opportunities for iterative improvements, while the inability to adapt to changes in design and production processes on the shop floor could result in unnecessary delays and increased costs. Automation, which is often considered to be synonymous with Industry 4.0, may accelerate production. However, if the manufactured products are not aligned with market needs or do not meet the necessary quality standards, companies could be impacted by rising inventory costs and reduced profitability, and lag behind their competitors.



In this scenario, the Fifth Industrial Revolution spells hope and shop floors around the world have begun to perceive its transformative potential. Research indicates that asset-heavy industries such as manufacturing will see the fastest adoption of digital twins, and industrial internet of things (IIoT) will support this adoption,¹ as their combined power can provide promising solutions to bridge some of the gaps that arise in a traditional shop floor setting. Hinging on the optimum leverage of human potential, Industry 5.0-enabled operational excellence can result in optimised operations, quality products, sustainability and employee satisfaction.

By providing a shared, real-time model of the production process and capturing real-time data from the shop floor, digital twins enable real-time monitoring and simulation, virtually replicating physical assets, processes or systems. By enhancing communication between different units – design, engineering and shop floor – it enables a smooth feedback loop for iterative improvements, while the simulated production scenarios help companies reduce waste and optimise resource allocation.

To add to that, predictive analytics provide actionable insights which result in informed decision-making. An analysis of historical and real-time data helps forecast demand, optimise production schedules and identify potential issues. There is also an option to explore design variations based on specified criteria which could lead to the development of more efficient, market driven, customer-centric products. All this combined contributes to safer, secure, sustainable and efficient work environments that are suitable for driving better business outcomes with people-power as its core.

Future-fit roadmap of Industry 5.0

For manufacturers, adoption of Industry 5.0 will enable them to build the resilience to deal with shocks, providing a healthy workplace for employees who have been increasingly anxious about job stability and security. Thus, developing the right roadmap for sustainability has now become a key priority for businesses.

To that end, the Fifth Industrial Revolution is a holistic advancement on Industry 4.0, a paradigm shift that adds collaborative solutions and adaptability to the smart technologies of the Fourth Industrial Revolution that enabled rapid and widespread automation of the shop floor.

While reinventing the shop floor, the focus of Industry 5.0 shifts from efficiency to creativity and ingenuity, and from mere automation to human-machine collaboration, carving out equal space for humans at the centre alongside machines. With the emphasis on the human component, change management becomes imperative to ensure that human-centricity, sustainability and circularity of the supply chain become the focal points of operations.

The change management imperative

A successful, holistic change management strategy can result in a satisfied, motivated and engaged workforce to drive productivity, while a sustainable environment can mitigate the risks of failure and resistance increasing the stickiness of change, fostering stability. When combined, they can enhance the resilience of a company. Grounded in these principles, Industry 5.0 entails the following four-pronged approach to be steered by employees and guided top-down by leaders with a robust mechanism to evaluate the benefits of the transition:

1. assess the impact of change on the shop floor
2. facilitate a shift in the workforce's mindset to overcome resistance
3. unlock human capital's potential with upskilling
4. redesign shop floor processes to drive innovation.

1. Assess the impact of change on the shop floor

For seamless upskilling, employers must put to rest any fears employees may have regarding new technologies, boost their confidence and give them the tools and freedom to innovate. Job rotation programmes, instead of traditional training, would



1 PwC, The synergy between digital twins and Internet of Things (IoT)

allow employees to experience diverse skill sets required for different roles.² Simultaneously, it is important to define, manage and measure the impact that the changes associated with Industry 5.0 practices will have on the shop floor. These changes need to be assessed on parameters such as workforce behaviour, roles and responsibilities, processes and technology. It is also important to evaluate whether the workforce is ready to adapt to change and whether the organisation has the right support to make the transition smooth.

A case in point is an AI-powered assembly line in a manufacturing unit that has been using digital twins to identify and eliminate bottlenecks in real time – increasing output and decreasing production time.

2. Facilitate a shift in the workforce's mindset to overcome resistance

To build a resilient mindset across the organisation, employers must identify the pain points and act on them. This would involve encouraging work-life balance, setting realistic expectations and transparent communication.³ Senior leaders need to assist middle managers to help build their own resilience and foster the same within their teams.⁴ The transformation needs to be assessed through an increase in employee satisfaction, not just productivity boost.

It is also important for leaders to identify the common reasons for resistance, such as scepticism about the benefits of change or fear of losing jobs due to automation. There could also be concerns about loss of autonomy. To increase buy-in, workers should be involved right from the planning stage. Open forums or one-on-one sessions may be required to ensure clear communication on how their roles and responsibilities will evolve.

As the new industrial equation reinforces the position of humans as central decision makers in a smart workspace, it is imperative to harness behaviours that encourage employees to get creative and be self-motivated. Equipping the workforce with tools that spark their ingenuity and allow them to collaborate with each other can drive productivity and efficiency.

For example, a car manufacturer has enabled people and robots to work side by side at future factories, while also creating a shared virtual space where engineers from around the world can log in to collaborate.

3. Unlock human capital's potential with upskilling

With consumers becoming more vocal about social and environmental issues, companies are on the lookout for ethical skills. However, with limited time

and resources, long reskilling and upskilling programmes are likely to make the employees weary and disengaged. Companies, therefore, need to adopt tailored approaches and facilitate upskilling in short courses in a gamified environment to enable a smooth and steady skill transfer.

In this context, a training needs assessment can enable businesses to identify workforce competency gaps. The assessment could focus on identifying the gaps between the current level of knowledge and skills on the shop floor and the desired level of knowledge and skills for Industry 5.0 technologies. The results can help identify key areas for upskilling as well as the educational methods that would be relevant to bridge these gaps.

The use of AI will also transform an Industry 5.0-enabled world. AI, which has three main uses today, assisted intelligence (GPS in a car), augmented intelligence (combination programmes that enable a service, like a ride-sharing app) and autonomous intelligence (machines acting on their own), could be used to create a world where human abilities are amplified as machines help mankind process, analyse and evaluate data.⁵

A case in point is PwC's engagement in Europe where the team is working with a startup to create a new offering which uses augmented reality on factory shop floors. The offering aims to ensure quality assurance on the shop floor, upskill manufacturing workers and reduce cost of poor quality (COPQ).

2 PwC, Global Workforce Hopes and Fears Survey 2024

3 Ibid.

4 Ibid.

5 PwC, Workforce of the future



4. Redesign shop floor processes to drive innovation

Manufacturers need to map current production processes to identify areas for integration of Industry 5.0 to drive productivity and innovation. Accordingly, they need to invest substantially in research and development (R&D) and foster a culture of innovation. Streamlined workflows, improved collaboration and new technologies could enable continuous improvement.

Breaking down silos between various functions can encourage brainstorming and problem-solving. Thus, workflows and processes should be restructured to promote agility, collaboration and flexibility. Some companies have already begun work in that direction.

Having adopted Industry 5.0 principles to drive innovation and flexibility in production lines, a company has developed technologies that are energy efficient and allow for precise customisation of machines to meet specific requirements, thus enabling the production of highly personalised products.

PwC's change management framework

Effective change management strategies are essential for operational excellence, as they can help overcome employee resistance and foster a culture of continuous

improvement. It is, therefore, crucial for business leaders to understand what motivates their shop floor workforce and train them in the key skills of Industry 5.0, which include:



Cognitive skills

Cognitive skills are rapidly growing in importance, which shows the increasing significance of complex problem-solving in the workplace.⁶ Emotional intelligence and critical thinking are important to develop the right prompts to fully leverage advanced technologies. Cognitive abilities also play a key role in interpreting and analysing data to make strategic decisions.



Sustainability skills

Sustainability skills and practices will be at the heart of Industry 5.0 transformation. Employees can be trained on integrating IoT devices to monitor emissions in real time and leverage data analytics to optimise resource consumption. The workforce needs to stay updated on the latest environmental regulations and their implications. To make this process engaging, employers can highlight and reward innovative sustainable practices adopted by employees in their day-to-day life.



Digital skills

A smooth transition to Industry 5.0 will require expertise in AI/ML, knowledge of robotics and automation, and cyber physical systems, as well as data analytics. Combining digital twins with reinforcement learning, a branch

of ML that lets a software learn through rewards and feedback, has been showing promise across sectors the world over.⁷ For example, by combining digital twins, simulations and reinforcement learning, autonomous vehicle manufacturers are able to simulate varied driving scenarios and weather conditions to identify risks and optimise efficiency of their algorithms and sensors, improving safety and driving behaviour.⁸



Cybersecurity skills

The transition to Industry 5.0 will entail more connected product and service value chains and will warrant pre-emptive and intelligent cybersecurity measures to safeguard the integrity of businesses, especially their manufacturing processes.⁹ While transitioning to Industry 5.0, organisations need to enhance overall cybersecurity controls; educating employees on both the basics (e.g. malware and phishing) and advanced topics of cyber security, such as AI regulations and ethics, IoT security, and data privacy will be equally important. The training could be tailored to specific job roles and can be done via workshops where potential attacks and defences are simulated.

PwC India's change management strategy includes engagement activities, tailored communications and training support to engage, adopt and use.

In the case of a Gujarat-based manufacturer which embarked on a digital transformation journey, PwC India developed an effective change management strategy

6 World Economic Forum, The Future of Jobs Report 2023, Skills outlook

7 PwC Germany, The Perfect Match – Digital Twins and Reinforcement Learning

8 Ibid.

9 PwC, Decoding the Fifth Industrial Revolution

which started with identifying the formal and informal forces that were at play in the organisation.

Assessment of formal and informal processes

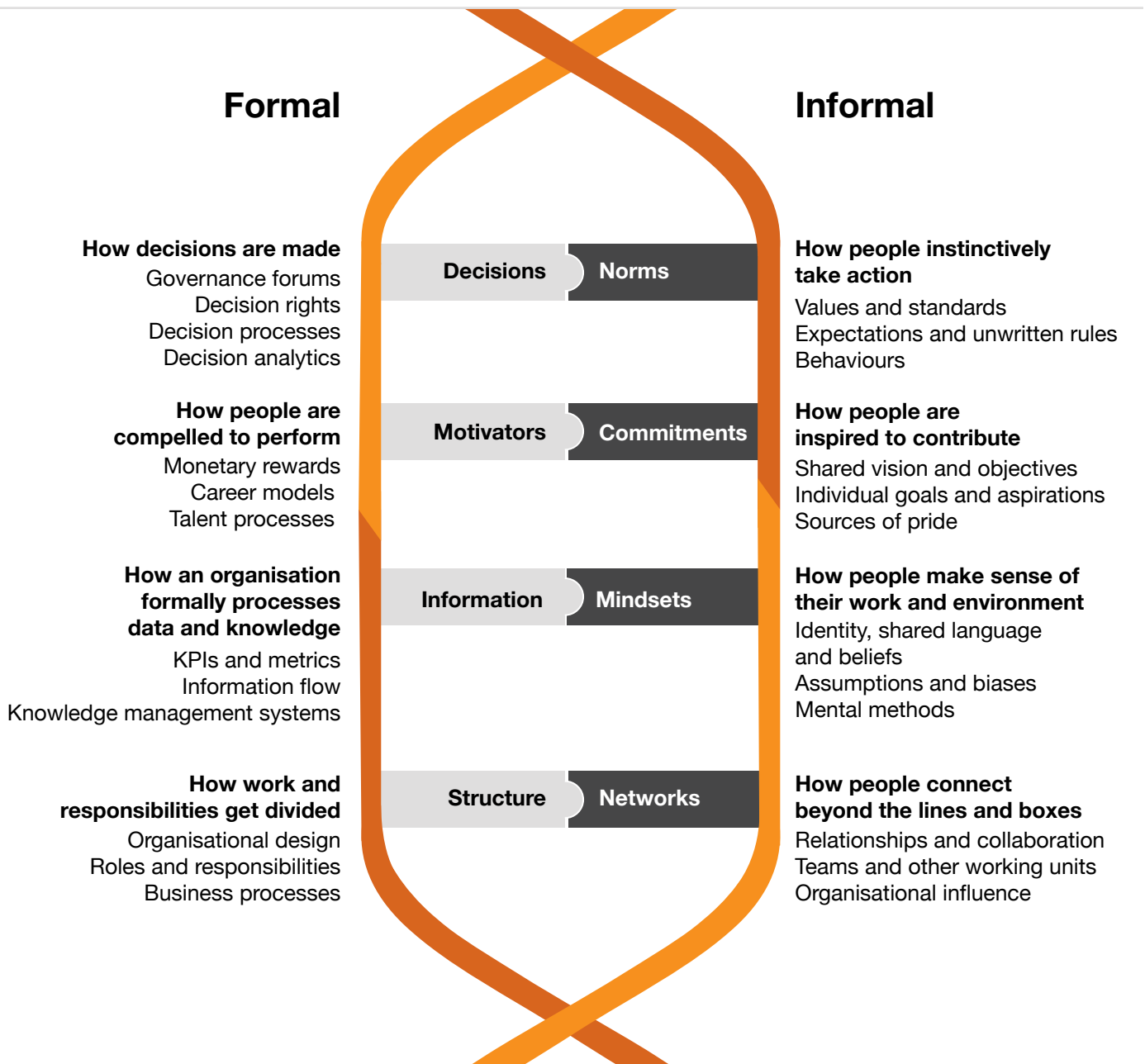
As-is formal processes: The as-is state of formal functions was examined which included factors associated with the company’s decision making, such

as the incentives it offers its high performers and the framework it uses to divide responsibilities.

Informal processes: To take stock of what drives employees, the informal people-centric processes of the organisation were assessed. This involved examining the unwritten rules and behaviours that lead people to act instinctively,

understanding the motivations – like a shared vision and individual aspirations, which inspire workers to contribute, understanding the ways in which people connect to their workplace (shared languages and beliefs) and looking at how the relationships built in the workplace last outside of it.

Figure 1: Analysis of the as-is state of formal and informal people-centric processes



Source: PwC analysis



The results of the assessment of formal and informal processes were combined with digital transformation to enable business growth and spur innovation opportunities, address market disruptions such as changing consumer preferences and adopt sustainable and regulatory standards.

Following this, programmes were curated to drive the four essential pillars for adoption of digital culture – skill, mindset, relationship and behaviour – by first setting and communicating clear and measurable goals.

The change management strategies and operations excellence initiatives were meant to:

- achieve first mover advantage for the manufacturer
- build a happy workforce enabled by a digital and agile culture
- create a sustainable end-to-end digital value chain
- benchmark the level of digitisation with global manufacturing standards
- generate value through differentiated capabilities such as increased digital maturity score, data-driven and intelligent decision making.

Measuring change

In a span of a year-and-a-half, PwC India helped the company optimise its operations by:

- enabling strategic decision-making and developing a smart factory
- setting a key performance indicator (KPI) baseline
- refining enterprise architecture and solutions
- integrating data analytics solutions.

The company saw 10% to 12% improvement in overall equipment effectiveness (OEE) over the baseline and up to INR 5 crore was saved in energy consumption costs. Besides, the freight cost came down by 3%, there was a reduction in safety incidents and a 15% improvement in on time in full (OTIF).¹⁰

The road ahead

The investment in Industry 5.0 technologies is, at present, fragmented and its adoption is not uniform across geographies or sectors. To keep manufacturers from running into regulatory hurdles, it is important for governments to form clear regulations on Industry 5.0 technologies and practices, while private players must make the best use of such policies and develop appropriate adoption roadmaps. As with any new technology, the adoption of Industry 5.0 is also likely to open

up cyber vulnerabilities, especially as it operates on increased interconnectedness. Companies must adopt fool-proof data safety plans and train employees on cyber security.

Substantial investments are still required by the government and the private sector to make the adoption of Industry 5.0 a reality. For green manufacturing, a key tenet of Industry 5.0, manufacturers also have an opportunity to leverage government incentives such as the National Programme on High Efficiency Solar PV Modules¹¹ and the Green Credit Programme.¹² The former aims to reduce import dependence in the renewable energy sector and ramp up sourcing of local material in solar manufacturing¹³ while the latter incentivises voluntary environmental actions across diverse sectors.¹⁴ The long-term success of sustainability initiatives will depend on strong employee engagement and support. Companies which invest in a shared vision are likely to be gainers, as employees are prone to follow through when they copilot rather than merely execute the change.

Also contributing to this article were: **Vishnupriya Sengupta, Ruchika Uniyal and Megha Adhikari**

10 PwC analysis

11 Production Linked Incentive (PLI) Scheme: National Programme on High Efficiency Solar PV Modules | Ministry of New and Renewable energy

12 PIB, Notification issued for Green Credit Program (GCP) and Ecomark scheme Under LiFE Initiative to Promote Sustainable Lifestyle and Environmental Conservation

13 Production Linked Incentive (PLI) Scheme: National Programme on High Efficiency Solar PV Modules | Ministry of New and Renewable energy

14 PIB, Notification issued for Green Credit Program (GCP) and Ecomark scheme Under LiFE Initiative to Promote Sustainable Lifestyle and Environmental Conservation



About PwC

At PwC, our purpose is to build trust in society and solve important problems. We're a network of firms in 151 countries with over 360,000 people who are committed to delivering quality in assurance, advisory and tax services. Find out more and tell us what matters to you by visiting us at www.pwc.com.

PwC refers to the PwC network and/or one or more of its member firms, each of which is a separate legal entity. Please see www.pwc.com/structure for further details.

© 2024 PwC. All rights reserved.

Contact us

Sudipta Ghosh

Data and Analytics and Industrial Products Leader
sudipta.ghosh@pwc.com

Ankur Basu

Partner, Technology Consulting and Industry 4.0 lead
ankur.basu@pwc.com

Ajay Deshmukh

Partner-Advisory-Climate and Energy
ajay.a.deshmukh@pwc.com

Contributors to this edition:

**Raghav Narsalay, Vishnupriya Sengupta,
Ruchika Uniyal and Megha Adhikari**

Editorial: Dion D'Souza and Rubina Malhotra

Design: Harshpal Singh

Data Classification: DC0 (Public)

In this document, PwC refers to PricewaterhouseCoopers Private Limited (a limited liability company in India having Corporate Identity Number or CIN : U74140WB1983PTC036093), which is a member firm of PricewaterhouseCoopers International Limited (PwCIL), each member firm of which is a separate legal entity.

This document does not constitute professional advice. The information in this document has been obtained or derived from sources believed by PricewaterhouseCoopers Private Limited (PwCPL) to be reliable but PwCPL does not represent that this information is accurate or complete. Any opinions or estimates contained in this document represent the judgment of PwCPL at this time and are subject to change without notice. Readers of this publication are advised to seek their own professional advice before taking any course of action or decision, for which they are entirely responsible, based on the contents of this publication. PwCPL neither accepts or assumes any responsibility or liability to any reader of this publication in respect of the information contained within it or for any decisions readers may take or decide not to or fail to take.

© 2024 PricewaterhouseCoopers Private Limited. All rights reserved.

HS/November 2024 - M&C 42358

