



Confederation of Indian Industry

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Technology-enabled manufacturing Growth prospects for eastern India



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Foreword ▶

Technology has been acknowledged as the backbone of business innovation and transformation. However, according to the CII-PwC survey (2016), the top four challenges to technology adoption that stand out in the eastern region are high initial investment, lack of adequate infrastructure in states, no compelling business reason to implement technology and lack of a skilled workforce. If India has to compete in the world market and grow at a rate of 7+%, it is important that the eastern region, and more so the manufacturing sector, contributes significantly. Further, as per the World Bank, by 2020, India will have a working population of 906 million, which will need jobs to sustain the country's growth. Achieving this target calls for a concerted effort from businesses, investors and government leaders.

At present, India's manufacturing sector contributes only 17% of the country's total GDP. In contrast, in strong manufacturing economies, this contribution has consistently remained above 30%. To stay relevant and competitive, India will need to make a much-needed leap, more so the eastern Indian states. Thus, it is important to reconsider the options available to companies, of which technology appears to be the best solution. The wave of new and emerging technologies presents new means of cost-saving and revenue generation every day. Through the adoption of these new technologies, the Indian manufacturing sector can grow both as a cost leader and as a differentiator.

Introduction ▶

In today's complex world, there is a need for organisations to be more agile and flexible. Enterprises are eager to find newer ways of doing business to stay ahead. Technology is the answer to many questions and the most powerful lever for growth. Nearly all enterprises are looking to leverage technology to transform their relationship with customers as well as other stakeholders.

New advances in technology such as data and analytics, cloud computing and the Internet of Things (IoT) are becoming key to meeting and exceeding the expectations of a wider group of stakeholders. A few companies have already begun exploring these new tools to meet customers' changing demands for sustainable ways of goods and services delivery. All major economies and global businesses are investing in newer technologies significantly to drive change. The companies in India, and particularly in Eastern India, will have to focus on newer technologies with renewed zeal.

To understand the views of leaders in this region, the Confederation of Indian Industry (CII) and PwC conducted a survey through CII's digital platform. About 53 business executives from all five states of eastern India responded to our questionnaire and shared their perspective on several aspects related to manufacturing and technology. The respondents represent a wide spectrum of industries, including engineering, food processing and steel. We received responses from many small and medium enterprises as well as large organisations. The responses were used to prepare this joint CII-PwC report, which attempts to showcase a set of new technologies that are poised to change the shape of the manufacturing industry. The aim is to improve the core of doing business successfully—understanding customers better, producing better goods to meet their needs and improving productivity to realise value.

Eastern Indian manufacturing sector: Selecting the right growth engine

Strong growth prospects

PwC's 18th Annual Global CEO Survey (2015)¹ revealed that leaders from Indian companies are very optimistic about future growth. As per the survey, 62% of Indian CEOs were confident about growth prospects in the next 12 months, as against 39% of the global CEOs. Even with respect to the next three-year period, Indian CEOs were much more optimistic (71% as compared to 49% globally).

The same sentiment is reflected in the survey² that CII and PwC jointly conducted this year to understand how the manufacturing industry in eastern India is faring. Nearly half of the respondents anticipate a higher rate of growth in the next three years. This optimism in eastern India comes from several regional and national factors. The central government's campaigns, such as Make in India and Digital India, are expected to show results in the next few years. Several smart cities are being planned in the eastern region. Further, the Amritsar-Delhi-Kolkata Industrial Corridor (ADKIC) is expected to connect seven states and hence facilitate logistics and boost demand for the manufacturing sector located in eastern India. The Government of India has eased and simplified industrial licensing requirements and de-reserved some of the items that were reserved for micro, small and medium enterprises (MSMEs) only, thus opening up more sectors for business investments. As a result of all these steps, the growth expectation is high in eastern India.

However, meeting the ambitious expectations will not be easy. The competition for business investments that exists at the country level exists at the state level too. In an increasingly globalised market, only those companies who can compete on the global stage will survive.

Need for a leap

With high intellectual capital and mineral resources, the eastern Indian states have immense potential for industrialisation, which is yet to be fully realised. Further, the brand value of these eastern Indian states in the business world is not on par with that of some of the highly industrialised states in India. At present, the eastern Indian states attract comparatively less FDI. Thus, competing with other parts of the country will be challenging.

Apart from the other states of India, nearby countries of similar size will also compete for foreign investors' capital. Countries such as Bangladesh, Cambodia, Myanmar and Vietnam are emerging as attractive investment destinations for their unique offerings. Low labour cost is no longer a competitive advantage. Germany's Industry 4.0 campaign and China's Made in China 2025 campaign are heralding a new era in manufacturing. To stay relevant and be competitive in the new manufacturing landscape, eastern India needs to take a leap towards planned technology-enabled manufacturing.



1. PwC's 18th Annual Global CEO Survey: <http://www.pwc.com/gx/en/ceo-agenda/ceo-survey.html>

2. CII-PwC Eastern India Manufacturing Survey, 2016: CII and PwC jointly conducted the survey of manufacturing business leaders of eastern India.



Selecting the right growth engine

To take this leap, can companies rely solely on market demand? Despite a global slowdown, India has shown healthy GDP growth recently. Domestic demand is still strong. Thus, companies have growth opportunities in the short term. However, with India's exports falling, the country may not be able to escape the global slowdown for long and may eventually fall into a recession. Eastern India will have to deal with this situation too. Moreover, except in the case of basic commodities, consumer demand is changing every day. Companies that are meeting today's market demand may find their products becoming obsolete very fast. In fact, they may lose their market even faster to global competition. Therefore, companies cannot afford to be complacent about market demand. They need to seek means to stay competitive and grow.

One of the ways companies can grow is by increasing operational efficiency, reducing cost and thus staying competitive even during a recession. In order to increase their operational efficiency, manufacturing companies have been adopting many processes, such as lean manufacturing and just in time (JIT), since the 1990s. They have also been applying IT systems such as enterprise resource planning (ERP) to streamline their business processes. However, simply sticking to these methods today will no longer yield a substantial incremental cost advantage.

Another way that companies can grow is by differentiating themselves by their product offerings and improved quality. Consumers have become more demanding than ever. More product choices, more customisation and co-creation of products are the norm today rather than fancy value addition. To cater to these changes in consumer behaviour, the manufacturing industry will need to diversify into more product lines and more customised variations. They need to produce faster and better quality products in a cost-effective way. Traditional manufacturing processes will gradually fall short when it comes to meeting all these needs.

The right growth engine needs to empower companies with enhanced operational efficiencies while at the same time moving them towards more flexibility, more agility and better quality. New technologies are unveiling new ways of cost saving and revenue generation every day. With the help of these technologies, companies will be able to improve operational efficiency, better monitor end-to-end operations, get more useful product feedback, differentiate their product offerings and shift to a business model that generates new streams of revenue.

A growth engine must enhance operational efficiency and, at the same time, move companies towards more flexibility, more agility and better quality. The new wave of technologies is offering different ways to achieve these objectives.

Technology-driven growth

Technology can drive growth in many ways. For example, although labour and equipment effectiveness are known ways to reduce cost, use of the right technology can offer unprecedented ways of improving effectiveness. The new cost leaders will be companies who are able to find and implement new ways to reduce costs. Technology can also be leveraged as a product differentiator by the manufacturing industry. Today's smart products are able to capture how customers are using them and send this data back to the company as feedback. Devices such as wearables, mobiles and cars are able to communicate with each other, capture the full context of a user, and accordingly deliver an enhanced experience. With these groundbreaking technologies, the means for delivering differentiated value are endless. Companies which can best leverage these technologies to enhance the value of their offerings will become the future differentiators.

Technology advancements are opening up unprecedented opportunities to create value and meet the expectations of a wider group of stakeholders—customers, regulators, employees, supply chain partners and investors. It's time for companies in eastern India to leverage these new technologies effectively and create a competitive advantage for themselves.

Arnab Basu
Leader, Technology Consulting
and Digital, PwC

Technology is a long-term driver of growth, and along with growth, it will bring constant change. The effect of this growth is not limited to companies as it includes other stakeholders. Society as a whole is expected to see disruptive changes such as increased local manufacturing, increase in entrepreneurship around niche products and technology services, a shorter cycle time, reduced inventory, on-demand production, and a product as a service model. Technology as a growth engine can empower eastern Indian companies to participate in the next industrial revolution and bring them on the same footing as companies in more industrialised nations, so that they remain competitive in the new era of manufacturing.

Faster adoption of game-changing technologies can only relink the manufacturing sector with the fast-moving technological wonders and advanced facilities. Adoption of advanced technology and industry best practices will make our industry more competitive in the global market. The changing mindset of the manufacturing sector in this region speaks about the growing readiness of the sector to meet the indigenous demand and take advantage of the anticipated growth.

RAdm A K Verma (Retd)
Chairman and Managing Director,
GRSE Ltd

Technologies that will make a difference

When opting for technology as a growth engine, it is essential to select the right technology and use it in the right way. Some of the top technologies that have the maximum potential for revolutionising the technology landscape of manufacturing are IoT, additive manufacturing and robotics.

IoT (the industrial version is called the Industrial Internet of Things [IIoT]) is a top trending technology since it is extremely powerful. It enables companies to extract digital data from physical machines and thus create a fully connected enterprise. It also enables machines to communicate with each other and hence take decentralised decisions. This was not possible before since there was a barrier between the digital and physical world. Going forward, companies will be able to monitor the health of their machines, track their supply chain fleet, monitor the entire production process, track employee productivity and collect feedback on their products even after sales. These technologies will provide companies of the future with insights into every detail, allowing for better management, continuous improvement, cost optimisation and a move towards perfection.

Another new technology is additive manufacturing, which is a process of adding up layers of 'ink' to create a product as opposed to the traditional process of removing material or forming shapes in plastic or liquid state. The growing need for product customisation and co-creation, difficulties of creating complex shapes using traditional manufacturing techniques, rapid prototyping and parts replacement is driving the adoption of additive manufacturing. Although this is not a new technology, it was never considered for serious mainstream production other than prototyping earlier. Today, with the falling cost of 3D printers and advancement in 3D printing (3DP) technologies, additive manufacturing is set to become one of the leading technologies used by manufacturing companies in the future.

Finally, robots are showing tremendous promise for advanced



The manufacturing sector in this region will have to quickly embrace the opportunities that technological developments offer us to make breakthrough improvements in production efficiencies. The Internet of Things, predictive maintenance practices, advancements in simulation and optimisation through data analytics, additive manufacturing, and many other developments allow us to make a paradigm change in the way we think about and go about manufacturing.

T V Narendran
Managing Director, Tata Steel Limited



automation. Robots have long been used in the manufacturing industry to do hazardous or repetitive work. However, the usage of robots is increasing. Advanced robots have sensors that can detect their surroundings and take decisions accordingly. This ability helps them to work in more unstructured and flexible settings and take decentralised decisions. Thus, robots are more suitable for a flexible setting, which is becoming more important today with an increasing need for product variety. Robots are also being used alongside the human workforce to create a hybrid workforce which can offer greater productivity.

The above technologies have vast potential. Significant industries of eastern India, such as mining, steel, engineering, textile and food processing, will continue to be the mainstay of manufacturing in this region, and they can use these technologies to transform themselves. The companies need to take a deep dive into their key capabilities and find out how they can use these technologies to create maximum value for their stakeholders. It is also important that an ecosystem of partnership comprising companies, the government, industrial bodies, consulting firms and educational institutions is created in order to establish a suitable business environment in which technology-driven growth can flourish.

Some of the technologies that have the highest potential to revolutionise the technology landscape are additive manufacturing, IoT and robotics.

Technology adoption: The eastern India story

To understand the growth potential in eastern India manufacturing, it is important to look at how the regional companies are using each of these technologies (IoT, additive manufacturing and robotics) today to meet wider stakeholder expectations and whether they realise the importance of these technologies. It is also important to find out the ways in which these technologies can be leveraged vis-à-vis how they are currently being used.

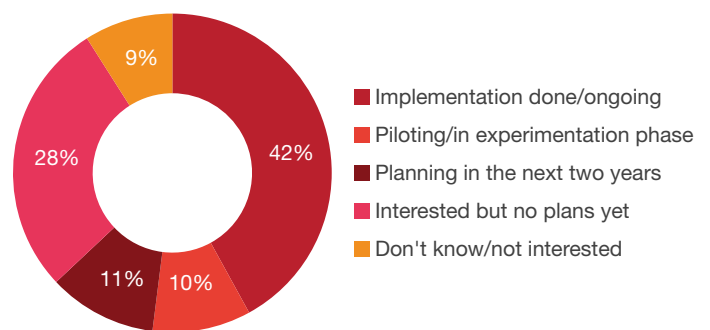
IoT

Companies in the manufacturing sector in eastern India should definitely consider leveraging IoT.

Current adoption status

At present, companies from various manufacturing sectors in eastern India, such as cement, chemicals, engineering and food processing, are adopting or have adopted IoT. The CII-PwC Manufacturing Survey reveals that nearly half of the business leaders surveyed have implemented or are piloting this technology. The eastern Indian leaders also recognise the importance of this technology more than their global counterparts: 81% of the leaders in eastern India view IoT as strategically somewhat or very important to their companies, as compared to 58% of the leaders from around the globe.

Question: What is your company's plan to adopt IoT? (Source: CII-PwC's Eastern India Manufacturing Survey, 2016)



Question: How strategically important is IoT to your organisation? (respondents who stated somewhat or very important) (Source: PwC’s 18th Global CEO Survey, 2015; CII-PwC Eastern India Manufacturing Survey, 2016)



Global IoT adoption forecasts are rather impressive. Gartner estimates³ that IoT hardware spending will increase at a CAGR of approximately 14% between 2016 and 2020 in the industry sector and at approximately 29% in the consumer sector. According to PwC’s 6th Annual Digital IQ survey, 20% of the companies invested in sensors in 2015 as opposed to 17% in 2014.⁴ These figures indicate a huge revenue growth opportunity for manufacturers of IoT-enabled devices and machinery, particularly in sectors such as engineering and capital goods, electronics and consumer goods. At the same time, these figures indicate that the manufacturing industry will invest substantially to support the implementation of IoT.

Leveraging the full potential of IoT in eastern India

One of the most important ways companies can implement IoT or IIoT is to connect the complete manufacturing process in such a way that it provides insight and leads to smart manufacturing. This is an environment where information related to all aspects of manufacturing—demand management, the supply chain, plant operation and resources—is brought together. This gives an enterprise a complete view of operations and supply-demand, thus facilitating decision-making. Another more powerful outcome of IoT is decentralised decision-making. IoT connects physical entities, allowing them to proactively analyse collected data in real time and communicate with each other. In a nutshell, the system is endowed with intelligence, thus taking automation to a new level.

The impact of Industrial Internet on significantly enhancing productivity and quality is yet to be seen in manufacturing across industries in India. For example, sensors today are telling you when repair and maintenance are required. You can take action before they are warranted. This improves productivity.

Viresh Oberoi
 Managing Director and CEO, mjunction services limited

Some examples of IoT and smart manufacturing are communication between products and machines through product codes, which enables machines to find out the production requirement,⁵ or to trace product performance data back to production data to gain insights into the correlation between production parameters and product performance.

Companies can also use IoT and wearables together to improve the productivity of individual workers. Recently, a multinational merchandise retailer started to track the movements of workers and goods gathered by them using armbands, thus eliminating the need for clipboard marking. In addition, the wearable can allot tasks and forecast completion time. This way, it is possible to reduce the reliance on full-time employees for operations and to improve productivity considerably.⁶ Another benefit of wearable technology at the workplace is greater convenience for field workers as data becomes available to them immediately. They could also be provided with an interface to enter data without returning to their computers.

Dominant use of IoT

- Plant and supply chain monitoring and optimisation, productivity enhancements, receiving feedback on a product while the customer is using it
- Hands-free driving, accident avoidance
- Landslide and equipment failure prediction, toxic gas detection for safety, tracking of miners and vehicles to improve productivity
- Early detection of maintenance requirement, tracking of energy consumption

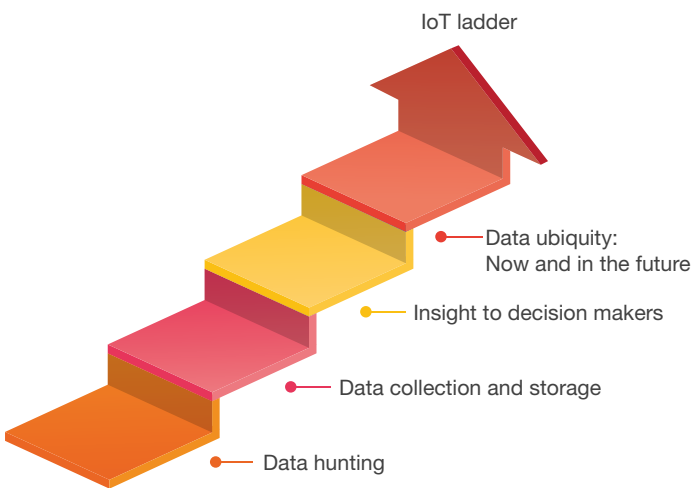
Moving beyond operational efficiencies, companies can come up with new ways to include IoT in their products offerings. This is especially useful for customer-facing companies. There is no dearth of options. Consumer durable and electronics companies can design devices such as tablets, mobiles, wearables, cars, air conditioners and televisions that can together provide a seamless experience. An India-based company launched a Wi-Fi enabled air conditioner that can be controlled from anywhere through a smartphone application.⁷ Similarly, automobile companies can use global positioning system (GPS) and general packet radio service (GPRS) technologies to enable customers to track their vehicles and monitor performance and health. An India-based automobile company has created such a tractor for farmers.⁸

3. Gartner Newsroom: <http://www.gartner.com/newsroom/id/3165317>
 4. PwC research and insights: <https://www.pwc.com/gx/en/research-insights/spotlight/internet-of-things.html>

5. IndustryWeek: <http://www.industryweek.com/manufacturing-smarter>
 6. Harvard Business Review: <https://hbr.org/2013/09/wearables-in-the-workplace>
 7. The Hindu: <http://www.thehindu.com/business/videocon-launches-wifi-enabled-ac/article6913495.ece>
 8. Telegraph India press release: <http://www.telegraphindia.com/external/display.jsp?mode=details&id=30609#.VhrYPI9600>

Climbing the IoT ladder

To implement IoT, eastern Indian companies have to adopt a step-by-step approach. PwC has identified four rungs for climbing the IoT ladder.⁹ The first step is data hunting, where a company needs to decide on the data that needs to be captured and then equip machines or locations with the appropriate Internet-connected sensors, controllers, cameras and gauges. Once this is done, data will start flowing. The next step is to collect, store and organise the data. Cloud services are the most suitable solution, as machines will produce a huge amount of data. The third step is to use analytics to generate insights from raw data and accordingly deliver data to decision makers through alerts, emails, etc. The fourth step is to make IoT ubiquitous in order to spread data collection and analytics to the supply chain and distribution and, at the same time, adopt new technologies (3D sensors, social software, augmented reality, location awareness, etc.) for greater connectivity.



Dealing with challenges

The implementation of IoT poses certain challenges. A major challenge is developing a clear vision and action plan. Leaders need to figure out exactly what the company wants to achieve with IoT. It is equally important that the same vision and action plan are agreed upon by all business functions. The primary purpose of IoT implementation—to enable all physical and digital devices of the organisation to communicate with each other—must be borne in mind. Therefore, if different IoT-related decisions or action plans are made without taking into account business functions, failure is likely.

Top challenges to IoT adoption

Strategic direction: Companies need to have a clear vision about the ways in which they will use IoT: increasing operational efficiency, changing the business model or enhancing product/service offerings.

Interoperability: Sensors, network communication, cloud or big data, analytics, etc., together make IoT work. Procurement or deployment without analysing overall impact can lead to faulty deployment.

Data security: With a huge amount of data being generated, companies will eventually have to opt for cloud services. Ownership and security of data transfers will be important concerns.

Trained workforce: Full knowledge of IoT requires knowledge of hardware, software and the network. To support this technology, companies will require trained workforces.

Lack of infrastructure: IoT will be fully effective when east Indian states have the right infrastructure. Reliable connectivity is the biggest requirement.

Another challenge in IoT implementation is data security. Since a huge amount of raw data and insights will be produced over the course of time, it is essential that data security is given due importance. The other challenges are largely resource and environment related. Since IoT is a fairly new technology, it is hard to get appropriate talent. The government, companies and educational institutions in eastern India need to work together to create a trained workforce, both blue-collar and white-collar. Besides, the government can play an important role in pushing IoT by implementing policies and ensuring that the required infrastructure is in place (especially reliable and fast Internet connectivity).

Action taken by the government

The IoT policy document issued by the Department of Electronics and Information Technology (DeitY) aims to create an IoT industry worth 15 billion USD in India by 2020. The plan is to achieve this goal by developing human resources, undertaking research and development, and developing IoT solutions specific to Indian needs in different sectors and smart cities. The policy aims to increase the number of connected devices from 200 million to 2.7 billion by 2020.

9. PwC report: <http://www.pwc.com/us/en/industrial-products/assets/big-data-next-manufacturing-pwc.pdf>

In the 2015 budget, the Government of India allocated 7,060 crore INR to the smart cities project, which aims to expand IoT massively. The government has also announced the launch of a Center of Excellence for IoT in Bengaluru.

These steps will surely boost IoT adoption in the country and in eastern India. Similar steps can also be taken at the state level to create infrastructure and develop talent.

Additive manufacturing

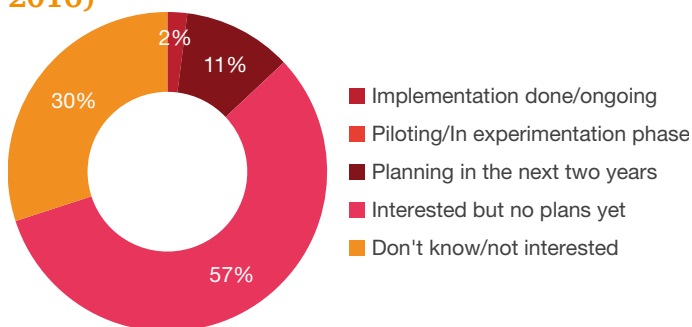
Additive manufacturing is another breakthrough technology that will shape the industry. Recent advances in 3DP technology have led to additive manufacturing being absorbed into the mainstream industrial manufacturing process. Eastern India needs to explore ways to adopt additive manufacturing and 3DP in general.

Eastern India has started using 3DP for visualisation and prototyping. The question to ask is, how quickly can these techniques be made mainstream?

Current adoption status

Eastern India is still using additive manufacturing mostly for visualisation purposes (creation of toys, building models, etc.) and, in some cases, for prototyping. This method is yet to be adopted in mainstream manufacturing. The CII-PwC survey revealed that 46% of eastern Indian leaders recognise the importance of additive manufacturing to their organisations as compared to 38% of the global leaders in the manufacturing industry. Among these participants, 2% have adopted additive manufacturing in some form.

Question: What is your company's plan to adopt additive manufacturing? (Source: CII-PwC Eastern India Manufacturing Survey, 2016)



In the global scenario, however, we see a surge in the adoption of 3D printers. According to estimates, the global 3D printer market is set to hit 6 billion USD in 2017 at a CAGR of 22%.¹⁰ In industrial manufacturing, early adopters have already started using 3DP to create final products. For example, GE uses 3DP to create fuel nozzles for their jet engines, and Boeing uses it significantly to create smaller aircraft parts.

Leveraging additive manufacturing in eastern India

There are huge opportunities for eastern Indian companies to adopt additive manufacturing, since the adoption rate is still very low. This method can help companies immensely in avoiding all procedural complexities (computer numerical control [CNC] machines, robots, programming, etc.) that arise in the case of traditional manufacturing of highly customised or one-of-a-kind products. Besides, the complex structure of some products makes it impossible to produce them as a single part using traditional manufacturing techniques. 3D printers make it easier to design and manufacture these products.

Question: How strategically important is additive manufacturing to your organisation? (respondents who stated somewhat or very important) (Source: 18th PwC Global CEO Survey, 2015; CII-PwC Eastern India Manufacturing Survey, 2016)



Additive manufacturing also has potential applications in parts replacement. For manufacturers of products with long lives and a high demand for replacement parts and repair work, additive manufacturing technology can offer significant benefits.

Additive manufacturing offers numerous advantages. SMEs will benefit tremendously from this method. But the problem is that SMEs lack the required financial support. If programmes can be initiated to make this technology more affordable to them, then SMEs will be able to make the most of 3D printing.

Smita Pandit Chakraborty
 Managing Director, Phoenix Conveyor Belt India (P) Ltd

Furthermore, additive manufacturing can save cost in terms of material, labour and transportation as compared to traditional subtractive manufacturing. A PwC analysis of 3DP adoption by the global aerospace industry's maintenance, repair and operations (MRO) parts market estimates a 3.4 billion USD annual savings in material and transportation cost alone (assuming 50% of MRO parts are manufactured using additive manufacturing).¹¹

10. Wohler press release: <https://www.wohlersassociates.com/press59.html>

11. PwC's Technology Forecast: https://www.pwc.com/us/en/industrial-products/assets/3d-printing-next_manufacturing-pwc.pdf

Industry

Dominant use of additive manufacturing



Jewellery with customised and complicated designs can be created.



Additive manufacturing can be used for producing of different parts, parts replacement, prototyping.



Food in liquid or powder form can be 3D printed for increasing customisation and personalised nutrition.



Additive manufacturing is immensely helpful on account of the size, shape and material used in the electronics industry.



More customised products, complex parts, toys, etc., can be manufactured. Market demand for new product models can be tested with a few initial 3D printed products.



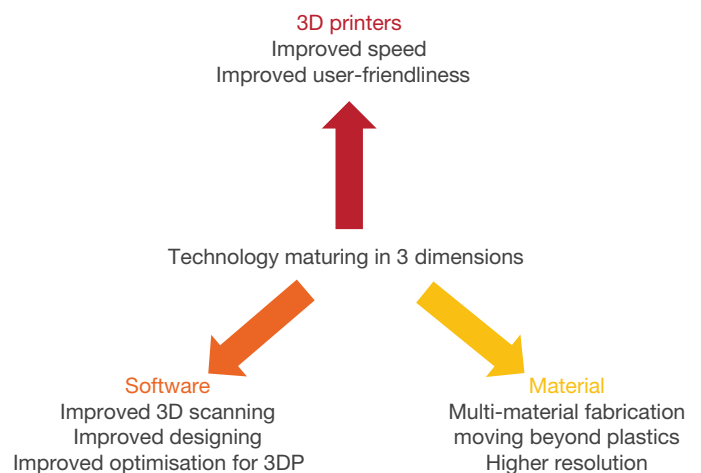
Customised equipment and replacement are time critical. Additive manufacturing enables the military, defence manufacturers and the government to fast produce one-of-a-kind products.

Companies can cut down costs even further by reducing of excess inventory through the adoption of the 'lot of one' model, whereby companies can stop producing unpopular products and manufacture more customised versions of popular products. For example, a toy company started producing customised rubber ducks in Hong Kong.¹² Alternatively, companies can first test the market with products created using small-scale additive manufacturing and use high-volume production only for those products which actually attract orders.

PwC's Disruptive Manufacturing Innovation Survey (2014)¹³ revealed that in the next few years, additive manufacturing is most likely to be adopted for low-volume highly specialised products as opposed to high-volume production. Eastern India can best use additive manufacturing for 'on-demand' manufacturing of customised products, creating complex parts, rapid prototyping (the most common use of 3DP thus far) and parts replacement. It should be noted that additive manufacturing does not require the setting up of large factories. However, the cost of 3D printers may pose a challenge, particularly for the MSME sector. Considering the business benefits 3DP can offer to MSMEs in eastern India, government agencies should begin to extend financial assistance for its adoption.

Technologies maturing fast

Most of the challenges around the mass adoption of 3DP revolve around the limitations of the printing process. According to PwC's Technology Forecast,¹⁴ 3DP technology is advancing in three main areas: printers and printing methods, software to design and print, and material used in printing.



12. PwC's Technology Forecast: https://www.pwc.com/us/en/industrial-products/assets/3d-printing-next_manufacturing-pwc.pdf

13. PwC's Technology Forecast: <https://www.pwc.com/us/en/technology-forecast/2014/3d-printing/features/materials-3d-printing-transformation.html>

14. Ibid.

The speed of printers is improving through the use of different architectural approaches and printing mechanisms. For example, Delta Robot printers, a new breed, use a different mechanism of printing and are faster than the Cartesian printers of today. Adding more print heads is another method being explored to increase speed. Today's printers fall into two spectrums—high cost-high capability (for high-end industrial production) and low cost-low capability (for hobbyists). Gradually, a new middle category of printers that offer high-end capabilities at lower prices is emerging. This new category will foster massive adoption of additive manufacturing.

3DP-related software are improving every day. From scanning to printing, software serves as the backbone of the full cycle. Companies like Apple, Google and Intel are investing in 3D sensor technologies. 3D sensing and scanning capabilities are expected to be commonplace in the near future. Today, for instance, Matterform 3D scanners can create a 3D model of an object placed on a rotating platform and scanned from all angles. Software to optimise 3D models are able to generate an appropriate lattice structure that reduces material usage and increases the speed of 3DP without compromising on strength or stiffness.

Effort is also ongoing to develop the capabilities of multi-material fabrication. Most of the current printers work with only one type of material. Multi-material fabrication will enable the printing of a complete system as opposed to individual parts. Besides, 3D fabrication using metal in parallel with polymers is expected to become more common.

Disruptions by additive manufacturing

Before eastern India adopts additive manufacturing, it should be aware of some of the disruptions that this technology will bring. The biggest disruption is expected in the sphere of supply chain and intellectual property rights. The rise of additive manufacturing with minimal factory set-up will enable a large number of small-scale factories to be set up locally. These factories will operate close to the customer base in order to reduce long supply chain costs. This trend can potentially reduce the supply chain to one link, reducing the need for transportation and logistics. Additive manufacturing will also change how customers view manufacturing. With greater customisation and personal touches, fewer mediators, and more agility and responsiveness, manufacturing companies will redefine their relationship with their customers.

Disruptions by additive manufacturing/3DP



- Restructured supply chain
- Threat to intellectual property
- Changed relationship with customers/end users
- Reduced need for transportation and logistics

Robotics

One more important technology that is making its mark today is robotics. Given the advances in the field, robots have begun to be used in various new areas. Adoption of robotics has increased worldwide. Companies in eastern India need to start looking at meaningful applications of this technology.

A hybrid workforce composed of human workers and robots is the future workforce of a successful manufacturing company. Each sector and region will have to find its own way of developing such a workforce.

Current adoption status

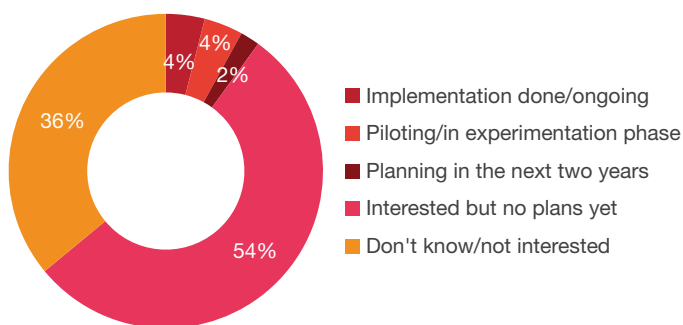
The CII-PwC Survey reveals that robotics adoption is low in eastern India manufacturing companies. Only 4% of the companies have actually adopted or are in the process of adopting robots. Further, 90% of the companies are either not interested or still do not have any plan to implement robotics. The percentage of industry leaders in eastern India recognising the strategic importance of robotics is also lower than that in the world: Of the eastern Indian leaders surveyed, 34% recognise the strategic importance of robotics for their business, as compared to 45% of the global leaders in the manufacturing industry.

However, globally, the adoption of robots has shot up. Since 2010, after the recession ended, the demand for industrial robots has accelerated considerably due to the ongoing trend towards automation and continued innovative technical improvements in industrial robots. Between 2010 and 2014, the average increase in robot sales increase was at 17% per year (CAGR). This has been the highest growth in robot installations thus far.¹⁵ According to the International Federation of Robotics, India is one of the countries where major growth of robotics is expected.

In eastern India, robots are currently being used mostly for precision work, hazardous work, bagging, packaging

15. International Federation of Robotics: <http://www.ifr.org/industrial-robots/statistics/>

Question: What is your company's plan to adopt robotics? (Source: CII-PwC Eastern India Manufacturing Survey, 2016)



Question: How strategically important is robotics to your organisation? (respondents who stated somewhat or very important) (Source: PwC's 18th PwC Global CEO survey, 2015; CII-PwC Eastern India Manufacturing Survey, 2016)



and material handling, which are their most common applications. However, advanced robots have a multitude of uses, which should be explored by eastern Indian manufacturers.

Leveraging advanced robotics in eastern India

Today's advanced robots have greater computing power and sensor technology to enable vision recognition, more sophisticated sound and movement detection, and tactile, force and torque control sensing (which allow them to sense an object that bumps into them and detect the presence of a human in their surroundings). These developments are enabling robots to make decisions based on new situations in unstructured environments as opposed to performing one repetitive task in a fixed position.

As a result, robots can carry out tasks like transportation of materials or supplies, picking and packaging, product testing and inspection alongside human resources. Apart from these uses, companies can deploy robots to work on products or components that are too small for humans to efficiently manipulate, such as micro-electro-mechanical systems. Companies can explore areas where robots can work alongside human workers and create a more productive hybrid workforce.

Moreover, robots are adding more value today in terms of flexibility and adaptability of the manufacturing process, thus surpassing the traditional benefits of speed, efficiency and productivity. This is a great opportunity for companies in eastern India, since flexibility will be an increasing need in manufacturing owing to changing consumer behaviour.

Robots increasing flexibility

There are many ways in which robots can bring greater flexibility in manufacturing. For one, companies can use robots to reduce changeover time. Advances in technology have reduced the time needed to reprogramme robots for different set-ups. Moreover, robots can handle parts with different geometries without a need for changing tools, thus reducing cycle time and saving considerable time and money, especially in the case of flexible set-ups.

Robots can locate un-machined parts of a job with the help of smart cameras, decide on the gripper, grip and move parts accurately in CNC machines—all of these activities are performed without human intervention. Awareness of surroundings and decentralised decision-making capabilities are making robots suitable for jobs in unstructured or semi-structured environments, where not every single parameter is defined through programming. Their ability to sense, think and act is redefining flexibility and automation.

Moreover, with IIoT, robots can communicate with each other and exchange knowledge with each other, thus improving the decentralised decision-making process even further. PwC's Technology Forecast¹⁶ predicts that in future, robots of one plant may be able to transfer earned knowledge of a manufacturing process to the robots of other plants of the same company, which are situated in different locations, through cloud. This may signal the end of wage arbitrage and usher in an era offshoring closer to the end market.

Dominant use of robotics

Lion's share of robotics use: assembling, painting, welding—which are best done by industrial robots

Locating, placing, assembling high-precision products with great accuracy, inspection

Cutting, welding, joining, forming, taking measurements, surface treatment and finishing, inspection

Robotics to increase flexibility, reduce changeover time, enable more product variety from a single factory

Material handling and packaging

16. PwC Technology Forecast: <http://www.pwc.com/us/en/industrial-products/assets/industrial-robot-trends-in-manufacturing-report.pdf>

Dealing with challenges

Implementation of robotics has its own challenges. The top challenges are cost and user-friendliness. The total cost of robotics includes the cost of the robot, software, controller, technical support and all other requirements for set-up, which is significantly higher than the cost of the robot. However, prices are coming down. In the near future, with advancements in technology, prices are expected to decline further. Programming is also becoming less cumbersome, thus reducing the cost of technical support. Given the cost concern, the increased sales of robots worldwide in the last few years is mainly attributable to large companies. Small companies are still struggling with the cost of entry.

To address the second challenge regarding expertise, robot manufacturing companies need to work on technologies such as learning by demonstration. Since robots are meant to assist human beings and mimic the tasks currently undertaken by experts on the factory floor, it is practical that robots grasp the work through demonstration. In this way, experts do not have to spend valuable time learning how a particular robot works. This will also eliminate the need for hundreds of lines of code to enable a robot to perform a particular task in a fixed set-up.

Another huge challenge companies may face will be fatal accidents due to the lack of coordination between human workers and robots in the same or adjacent line. This problem must be dealt with by providing adequate training to workers on how to work with robots in a manufacturing line. At the same time, driving software are getting smarter and enabling robots to collaborate effectively (COBOTs) with human workers on the shop floor.

The fear of job reduction needs to be addressed appropriately in order to manage human resources. Whether robots will impact society as job makers or job takers is still debatable. However, replacing the expertise of people with robots will not be simple. Factories will require a dedicated workforce to monitor and maintain robots during production times. Moreover, growth of business as a result of robotics implementation may in turn increase the count of human workers. The company leadership needs to communicate their plans with enough clarity to address such staff concerns.

Top challenges to adoption

Not cost-effective

Insufficient resources and expertise

Fatal accidents due to inadequate worker knowledge

Is the environment right?

The business environment of a state plays a crucial role in enabling technology-driven growth of the manufacturing industry. Minimal red tape and standardised and organised processes can give companies much more time and energy to invest in business goals and adoption of new technologies. Similarly, if states can ensure investments, the right infrastructure and trained human capital, some of the major hurdles will be removed for companies. To work towards this goal, all the stakeholders—namely companies, the government, industrial bodies, educational institutions and consulting firms—need to work together to create an appropriate ecosystem.

Implementation of 98-point action plan: State ranking (Source: Report by CII and World Bank)

West Bengal

Rank 11
46.9%

Orissa

Rank 7
52.12%

Chhattisgarh

Rank 4
62.45%

Bihar

Rank 21
16.41%

Jharkhand

Rank 3
63.09%

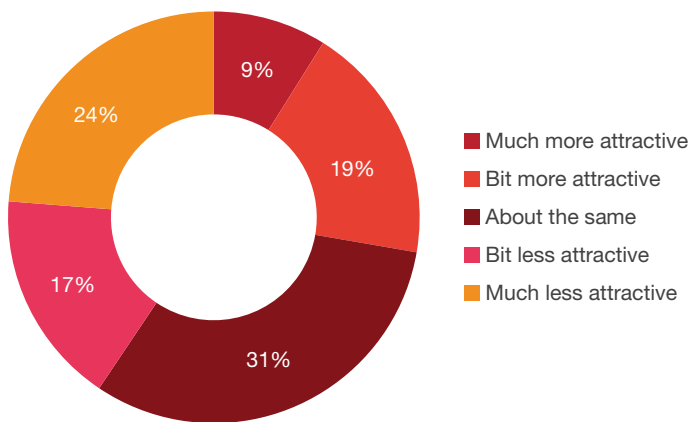
Ease of doing business in eastern Indian states

For technology-driven growth, ease of doing business is a 'hygiene factor'. The World Bank's ranking measures ease of doing business in terms of ten defined criteria. As per the World Bank's 2016 ranking, India ranks 130 among 189 countries. To bring this rank down to within 50 by 2017, the Government of India's Department of Industrial Policy & Promotion (DIPP), in collaboration with state governments, has identified 98 action points to be implemented by the latter. The Government of India has also ranked states and union territories as per their implementation status of these action points. Eastern Indian states performed fairly well in this ranking.

In 2015, one of the prime focuses of CII was promoting ease of doing business both at the state and national level. As part of this initiative, CII started working closely with the Lee Kuan Yew (LKY) School for Public Policy, Singapore, on ease of doing business. The confederation proposed that the governments of the eastern states sign a tripartite agreement with CII and the LKY School for Public Policy to create a roadmap for promoting ease of doing business in the states. The states of Chhattisgarh, Bihar and Odisha came on board and signed the tripartite agreement. This led to a significant improvement in the ease of doing business scenario in the region, which is evident from the fact that four out of the five eastern states were ranked among the top eleven in the DIPP–World Bank ranking on ease of doing business.

Reforms are being implemented to improve the regulatory environment, and companies have begun to feel them on the ground. As per the Eastern India Industry Survey by CII and PwC India, almost 36% of the industry leaders in eastern India thought that doing business in the region was easier in the last three years. About 38% of the participants thought it remained at the same level. It is expected that with the gradual implementation of the central government's policies and with states' continuous efforts, ease of doing business will improve further. In Union Budget 2016, ease of doing business has been identified as one of the nine pillars to transform India and has been given significant attention. This focus is expected to further expedite the improvement of the regulatory environment.

Question: Do you think ease of doing business has improved in your state during the last three years? (Source: CII-PwC Eastern India Manufacturing Industry Survey, 2016)

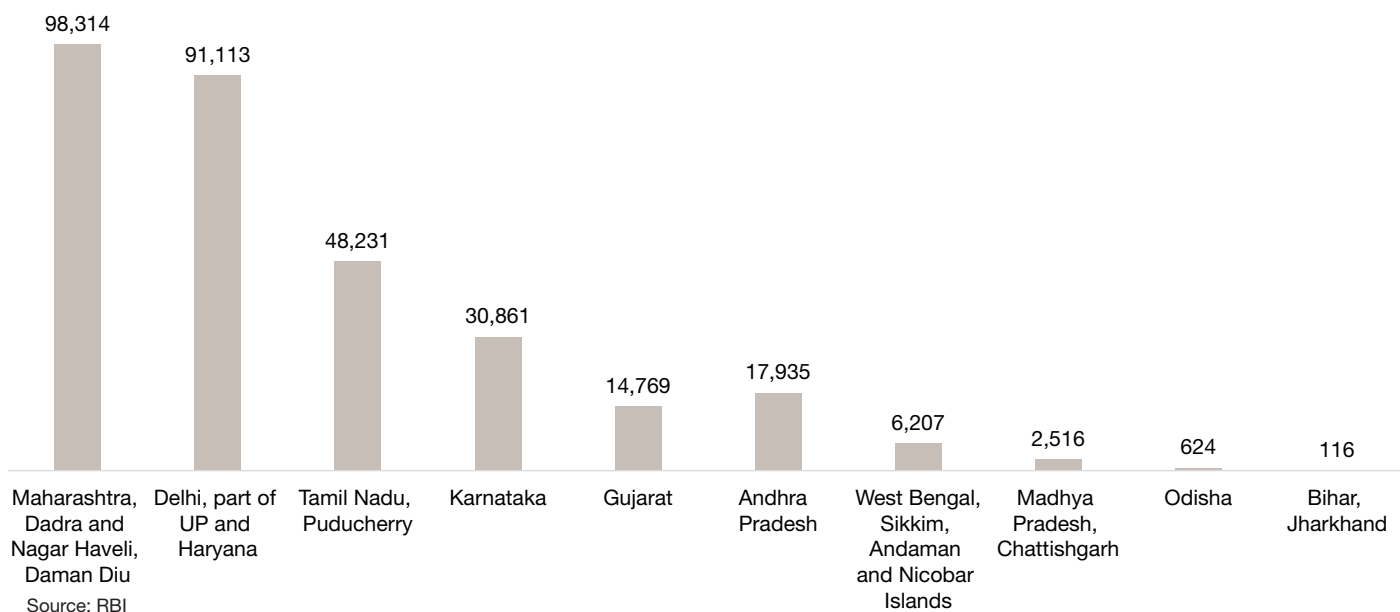


Companies also feel that state-specific initiatives need to be taken in parallel with the implementation of the central government’s policy initiatives. The top three action points for states that emerged from the CII-PwC survey are initiating new business-friendly policies, solving land and labour-related issues, and ensuring good governance in the states.

Building the brand value of eastern Indian states

Building a state’s brand value is crucial to ensuring industrial growth. States need to reach out to the private sector both within and outside the country for investments. Higher investments often mean operations set up by bigger companies. These bigger companies are better equipped to pioneer the adoption of emerging technologies, which other companies can then emulate. The eastern Indian states have been able to attract significant investments over the last couple of years. With the right plan in place, eastern Indian states can attract more investments, including FDI.

FDI inflow (April 2012–Jan 2015)



The eastern states are making efforts to bring about a turnaround. Leaders from multiple eastern Indian states have visited other countries to attract new foreign investments. Some of the states have started new campaigns or improved state-specific issues to transform their image. How is this affecting the perception of the states according to the business leaders with operations in eastern Indian states?

According to the CII-PwC survey, 68% of the business leaders felt that state governments were projecting their profile and opportunities to the business community effectively and proactively. They believed that the governments of these states could do more by introducing more business-friendly policies and ensuring good governance and the proactive resolution of land and labour issues.

- 68% of the respondents believed that their states were taking the right steps towards brand building.
- 40% of the respondents thought their states were not yet as attractive a brand as some of the other states in India.
- Top priorities for states identified by business leaders: business-friendly policies, land and labour issues, good governance



West Bengal has undergone a change in the last few years. We have seen changes in terms of infrastructure, roads, highways, hotels, etc. Also, there have been changes in the IT/ITES sector at New Town in Kolkata. We are waiting for major investments in the field of manufacturing.

Smita Pandit Chakraborty
Managing Director, Phoenix
Conveyor Belt India (P) Ltd



Eastern India, and specifically West Bengal, is thriving with MSMEs; it is high time that they are equipped with emerging technologies so that they can enjoy greater profitability and become suppliers of sensors in order to reap the benefits of the surge in the application of IoT. This will open up a plethora of opportunities for the export of niche items from eastern India, which will reinforce the region's position as the gateway to ASEAN countries. The government can develop a cluster of emerging technologies to enable faster growth.

Dipankar Chakrabarti
Executive Director, Advisory, PwC India



Are companies ready?

Readiness for technology adoption of eastern Indian companies reflects their growth potential, since technology is the future growth engine. A company can be called ready when it has all the qualities to drive end-to-end technology implementation and associated changes enterprise-wide. The impact of the change brought by the new wave of technologies is substantial, spanning the business model, value proposition, culture, business processes and talent requirements of a company. Therefore, the likelihood of implementation failure is high owing to risk averseness, difference of opinion at the top leadership level, lack of leadership to drive changes, ineffective communication and inertia against big change. Hence, it is important to check readiness. We measured readiness in terms of three parameters: leadership, operational maturity and mindset for innovation.

Leadership

Strong leadership is the foremost component needed to drive change. The initial leadership may come from top-level leaders such as CXOs, preferably the CEO. This leadership has to ensure that technology is being considered as part of a strategy-making process and that the organisation has a clear roadmap for technology. The leaders also need to make sure that the various aspects of new technology adoption are discussed and agreed upon and strategies are developed accordingly.

The next challenge for leaders is to ensure that resistance to new technologies inside the organisation is addressed. The value of new technology implementation and associated changes must be well communicated and understood at each level. Once this is achieved, the leadership will percolate down the organisational hierarchy.

The survey indicates that in eastern Indian manufacturing companies, the top leadership is well aware of newer technologies and has integrated technology into the strategy formulation process. However, communication may be a barrier. Technology was well communicated at the CXO level in only 26% of the cases, and in 25% of the cases, it was well communicated enterprise wide. It was also found that most of the companies lacked a multi-year technology roadmap.

53%

The CEO is the champion of newer technology adoption.

66%

Technology is part of the agenda of developing a business strategy.

26%

The technology strategy is agreed upon and shared at the C level.

25%

The business and technology strategy is well-communicated enterprise wide.

11%

A multi-year technology roadmap exists.

36%

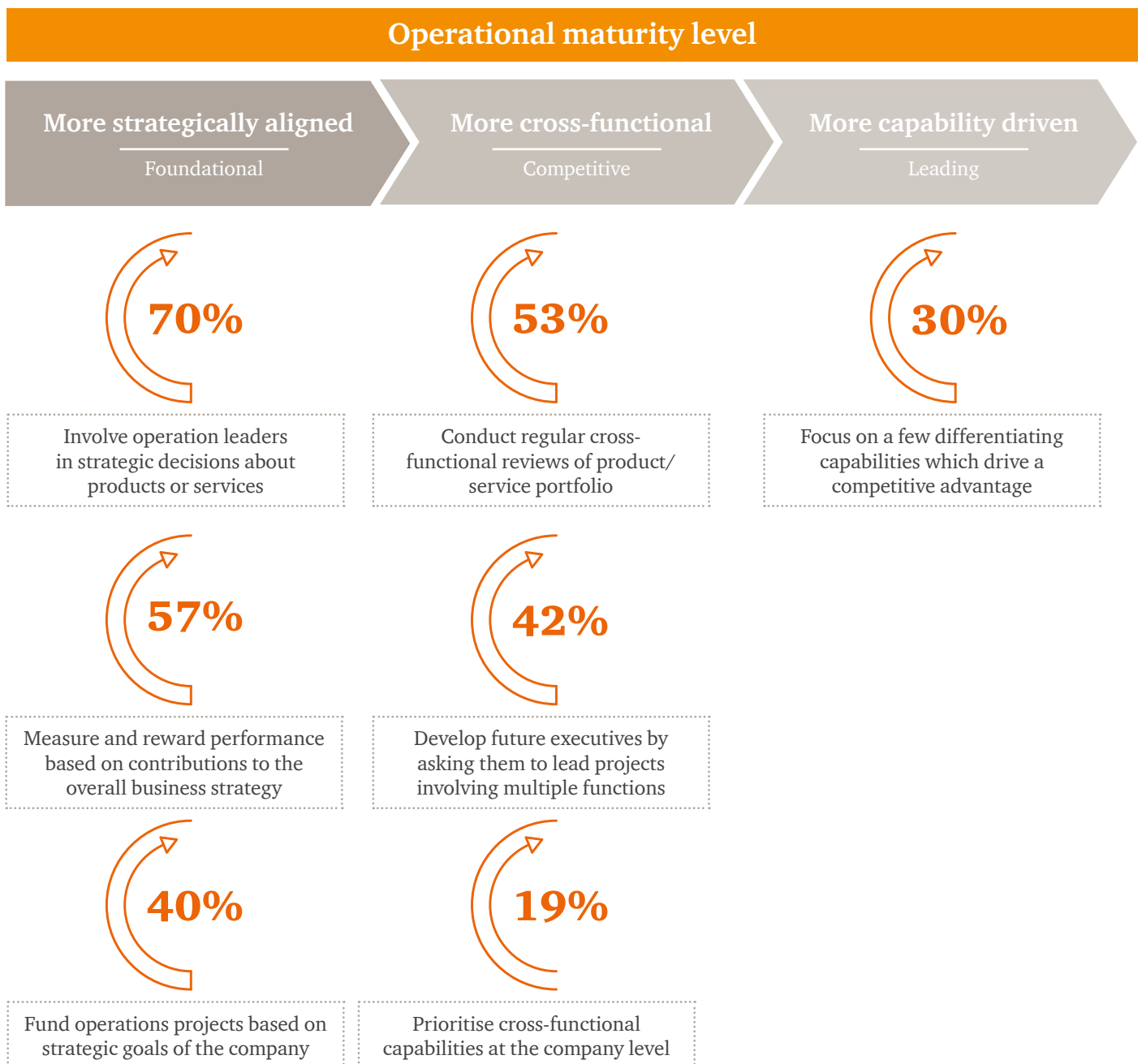
Outcomes of technology investment are consistently measured.

Source: CII-PwC Eastern India Manufacturing Industry Survey, 2016

Operational maturity

PwC's Global Operations Survey (2015)¹⁷ shows that operations in organisations are maturing along three dimensions—they are turning more strategically aligned, cross-functional and capability driven. Being more cross-functional and capability driven will help organisations to identify the most important capabilities to focus on. This will in turn help them to identify the areas where technology will

add value. The cross-functional nature of an organisation will also help to get a buy-in from all the leaders of different business functions, thus leading to successful implementation throughout the enterprise. Strategic alignment will help an organisation to prioritise the right projects and programmes in line with its strategy and create the right performance measurement criteria.



Source: CII-PwC Eastern India Manufacturing Industry Survey, 2016

17. PwC's Global Operation Survey (2015): <http://operationsurvey.pwc.com/>

In the CII-PwC Eastern India Manufacturing Survey (2016),¹⁸ participant companies were measured against the attributes that define these three levels of operational maturity. It was found that improvement was mostly needed with respect to two of these attributes: prioritisation of cross-functional capabilities at the company level (19% responded that they prioritise) and focus on differentiating capabilities which will drive a competitive advantage (30% responded that they have this focus).

Mindset for innovation

The right use of technology will be as important as the technology itself. According to PwC’s 19th Global CEO Survey (2016),¹⁸ the winners in the innovation game will be those that harness technology and innovation to deliver products and services that are cost-effective, convenient, functional and sustainable.

Problems arise when the company leadership overlooks the importance of innovation or when the body of the organisation sees innovation as separate from the mainstream operations of the business. Successful companies today recognise that innovation is a mainstream process. Therefore, establishing a culture of innovation inside the company is very important. Innovation needs to come from the heart of the company—the people at every level who are dealing with day-to-day operations.

In eastern India, nearly half of the companies offer recognition and rewards for innovation and they review breakthrough technologies regularly. However, a few of the companies have an innovation strategy and structured management of innovation effort. It has also been observed that companies are not using social media for innovation. Social media can create a rather strong platform where employees can share ideas, experience, creative ways of solving problems, etc., from which innovation can arise.



Source: CII-PwC Eastern India Manufacturing Industry Survey, 2016

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Five questions for organisations to assess their readiness for technology-enabled growth:

1. Have you identified your differentiated capabilities?
2. Have you assessed your differentiated capabilities on the basis of newer technologies?
3. Have you assessed the challenges that you may have to overcome while adopting newer technologies?
4. Have you developed your workforce to lead the adoption of newer technologies?
5. Do you have a communication plan to effectively explain the adoption of newer technologies to your stakeholders?

18. PwC 19th Global CEO Survey 2016: <http://www.pwc.com/gx/en/ceo-agenda/ceo-survey-2016.html>

Facilitating technology-driven growth: Addressing the challenges

As companies proceed with the adoption of these technologies, they will come across challenges. Many of them can be solved at the company level. For many others, companies, state governments, consulting firms, industry associations, educational institutions, etc., need to work together. All of these bodies need to form an ecosystem through which challenges are identified, recognised and then solved.

According to the CII-PwC survey (2016), the top four challenges for technology adoption are as follows: high initial investment, lack of adequate infrastructure in states to support these technologies, no compelling business reason to implement them and lack of a skilled workforce.

There is a problem in our education system, which is causing a considerable gap between a person's education and his employability. Today, we have vacancies but often fail to find the right talent to fill the need.

Viresh Oberoi
Managing Director and CEO, mjunction services limited

As per the survey, 56% of the respondents thought that states are still lagging behind in the infrastructure to support these technologies. States and companies together need to find out which particular areas are pain points and focus on them. More than one-third of the respondents believed that lack of a skilled workforce was a big challenge. As technology is changing very fast, keeping the skill set of the workforce relevant is going to become a major challenge in the near future. Companies, educational institutes and the government need to work collaboratively to find out how the education system can be made more relevant and skill-oriented, and can create a productive workforce for industries of the future. Union Budget 2016 specifically focusses on skill building through initiatives such as the setting up of multi-skill training institutes across the country and of the National Board for Skill Development Certification. These are steps in the right direction. Additionally, the eastern India manufacturing industry can leverage its existing IT industry to support the new technologies and train its workforce, since these new technologies will involve networking, cloud, big data analytics, software for 3DP and software for robots.

Half of the survey respondents did not find relevant business reasons to implement these technologies. A mindset for innovation and leadership will help companies identify more useful cases and reap the benefits of these technologies. Globally, companies belonging to every sector are increasingly finding new ways to use these technologies to create value. There is no shortage of ways in which these technologies can offer value, and companies in eastern India need to determine them.

Question: What do you think are the potential factors that can hinder/are hindering the adoption of the technologies discussed above in your company? (Source: CII-PwC Survey, 2016)

High initial investment

62%



Not enough infrastructure in state to support the technologies

57%



No compelling business reason to implement them

49%



Lack of skilled workforce

38%



According to the results of our survey, most of the respondents perceived high initial investment to be the main barrier. Many of these technologies, such as 3D printers and robots, pose a considerable cost to companies. However, once companies are able to find the right business cases, the long-term benefits can overshadow the high initial cost. It is essential that companies create a multi-year technology plan and clearly present the future benefits of technologies. This will make technology implementation a profitable investment for companies instead of mere utilisation of the budget.

For small and medium-sized enterprises (SMEs) in particular, adoption of these technologies can remain a challenge from the financial perspective. If easy finance or other policy support can be provided to SMEs, technology adoption, and hence long-term growth, will receive a boost.



Conclusion

Technology has become indispensable to business transformation. As per PwC's 19th Annual Global CEO Survey, 51% of the CEOs are making significant changes in order to use technology to deliver on wider stakeholder expectations. In the manufacturing industry, technology is helping to enhance productivity, profitability as well as competitiveness. Upgradation of traditional technologies—from lean manufacturing and ERP to the latest advancements such as IoT, additive manufacturing and robotics—is driving growth in the sector. However, such IT investments will need to be accompanied by a well-defined strategy, including an innovation strategy and the structured management of innovation effort. Simultaneously, much-needed support needs to come from the government. Organised processes can give companies more time and energy to invest in business goals and the adoption of new technologies. Similarly, if states can ensure that the right infrastructure and trained human capital are in place, some of the major hurdles faced by companies will be eliminated.

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About CII

The Confederation of Indian Industry (CII) works to create and sustain an environment conducive to the development of India, by partnering industry, the government and civil society through advisory and consultative processes.

CII is a non-government, not-for-profit, industry-led and industry-managed organisation that plays a proactive role in India's development process. Founded in 1895, India's premier business association has around 8,000 members from the private as well as public sectors, including SMEs and MNCs, and an indirect membership of over 2,00,000 enterprises from around 240 national and regional sectoral industry bodies.

CII charts change by working closely with the government on policy issues, interfacing with thought leaders, and enhancing efficiency, competitiveness, and business opportunities for industry through a range of specialised services and strategic global linkages. It also provides a platform for consensus building and networking on key issues.

Extending its agenda beyond business, CII assists industry to identify and execute corporate citizenship programmes. Partnerships with civil society organisations carry forward corporate initiatives for integrated and inclusive development across diverse domains, including affirmative action, healthcare, education, livelihood, diversity management, skill development, empowerment of women, and water.

In its 120th year of service to the nation, the CII theme of 'Build India - Invest in development: A shared responsibility' reiterates industry's role and responsibility as a partner in national development. The focus is on four key enablers: facilitating growth and competitiveness, promoting infrastructure investments, developing human capital and encouraging social development.

With 66 offices, including 9 centres of excellence, in India, and 9 overseas offices in Australia, Bahrain, China, Egypt, France, Germany, Singapore, the UK, and the US, as well as institutional partnerships with 312 counterpart organisations in 106 countries, CII serves as a reference point for Indian industry and the international business community.

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