ENHANCING COMPETITIVENESS OF MSME IN INDIA: INDUSTRY 4.0

Technology as a key lever in what is evolving as fast changing land scape in industry 4.0 and readiness of Indian industry's to adapt.

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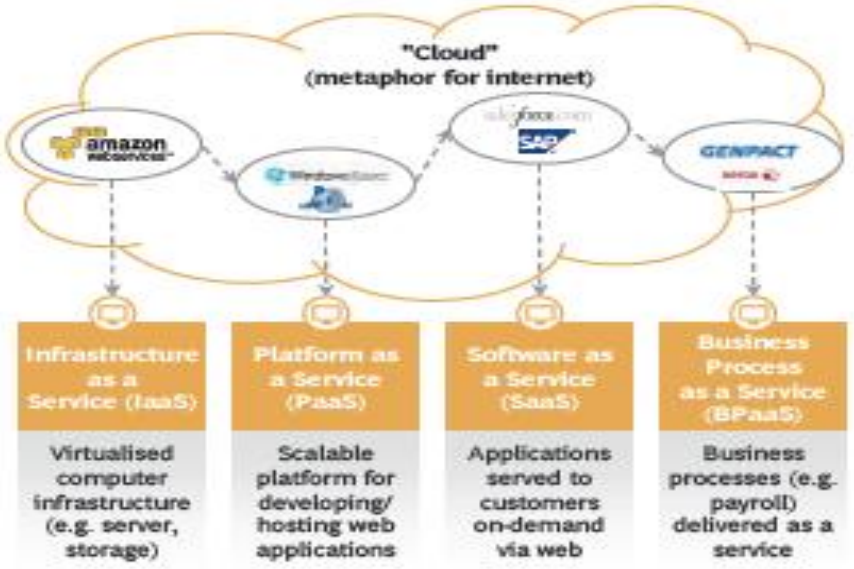
THERMAX 50 Vibrant Years

Technological megatrends have created conditions ripe for this revolution

Abundant and cheap computing power

- **Cost of Processing Power** — 50x — Over the pas ten years
- **Cost of Bandwidth** — 40x — Over the past ten years
- **Cost of Data Storage** — 20x — Cost per MB over the past ten years
- **Cost of Sensors** — 50% — Avg. cost over the past ten years
- **Cost of Robots** — 30% — Avg. cost of robots over the past ten years

Availability of low cost on-demand cloud platforms



So why is Industry 4.0 relevant now? Technology breakthroughs in the past 10 years have made the cost of key technology enablers like bandwidth, processing power, cloud storage, sensors, and robots, crash to a fraction of what they were 10 years ago. The performance, size and availability of these cyber-physical systems have also dramatically improved, making them accessible to manufacturing shop floors. Cloud services have made connected enterprise management systems available to even small and medium enterprises (SMEs). These structural changes in the ecosystem have created conditions for efficiency and productivity gains and the momentum for the widespread adoption of Industry 4.0.

Source: Goldman Sachs; Deloitte; BCG Analysis.

THE NEW PARADIGMS

Late 18th century | Beginning of 20th century | 1970s–2000s | 2010 onward

Moor's Law of exponential growth

First industrial revolution: Power generation

- Introduction of the power loom in 1784
- Mechanization of production facilities with water and

Second industrial revolution: Industrialization

- Introduction of the assembly line in slaughterhouses in 1870
- Electrification drives mass production in a variety of industries

Third industrial revolution: Electronic automation

- Development of the first programmable logic controller (PLC) in 1969
- Growing application of electronics and IT to automate production processes

Fourth industrial revolution: Smart automation

- Increasing use of cyber-physical systems (CPS)
- In January 2011, Industry 4.0 was initiated as a "Future Project" by the German federal government
- With the introduction of IPv6 in 2012, virtually unlimited addressing space becomes available
- Governments, private companies, and industry associations have been focusing on Industry 4.0 and making investments since

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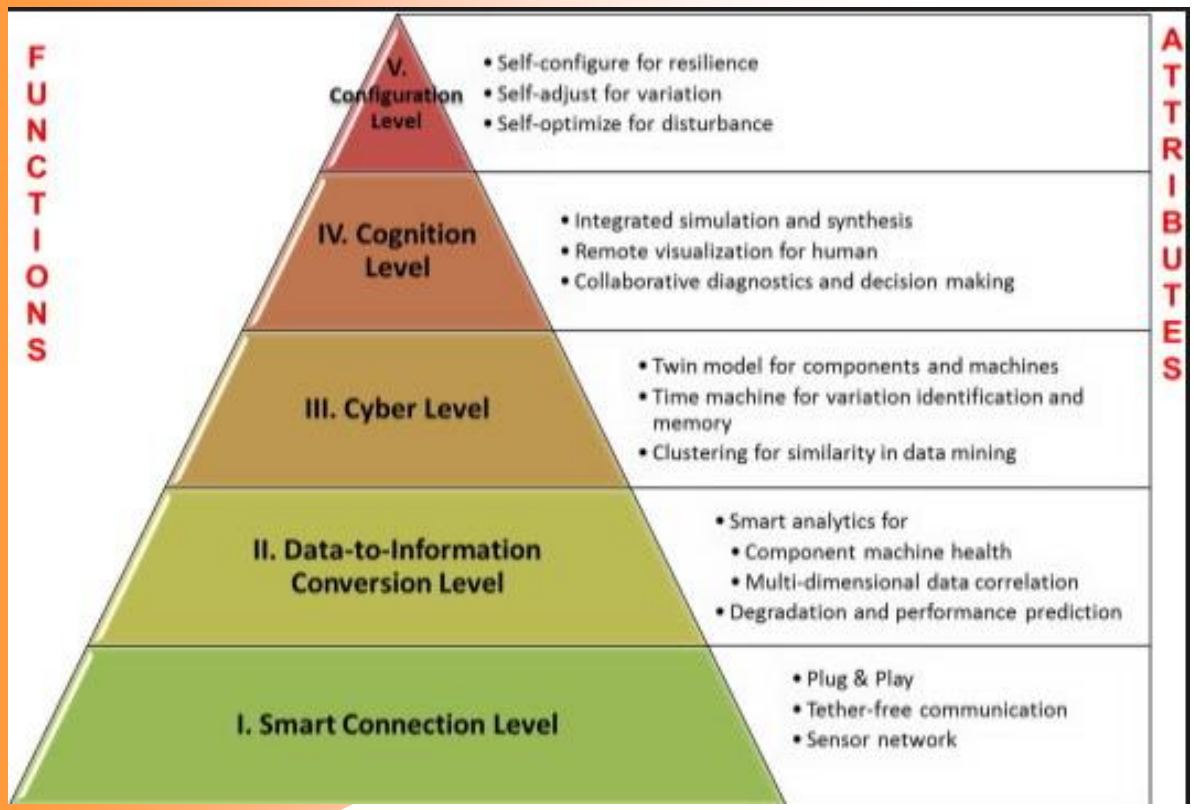
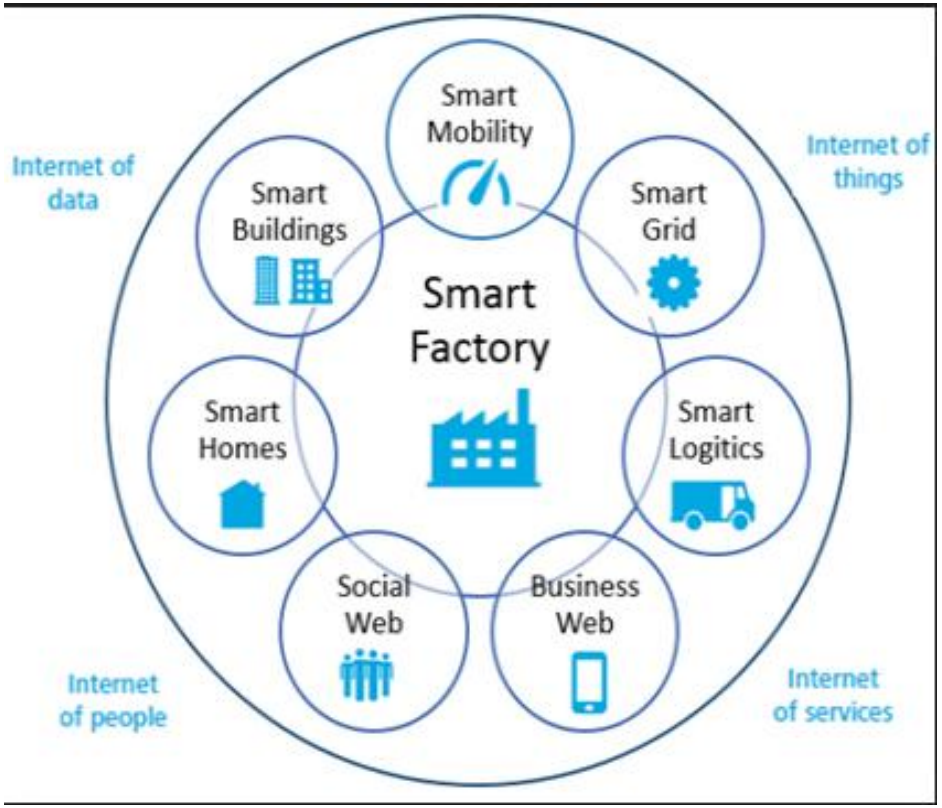
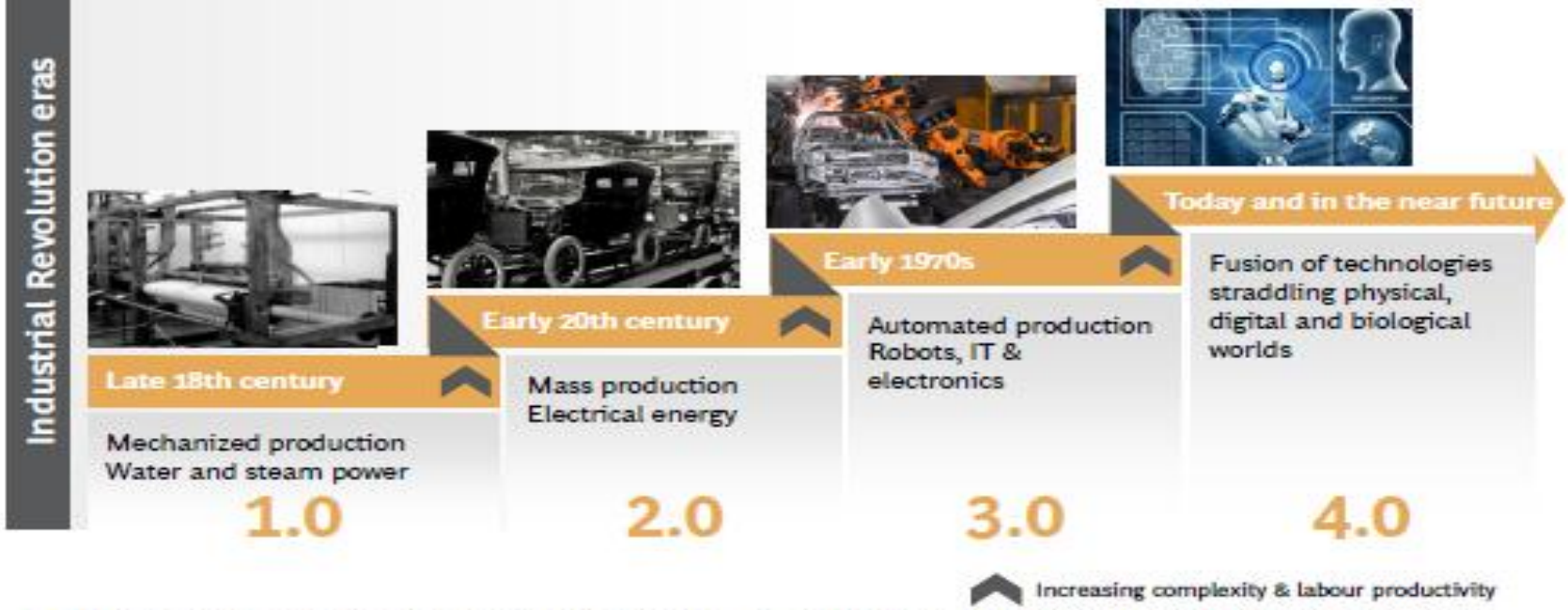
TECHNOLOGY MUST BE ALL PERVADING IF COMPETITIVENESS HAS TO BE ACHIEVED.





We are already in the era of Industry 4.0, The Fourth Industrial Revolution



With every industrial revolution we have seen labour and asset productivity multiply and structural shifts emerge in the manufacturing world order. From the steam and water power in the 1700s to the electric and automation revolutions in the 19th century, we have already seen three big shifts. We are now in the midst of The Fourth Industrial Revolution where digital technology is transforming traditional manufacturing to give rise to connected cyber physical systems. This latest revolution is fittingly called Industry 4.0.

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Several core technologies are driving Industry 4.0

Big data and analytics
- Real-time data processing
- Data driven decision making

Simulation
- Upfront optimization of products / processes

Augmented Reality
- Real time information in semantic context
- Assistance in navigation, diagnostic, repair etc.

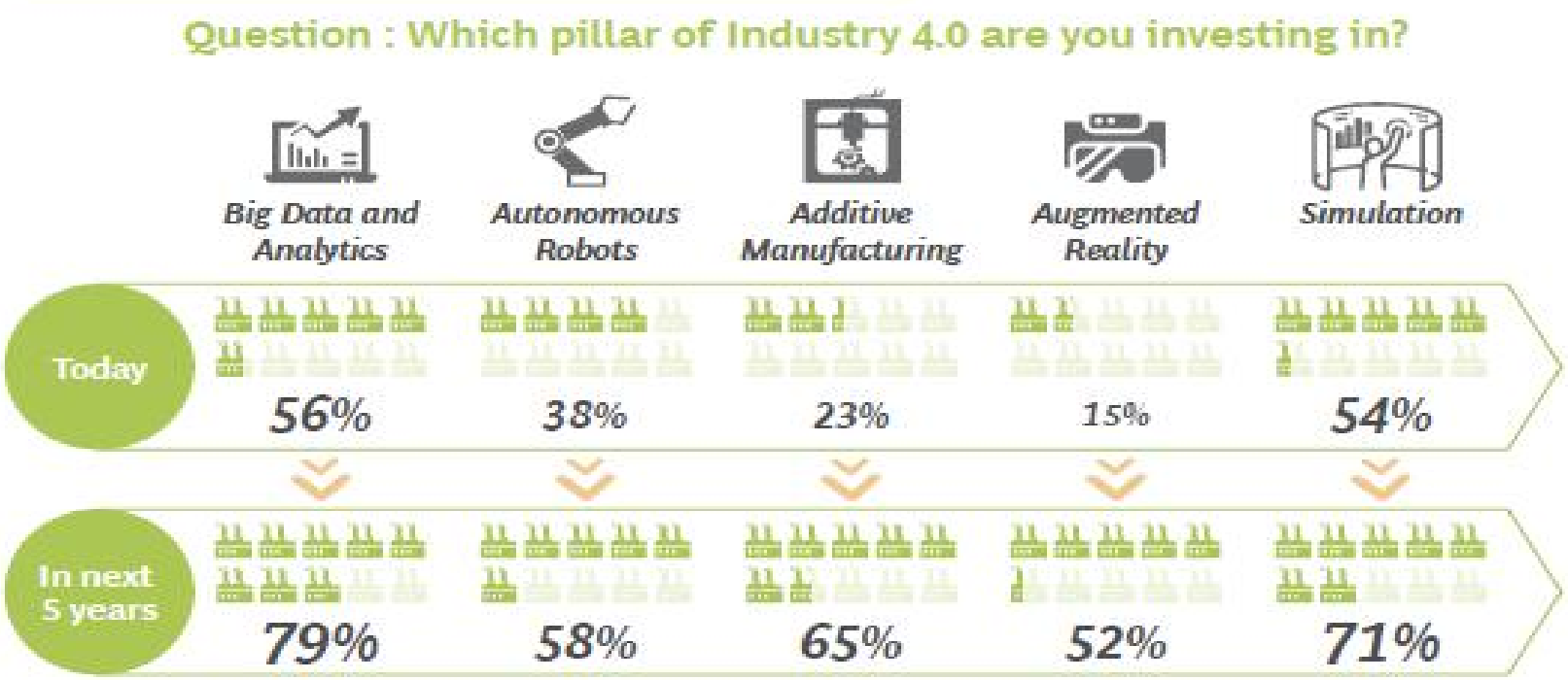
Autonomous robots
- Self learning industrial robots
- Integrated sensors
- Standardized interfaces

Additive manufacturing e.g. 3D printing
- On-demand manufacturing
- Mass customization
- Rapid prototyping and tooling

Industry 4.0

Few core technologies combine to create multiple use cases across the manufacturing value chain. Many of these have already been in use standalone. With Industry 4.0, these technologies are getting used together and transforming the conventional manufacturing value chain.

India Inc. is already adopting Industry 4.0 technologies



As the adoption of Industry 4.0 technologies accelerates in other countries, Indian manufacturers are drawing a roadmap to incorporate these technologies. Our CII–BCG survey reveals that more than 50% of manufacturers have either already invested in or are in the process of investing in the majority of the Industry 4.0 technologies. Big data and simulation are technologies that almost two-thirds of companies are expected to adopt within the next 5 years.

Source: CII–BCG Manufacturing Leadership survey 2016.

How do we ensure that this adaptation becomes all pervading especially in MSME where Artificial Intelligence (AI) and Machine Learning (ML) becomes a part of their ECOSYSTEM

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Three key lessons to be learnt from the manufacturing superstars

Lesson 1

Exploit natural advantages

- Identify natural advantages in comparison with competing countries
- Advantages can be based on geographical location, labour, energy costs, etc. (e.g. Mexico for geographical advantage and China for low-cost labour)

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Three key lessons to be learnt from the manufacturing superstars

Lesson 2

Invest to create competitive advantages

- Create strong barriers for competition to break into a sector. Significant spend on R&D and innovation can create a knowledge barrier for other countries to compete with (e.g. South Korea & USA)
- Invest in infrastructure and human capital to keep a competitive advantage over other countries–Spend on education, infrastructure (e.g. China & South Korea)

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Three key lessons to be learnt from the manufacturing superstars

Lesson 3

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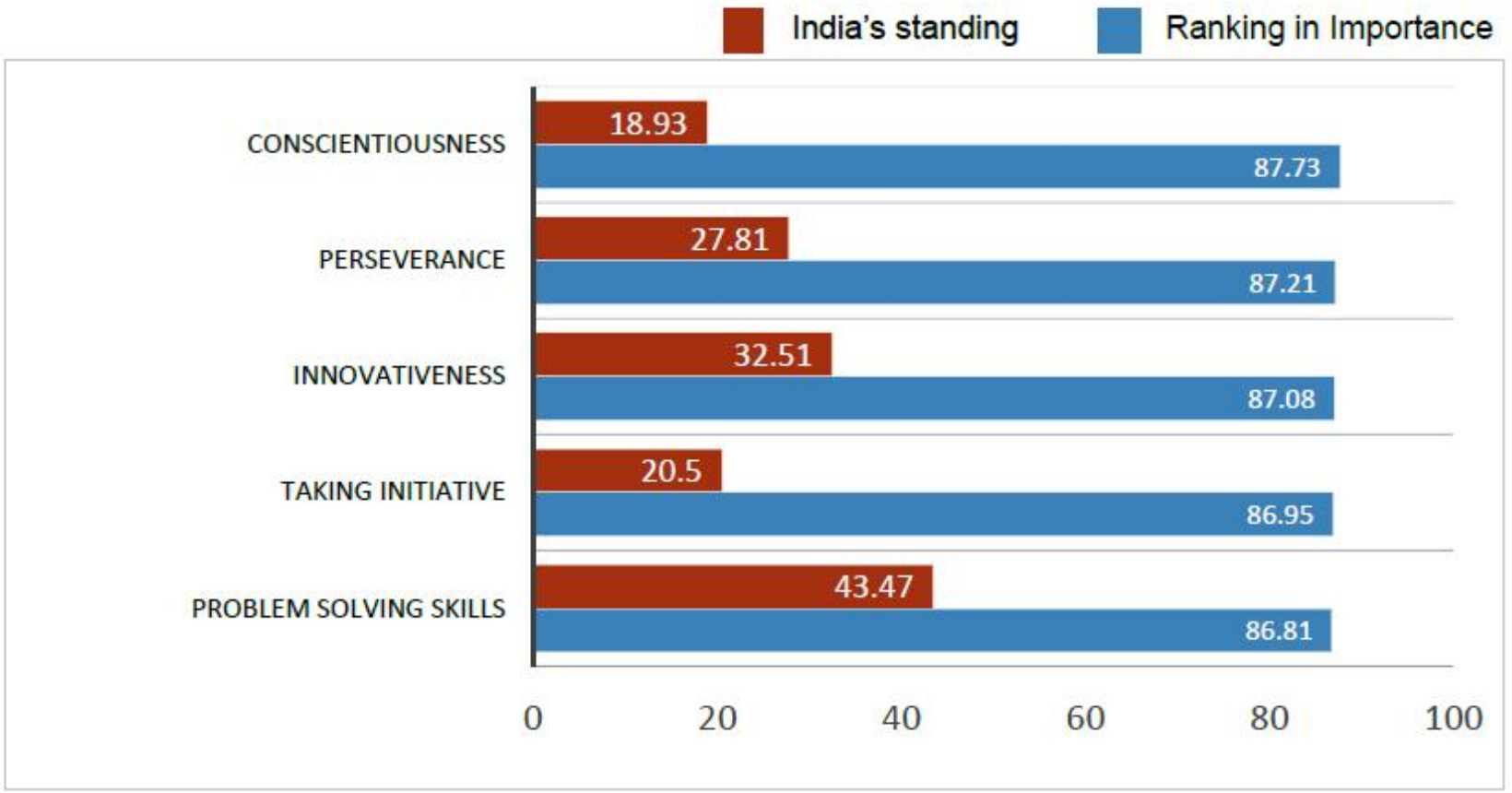
TOWARDS INDSUTRY 4.0 TRAJECTORY, THEN AGAIN IT IS NOT TECHNOLOGY ALONE…….

Given below is how the survey ranked the five most important attributes and where India stands.



Huge gap: India's standing vs. the desired goal

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Except in the “problem solving metric” the survey showed that we are underperforming in all other metrics. We need to seriously introspect on this.

Taking initiative and perseverance appear to be the main stumbling blocks. We want some one else to take the initiative and happy to be a follower mode. This is very concerning attribute.

And this is not merely at MSME level, it is pervading in all leader industries both in public and private space

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FOCUS TO REACH SUPERSTAR STATUS: SEQUENTIAL OR IN PARALLEL

1. Examine the current processes / systems/ machines/ tools & tackles for automation, on line quality checks and productivity enhancement strategies. This will be the first step to the road to Industry 4.0

2. Explore new manufacturing processes like Laser Cutting, Laser Welding, Cobot (collaborative Robot) deployability, multi axis systems and SPMs (special purpose machines)

3. Introduce sensors and many low cost on line monitoring systems for tracking and performance

4. Move now to use of data based cloud systems and develop algorithms to broadcast the manufacturing status remotely to the benefit of all the stake holders.

5. Machine Learning tools to interact within and outside

6. Finally the new 3 D manufacturing processes and additive systems

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AND WHAT IS NEEDED TO MAKE THIS HAPPEN?

AT MSME LEVEL

1. Mind set that " we can adapt " to the new paradigms. Flexibility in our thinking. Perseverance till success
2. Innovative eco system. Allow for experimentation & failures for ultimate success
3. Employed human skill sets to be elevated to a different level.

AT POLICY LEVEL

1. Human skills for Industry 4.0 to be developed in the academic curriculum
2. Financing this transition by attractive packages , FDI investment, R&D investments in all the modern machines required for automation & robots
3. Improving the infra structure from soft (like data storage) to hard (roads & ports)

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Reinforcing the foundation: 5 point agenda for manufacturing leaders

Think Big–think long-term, think global
- Create and defend competitive advantage across whole value chain, focusing on an 8 to 10 year path to success

No. of Fortune 500 companies:
China 103 Vs. 7 India

Relentlessly focus on productivity
- Significant productivity gap with other manufacturing countries needs to be filled to become globally competitive

1.5x
China's labour productivity as compared to India

Fortify and further improve quality
- Indian auto component industry has set a perfect example of steadily improving quality to become world class. Other industries need to replicate this success story

Cumulative No. of Deming prizes (2002-15)
India 22 Vs. 28 Rest of World

Bet on R&D and innovation
- Indian manufacturers need to increase investment in R&D and innovation to build competitive advantage beyond low cost labour

No. of R&D professionals per million
China 1,100 vs. 190 India

Invest in lifelong learning of employees
- As labour cost advantage diminished over long-term, manufacturers should proactively invest in lifelong training of employees to build highly competent workforce

Training spend as % of labour cost
China 5% vs. 2% India

In a fast evolving global manufacturing landscape, Indian manufacturers are competing against leading manufacturers with bigger scale, superior productivity, superior employee skill base, R&D capabilities and quality capabilities. To win market share from these competitors, Indian manufacturers need to act on each of these fronts to fill key gaps and become globally competitive.

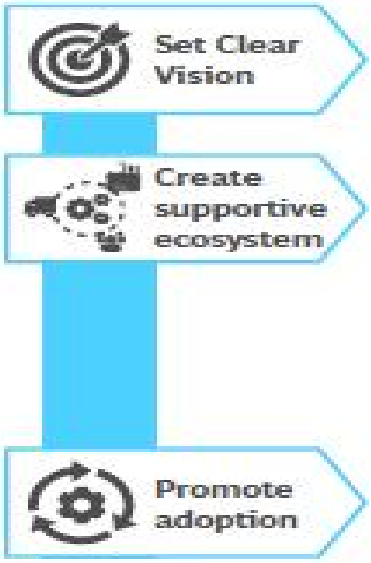
Source: EIU; Oxford economics; BCG Survey.

Reinforcing the foundation: 9 point agenda for government

Capabilities	**Accelerate technology transfer** » Support systematic indigenization of technology	**Promote R&D and innovation** » Incentivize R&D and innovation to develop it into key pillar of sustainable competitive advantage	**Improve workforce skill base** » Skill improvement program to improve quality of labour and engineering workforce
Competitiveness	**Build global scale** » Leverage domestic demand to nurture and develop global scale	**Develop cluster-based ecosystem** » Build world class clusters containing core infrastructure for supporting operations, common facility centres etc.	**Ease trade barriers** » Prioritize FTA with key importing nations » Expand export promotion schemes with tax breaks to more sectors
Building blocks	**Infrastructure** » Establish world-class infrastructure in ports, rail and road	**Ease of doing business** » Improve labour flexibility, faster and simplified clearance and approvals (e.g. land acquisition, environment clearance)	**Capital** » Ease capital constraint by relaxation of FDI limits and increase in credit availability

Many recommendations have been made in the past about reviving manufacturing growth and government has already taken action in right direction. Indian government should continue fixing the building blocks by accelerating the infrastructure execution, improving ease of doing business through structural reforms and increasing capital availability. It is critical to keep a steady focus on gaining global competitiveness by building global scale, developing world-class clusters and easing trade barriers to improve export competitiveness. To ensure sustainable competitive advantage, policy makers also need to promote development of capabilities by accelerating technology transfer, promoting innovation and improving workforce skill base.

Technology adoption: Government agenda to promote and enhance competitiveness



India as global top 3 manufacturing economy

- Annual labour productivity growth of 5% for next 10 years leveraging technology
- Technological readiness rank (WEF competitiveness index): 120 (2016) ⇒ 30 (2025)

Build world class digital infrastructure	Improve support system	Education reform to train future workforce
• Develop high bandwidth network for smart factories	• Develop Industry 4.0 Innovation Center to support technology adoption • Allocate part of 10,000 Cr startup India fund for Industry 4.0 startups	• Overhaul education system to impart skills required for future jobs

- Productivity linked incentives such as tax breaks, capex subsidies
- Exemption of import duties on Industry 4.0 related technologies
- Reward companies leading in Industry 4.0 maturity index

Proactive adoption of Industry 4.0 can take India to the league of top manufacturing countries. We need to sustain a bold vision of becoming a top 3 manufacturer. To realize the existing target of 10% annual growth in manufacturing, India needs to consistently improve labour productivity by 5% every year. To realize these ambitious goals, the government needs to build world class digital infrastructure and carry out education reforms required to make the Indian workforce future ready. CII–BCG leadership survey reveals that industry leaders expect the government to play a role in increasing awareness about Industry 4.0. This can be achieved by developing a dedicated Industry 4.0 innovation centers that will also support the SME sectors in the adoption process. Development of low cost indigenous solutions can be accelerated by allocating part of startup India funds for Industry 4.0 startups.

As other developed and developing countries provide productivity linked incentives to local SMEs, India also needs to create a level playing field by matching such incentives and additionally promoting import duty and tax breaks for companies that adopt these technologies to enhance competitiveness.

Source: World Economic Forum.

Technology adoption: CEOs need to challenge status quo and develop an adoption strategy

CEOs to own and drive the Industry 4.0 transformation

- Assess status quo with respect to existing technological changes, competitor's positioning and existing capabilities
- Set ambition level for company to achieve across 4 categories–Productivity, Quality, Speed and Flexibility
- Drive the transformation journey

Develop strategic roadmap to fill the capability gap

- Invest in developing and acquiring talent equipped with future-ready skills
- Develop a culture of innovation, experimentation, collaboration and continuous improvement
- Evaluate M&A as potential option to fill key capability gap

Re-engineer value chain and re-imagine offerings, starting from high impact use cases

- Generate quick wins by implementing limited use cases with proven impact
- Proactively invest in long-term initiatives that will create sustainable competitive advantage.
- Manage data as a valuable strategic asset

The CEO's role is central in any technology adoption journey. It is the CEO's responsibility to challenge the status quo of all key processes, and set a bold vision for competitiveness through technology adoption. A change of this kind is always driven from the top, with the CEO chairing the steering committee meetings. An often missed area in such journeys, is that of people. Having technologically capable mid-managers and key front-line staff is critical to ensuring a successful transformation but is not always easy to do. It is important to define the capability gap and draw out a clear roadmap to plug key gaps–through a mix of training/hiring levers. In driving the detailed transformation agenda, it is prudent to carry out a diagnostic that identifies the key processes across the organization that are conducive to step-improvement through technology-adoption. And, having done so, it is always helpful to drive a mix of 'quick wins' and a set of long-term initiatives that could involve higher investment and experimentation. A balanced approach such as this, ensures early momentum while retaining the focus on big-ticket items.

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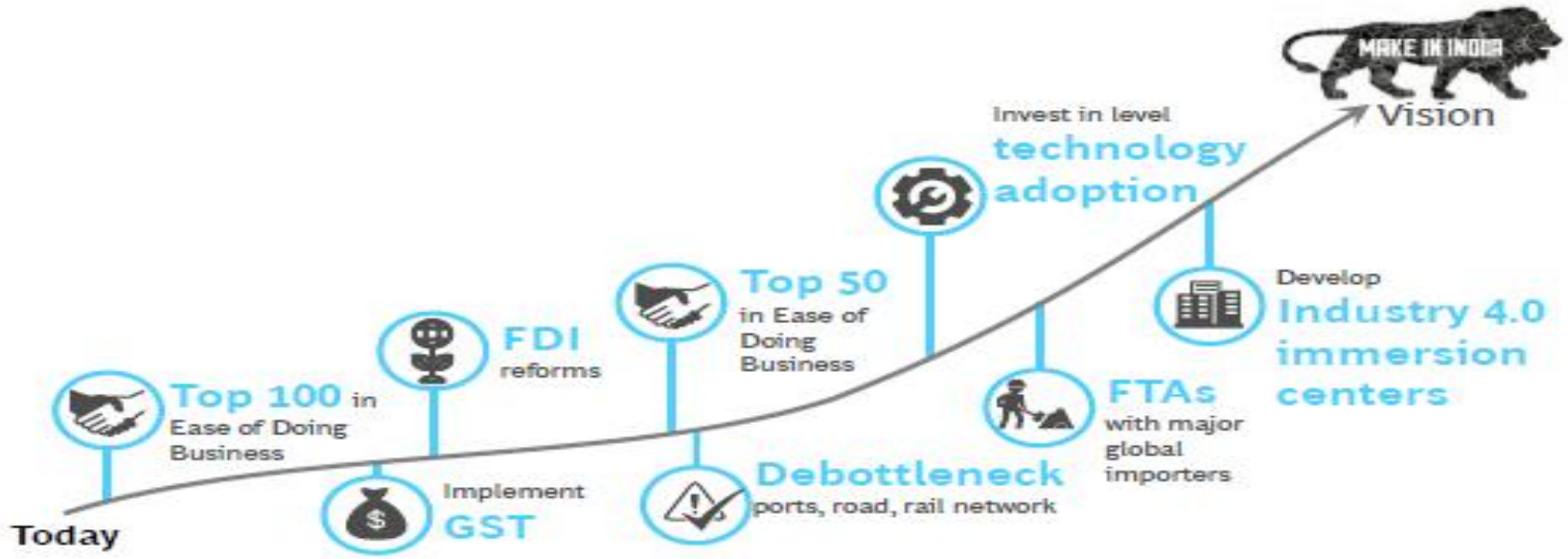
Make-in-India: The need for concerted multi-pronged action agenda to realize vision



Indian manufacturing sector is at a cusp of a new dawn. Many factors such as government-led structural reforms, infrastructure growth, increasing foreign investment, and increasing domestic demand have potential to create a long-term growth momentum for Indian manufacturing. To maintain growth momentum, government needs to accelerate the pace of infrastructure development, policy reforms and trade agreement negotiations. Indian manufacturers also need to aggressively adopt advanced technologies to transform themselves into globally competitive manufacturers. To achieve ambitious targets set as part of Make-in-India initiative, manufacturing sector needs to grow by double digits and we have more favorable factors than any other time in recent history. The time has come for India to transform itself into a manufacturing powerhouse.

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Thank You!

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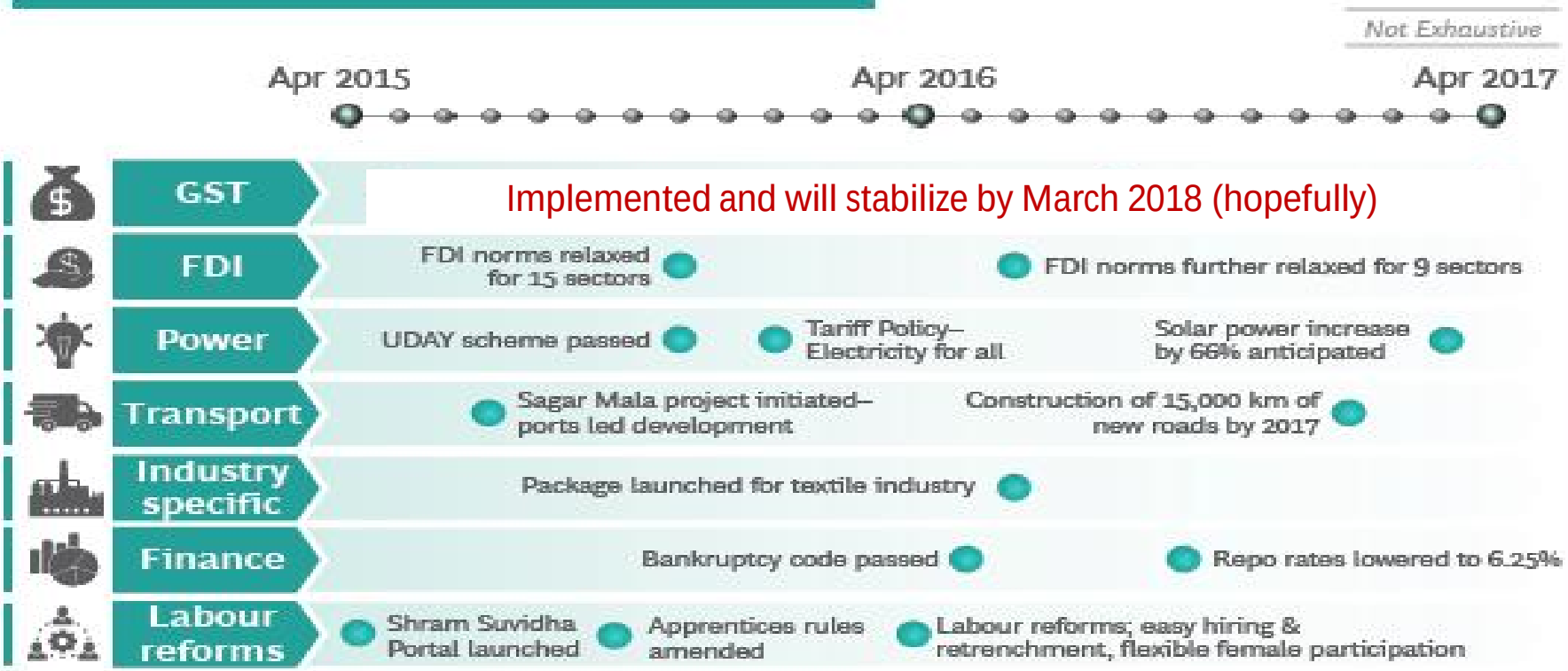
"Make in India": Government initiatives in place to drive manufacturing growth



Although the recent rate of growth has been a concern, the long term business environment is improving. Make in India has been more than just a buzzword. The government has made good on its commitments to drive the manufacturing sector by introducing a set of initiatives to improve manufacturing performance. Infrastructure, policy and taxation efforts across have resulted in landmark reforms.

Source: Press articles.

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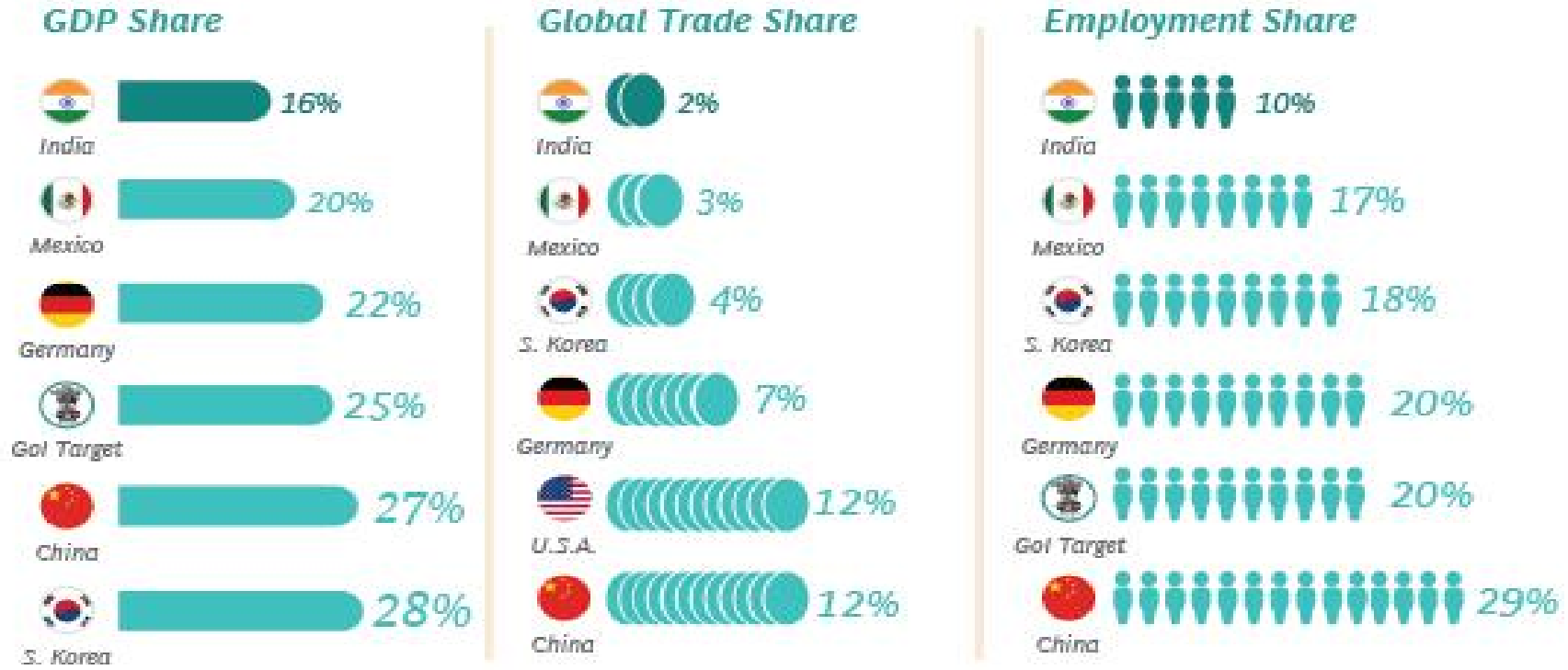
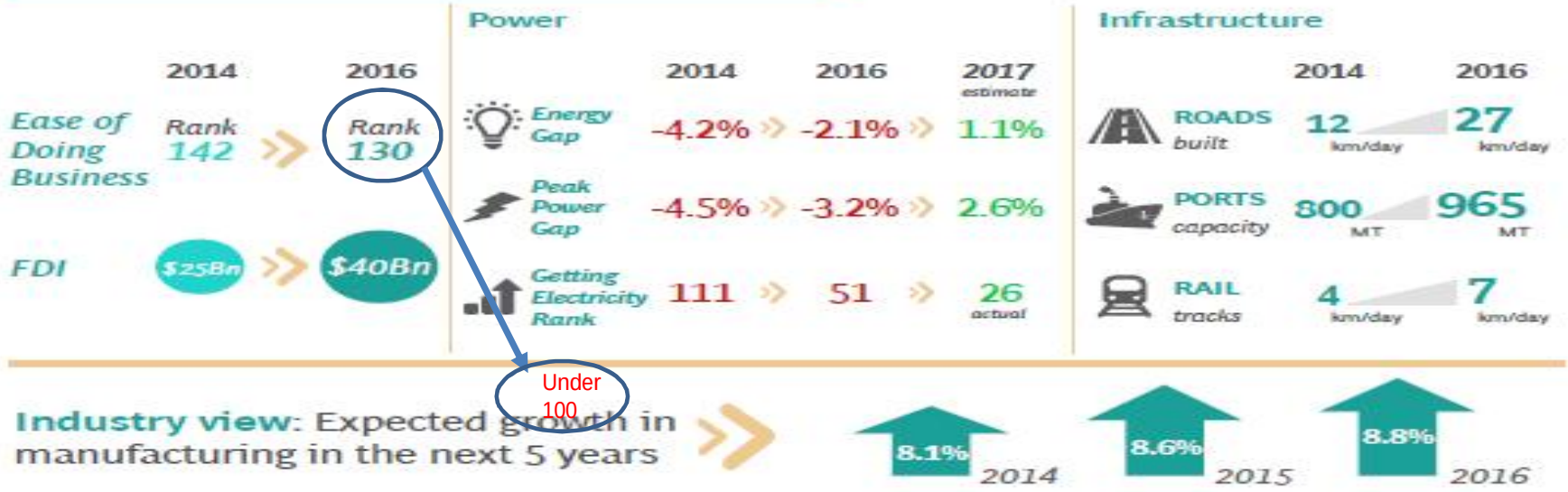
There is significant untapped potential for Indian manufacturing



While historical growth has been impressive, benchmarks indicate an even greater potential ahead. Many government initiatives have targeted a 25% GDP share; China's manufacturing sector is already at 27%. Covering only 2% of global trade and 10% of formal employment, India's manufacturing holds enough potential to drive a new era of inclusive economic growth for the country.

Source: Euromonitor; WTO; World Bank; Government of India; BCG Analysis.

Results visible along with increased optimism in the industry



The results are visible. Ease of doing business rankings, power availability, infrastructure, and FDI inflows have all seen significant improvement over the past 2 years. The impact is also evident on the mood and optimism of the industry with key industrial leaders today having higher growth expectations. While this is a good start, how this optimism translates into growth on ground remains to be seen. It will require continued efforts from both industry stalwarts and policymakers alike in order to reverse the current trend.

Source: World Bank; Ministry of Power; Ministry of Road Transport & Highways; Ministry of shipping; Department of Industrial Policy & Promotion; CII–BCG Manufacturing Leadership Survey.

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WE ARE NOT SHOWING ENOUGH FLEXIBILITY TO THIS NEW REVOLUTION. NOT ONLY MSME, EVEN LARGE MANUFACTURING INDSUTRIES ARE NOT SHOWING THE DESIRED AGILITY

Two structural shifts shaping global manufacturing

While the Indian manufacturing sector is steadily growing, it is equally important to keep an eye out for global shifts. Two such shifts are outlined in the next few chapters –

- Rise of other manufacturing economies: the global manufacturing superstars
- Technological changes: The Fourth Industrial Revolution also known as Industry 4.0

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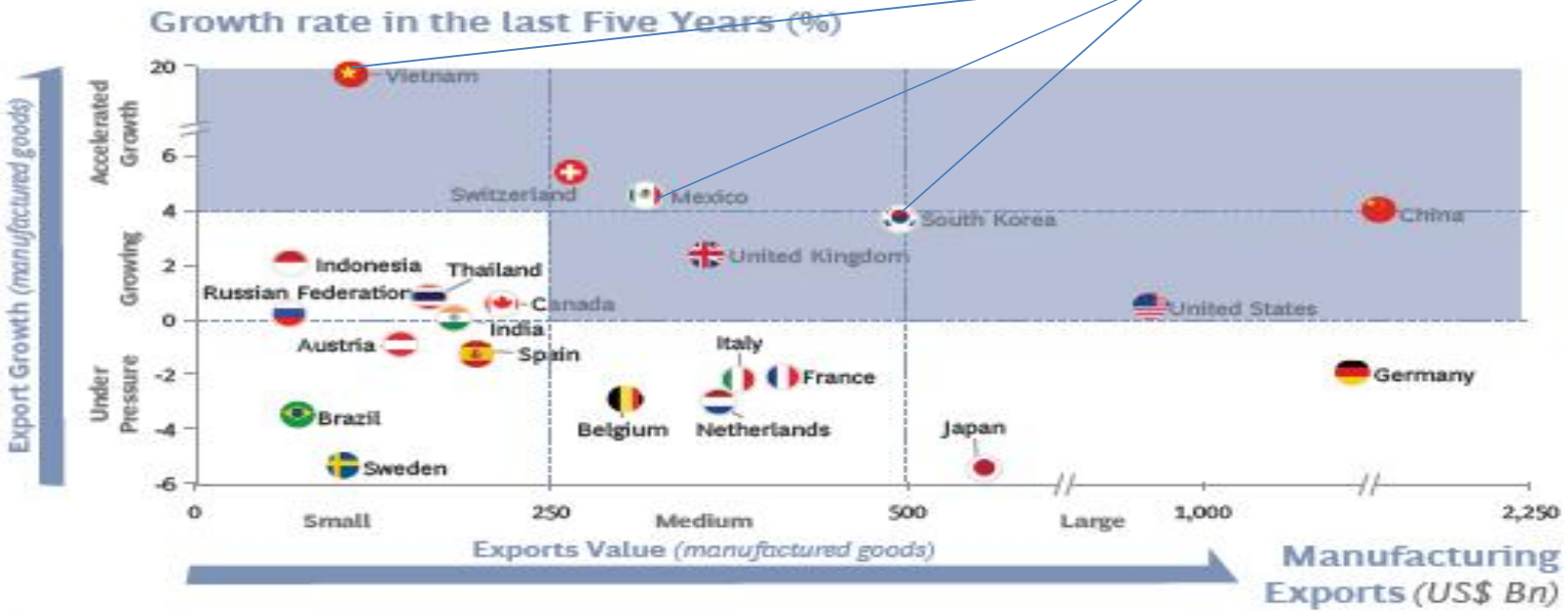
GLOBAL SUPERSTARS : MEXICO & VIETNAM ARE SHOWING THEIR WAY AND INDIA MUST LEARN LESSONS

Seven manufacturing superstars have shown growth in exports over the past five years

CASE STUDIES WORTH EXPLORING



In a period where the world trade in manufactured goods has been on the decline, there are several countries that have still managed to consistently increase their exports. As we evaluate the ways in which India can boost its manufacturing sector and progress towards its 'Make-in-India' targets, it is worthwhile to learn from these manufacturing superstars. These superstars consist of six large manufacturing economies (above $250Bn of export) that have shown positive export growth in the past five years. They are Switzerland, Mexico, United Kingdom, South Korea, United States of America and China. An addition to this list is Vietnam with its extraordinary 20% growth.

Source: World bank; World Development Indicators data; BCG Analysis.

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Mexico: Building on location advantage

Electricity (c$/KWh)	4	▲45%	7.33
Labour ($/h, productivity adjusted)	20	▲45%	37
Peso vs USD depreciation	2004: 11.3	▼29%	2015: 15.9

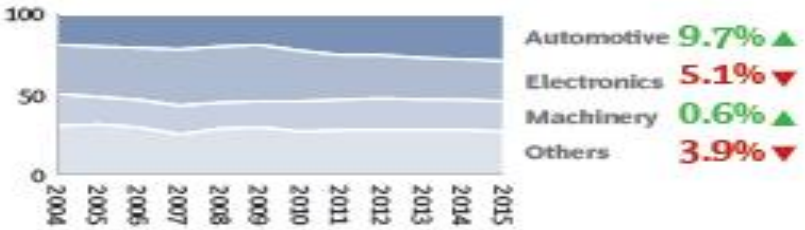
1 USD vs Peso

0% Duty on Mexican goods in USA

44 Free Trade Access to developed markets including USA, EU, Canada

% Share of exports

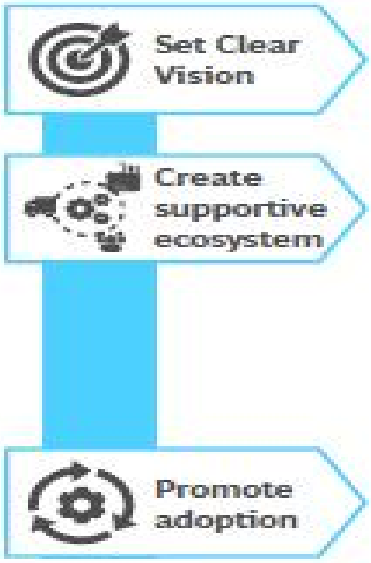
% Share of exports



Mexico's proximity to the USA, the world's largest consumer market, is the cornerstone of its early success. Taking advantage of its low labour costs, Mexico targeted the US market and inked free access to the United States with a Free Trade Agreement(FTA) in 1994. The maturing of this agreement (phasing out of trade barriers) led to export growth in the ensuing decade. While the USA still gets the largest share of exports, Mexico has diversified by increasing exports of automotive and machinery to other countries. The government has continued to focus on manufacturing exports, establishing FTAs with 44 countries, the highest in the world. With continued labour cost advantages, depreciating currency and falling energy costs due to shale gas, Mexico is one of the cheapest manufacturing destinations in the western world. Skilled and hardworking labour force coupled with free access to most developed markets makes Mexico a very attractive destination to set up manufacturing units.

Source: Saner; EIU; BCG Analysis.
Note: Though not all sectors have duty free access through NAFTA, duties and tariffs have been phased out by 2009 for select sectors (e.g. Auto).

Technology adoption: Government agenda to promote and enhance competitiveness



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Example: Collaborative robots (cobots) can automate high precision labour-intensive tasks

Universal Robot's cobots assisting women factory workers

110+ *Cobots operating on assembly line*

7 *Processes automated by cobots*

<24 months *Payback period*

Traditional robots were designed to perform specialized tasks and operate from a cage. They require significant upfront capital and skilled staff for programming. The rise of collaborative robots, also called Cobots, are changing the game. They can work safely with humans, are easy to deploy and cost fraction of the traditional robot's cost. Today a cobot can be purchased at a cost of mid-size sedan, requires no annual maintenance contract and have payback within 24 months, even at Indian salaries. Bajaj Auto, world's 3rd largest two wheeler manufacturer, has been an early adopter of cobots made by Universal Robots. Bajaj has automated physically taxing processes that require high-end precision and today 110+ cobots operate with workers to provide flexibility, reliability and productivity gains. For Indian SMEs, capital expense and operating expense are of major concerns for adoption of any technology. Availability lower cost, versatile cobots can accelerate automation among SMEs as well.

Source: Industry interview

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Industry characteristics to drive adoption

Industry characteristics	Industry 4.0 levers
Precision & Quality	Self-optimization
Share of manual activities in production	Flexible manufacturing
Setup times & product variance	
Complexity (number of parts, number of SKUs)	Autonomous logistics
Logistics Complexity	
On-demand configuration	Integrated work-flows
Need for integrated supplier management	
Product complexity: material, form, technology	Virtual design
Speed of new product development cycle	
Supplier-aided smart design	

CII–BCG Manufacturing survey:
Top 3 sectors with Industry 4.0 potential

- Automobile and transport equipment
- Electrical and electronics machinery
- Medical, optical and precision equipments

CII–BCG Manufacturing survey:
Sectors with least Industry 4.0 potential

- Metal products
- Metals and mining
- Non-metallic products

Industry characteristics are expected to drive the adoption of Industry 4.0 technologies. Impact of any Industry 4.0 lever varies by sector given their unique characteristics. Industry characteristics may differ across geographies due to regulation, customer needs, labour intensity, etc. The results of CII–BCG Manufacturing survey reveal that Indian manufacturers are most optimistic of Industry 4.0 impact on auto, electrical & electronic machinery and precision equipment sectors, while metal and non-metallic products are expected to be least impacted.

Source: CII–BCG Manufacturing Leadership survey 2016.

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India needs to reinforce the sector's foundation and leverage Industry 4.0 to improve competitiveness

As Indian manufacturing shifts gear to catch-up with manufacturing superstars, action is required on two fronts. First, policy makers need to continue reinforcing the foundation by delivering on Make-in-India objectives. This will allow Indian manufacturers to effectively compete in global markets by removing inefficiencies and fully leveraging our competitive advantages. Second, with the fourth industrial revolution unfolding, Indian manufacturers need to proactively start adopting Industry 4.0 technologies. Here, government can play a key role in promoting Industry 4.0 by increasing awareness, providing incentives and building the necessary ecosystem.

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Core performance impacted across all production elements

Overall, these technologies have transformed value chains into more flexible (through programmable machines and robots), more efficient (through higher automation and shorter set up times), higher quality (through real time monitoring using sensors and actuators) and quicker to market (using data and simulation based modeling systems). Beyond these core benefits, manufacturing conditions are also improving with greater workforce safety, better working conditions, increased collaboration opportunities across production cells with greater data availability and increased resource utilization. The result has been a better environment for production.

Example: Autonomous robots in assembly lines

Cobot (collaborative robot) designed to co-work with humans

Trained through demonstration rather than programming

Low cost $22,000
Can replace
$15~$20 / hour
jobs for <$ 3/ hour

Continuously improving through remote software upgrades

Shop floors across the world, especially in developed economies like the USA, Germany and South Korea are already seeing this transformation. For example, autonomous robots like Baxter by Rethink Robotics are configurable, designed to work safely with humans and are highly adaptive. Tasks such as packing, loading and handling that were not possible with traditional robots are now coming into the ambit of automation. With costs as low as $22,000, payback for such automation is now in months rather than in years. This particular technology is already being used by firms in North America, including small enterprises with less than 20 employees, to compete effectively with China and Mexico.

Source: Press article search.

Example: Warehouse guidance systems using augmented reality

Images are representative

Augmented Reality (AR) is another technology that is transforming manufacturing and warehousing operations. An example is the DHL warehouse where AR glasses show operators the exact location and quantity for the next pickup, provide indoor navigation and also scan barcodes to report pickup and drop operations. Estimates suggest a ~2% cost reduction in the steady state due to a reduction in human errors, lower training costs, increased productivity, plus an increased speed of freight loading.

Beyond warehousing, AR has found applications in hands-on training, real-time operator guidance during manufacturing, and guiding repairs on complex machinery. The use of augmented reality empowers low skilled workers to execute tasks that typically require higher skilled workers.

Source: Press article search.

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Example: Lot size of one in semi-automated production

Auto-adjusting working station as per product requirements and workstation capabilities

RFID tagged products with the information on which tasks have to be carried out

Self adapting workstation to worker's height and ergonomic needs, skills, language and instruction requirements

Visual board to collect, filter and visualize production data, highlight potential problems, auto-alert function

Semi-automated production for making 200 variations of six basic models with **30%** decrease in production time

Another example is of the German auto component manufacturer Bosch which has managed to achieve flexible production with a lot size of one. This is done through the use of RFID codes on components, smart workstations and real time instruction to workers through work screens. With no set up times and machine guided real-time assembly, production time has seen up to a 30% decrease. Errors are also minimized. The ability to handle complexity has multiplied with little to no scale disadvantage. Traditional cost-complexity tradeoffs are being made irrelevant, ultimately leading to higher line utilization and lower costs.

Source: Press article search.

Example: Use of 3D printers to increase flexibility, speed and cost competitiveness

GE acquired 2 companies with advanced 3D printing capabilities to fill capability gap in 3D printing

400+ 3D printers in use with plans to add 1,000 more in next decade

On-demand production to replace conventional safety stock inventory and warehouse network

Plan to expand use to manufacture 100,000 components by 2020

Images are representative

High precision part created by additive manufacturing

GE has realized benefits from using additive manufacturing for jet engine components. With the acquisition of two European companies for $1.4 Bn, capability gaps in additive manufacturing were filled. Now instead of large warehouse networks and inventories of huge components, the company is producing components on demand close to the consumption center. Beyond the inventory and logistics cost advantages, more complex designs are leading to lower weights, reduced wastage and greater speed.
With more than 400 3D printers already in use, plans are in place to produce over 100,000 components through additive manufacturing by 2020.

Source: Press article search.

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Example: Multiple technologies are coming together to challenge status quo in auto manufacturing

Images are representative

Simulations and Big Data

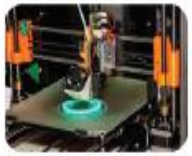
Simulations for crash testing reducing need for physical tests

Autonomous Robots

1,000+ robots including 160 specialist robots

Additive Manufacturing

Additive manufacturing for rapid prototyping and low cost components



Tesla, the twelve year old electric auto manufacturer, is competing aggressively with the century old auto giants and gaining ground too. Since the early days, Tesla has relied on heavy use of technology in its product development and production processes to keep costs low, improve speed to market while maintaining high quality. They have revolutionized auto manufacturing with greater use of simulations to cut down on development times and use of physical crashing models, use of additive manufacturing to create low cost components in-house, and high use of automation in its factories. Extensive use of technology allows Tesla to have better margins (24% gross margin versus 17% for GM) and better quality reflected in its #1 ranking for customer satisfaction.

Source: Press article search.

Structural shifts will change sector dynamics

Re-shoring of manufacturing closer to consumption centers

'Servicification' of manufacturing

Shift in skills of labour force

The last three decades saw the emergence of global supply chains as large pools of low cost labour in developing countries took to factory floors. However the fourth manufacturing revolution could fundamentally alter this trend.

As trade-off between labour and automation swings in the favour of the latter, manufacturing is returning to highly automated factories in developed countries. Small scale plants closer to the market are becoming more competitive than large off-shore plants. Digital technologies are driving consistent growth in labour productivity of developed nations, reducing competitiveness gap with emerging countries facing wage inflation.

The CEO of a leading manufacturing conglomerate quotes frequently that "Every Company Has to be a Service Company". The servicification of manufacturing is rapidly evolving as manufacturers disrupt their business model to capture shifting value pools. For example, GE has transformed itself from manufacturer to service provider, with digital revenues crossing $15Bn this year.

Rise of digital trading platform, digital supply chain and global services will fundamentally enhance the skills expected of the worker. Even the traditional manufacturer will need talent with new skills such as data scientist, robot supervisor and virtual reality designer.

One in two respondents expects greater than 50% process automation in the next 10 years

Question: What percentage of your processes are currently automated and how much is expected to be automated in the next 5 and 10 years?

As the adoption of these technologies increases, the automation of manufacturing processes is also expected to steadily increase. While more than 60% of survey respondents have less than 20% of current processes automated, this number is expected to fall below 20% in 10 years time. At the same time, more than half of the respondents expect to have 50%+ of their processes automated. This trend shows that Indian manufacturers are actively thinking about investing in automation technologies and planning to catch up to their global peers.

Source: CII–BCG Manufacturing Leadership survey 2015.

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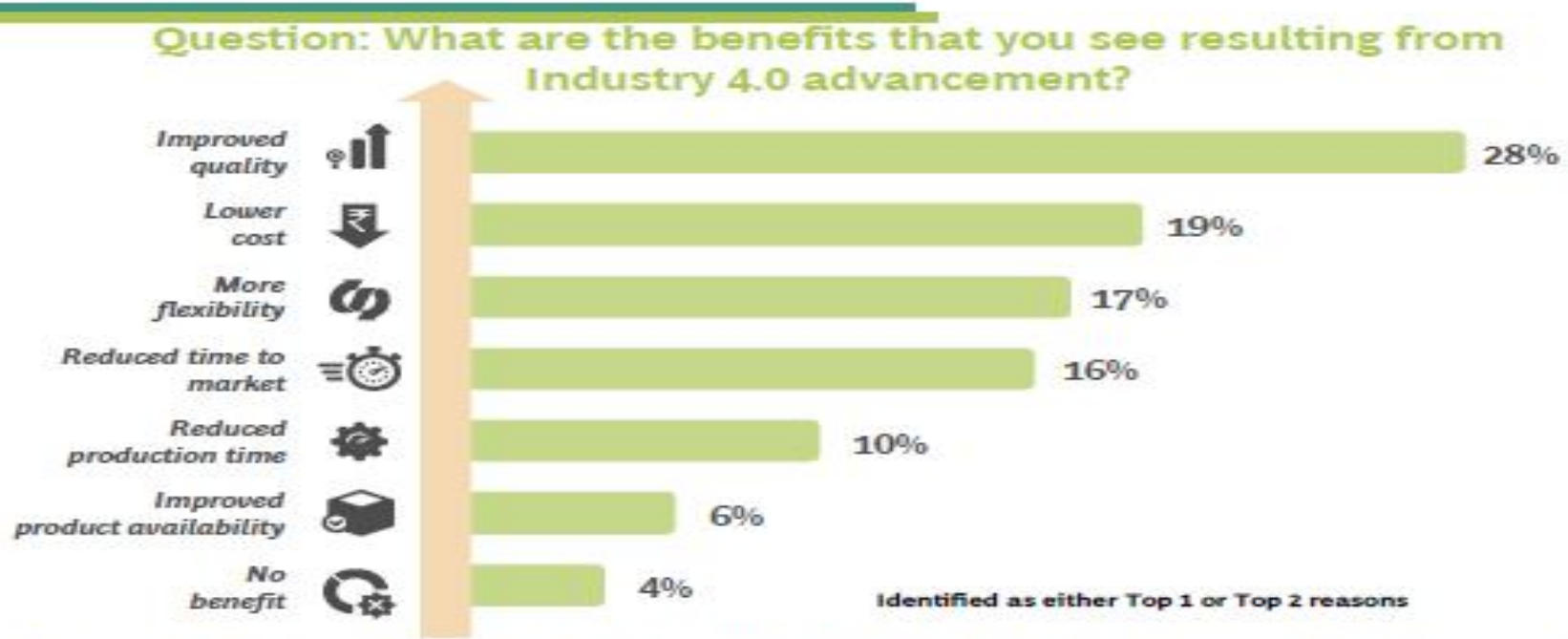
Quality improvement and cost reduction are primary objectives of adoption



Although cost and productivity have been the primary drivers of the accelerated adoption of Industry 4.0 in developed countries, quality is the most prominent benefit in India. Despite low labour costs, the availability of skilled and quality-conscious labour is a major pain point for Indian manufacturers. As Indian manufacturers move up in the value chain and aim to capture the export market, they need to fill quality gaps through automation and technology adoption. Cost, flexibility and reduced time to market are the second order benefits that Indian manufacturers target beyond quality.

Source: CII–BCG Manufacturing Leadership survey 2016.

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Example: Availability of low-cost IIoT solution is accelerating the adoption of Industry 4.0 in India

Device collecting data on legacy machines

Analytics engine providing real-time visibility of plant utilization

> "Altizon's solution was selected due to flexibility, scalability and low cost. Other solutions couldn't connect with our legacy machines"
>
> – Mr. Narinder Singh, *DGM , IT , Varroc*

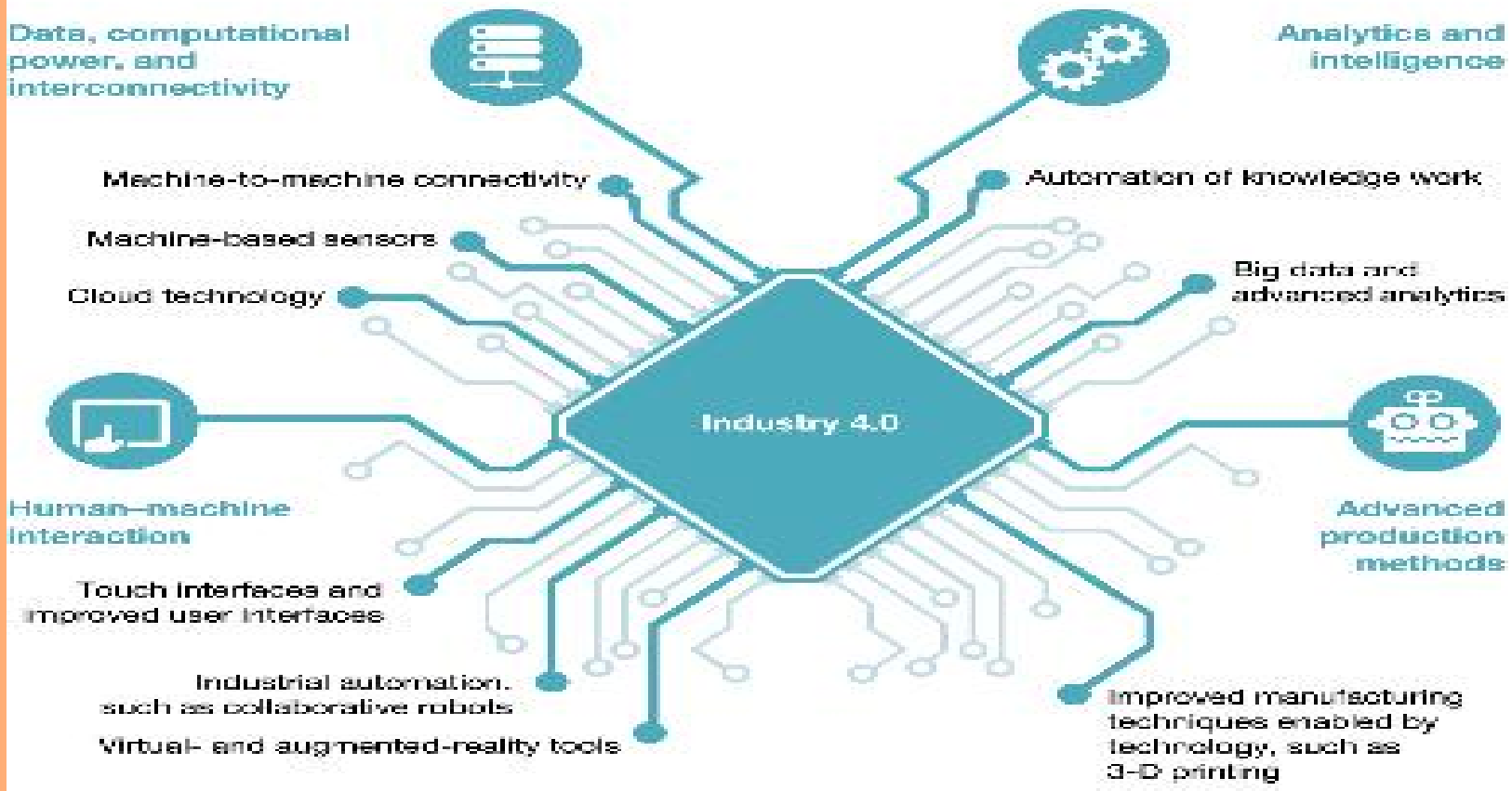
- Real-time monitoring and instant decisions enabled shop floor workers to take proactive decision
- Fast RoI
  - ~20% improvement in efficiency
  - 5% decrease in product defects
- Plan to implement solution in all 35 plants and develop algorithm for real-time decision making

So far the Industry 4.0 revolution has been led by western companies. Established industrial companies as well as startups have been dominating market share in these technologies. Most of their solutions are aimed at developed market, on the other hand Indian manufacturers operate in different operational environments–with lower labour costs, lower skilled labour, inconsistent digital infrastructure and a limited capacity to pay.

Varroc, an automotive component manufacturer with $1.3 billion revenue was looking for an effective, scalable solution to improve their competitiveness. After comparing various global solutions, Varroc decided to implement Altizon's IIoT platform as it met their diverse requirements better than competing solutions. Altizon's innovative system combined global functional benchmarks, competitive pricing, and flexibility to connect with legacy machines. Today, operational status of connected machines in Varroc's Uttarakhand plant are visible on the Datonis Platform within minutes. Rather than taking reactive measures on old data, supervisors on shop floors are empowered with real-time decision making, improving effectiveness and creating real impact on the bottom line.

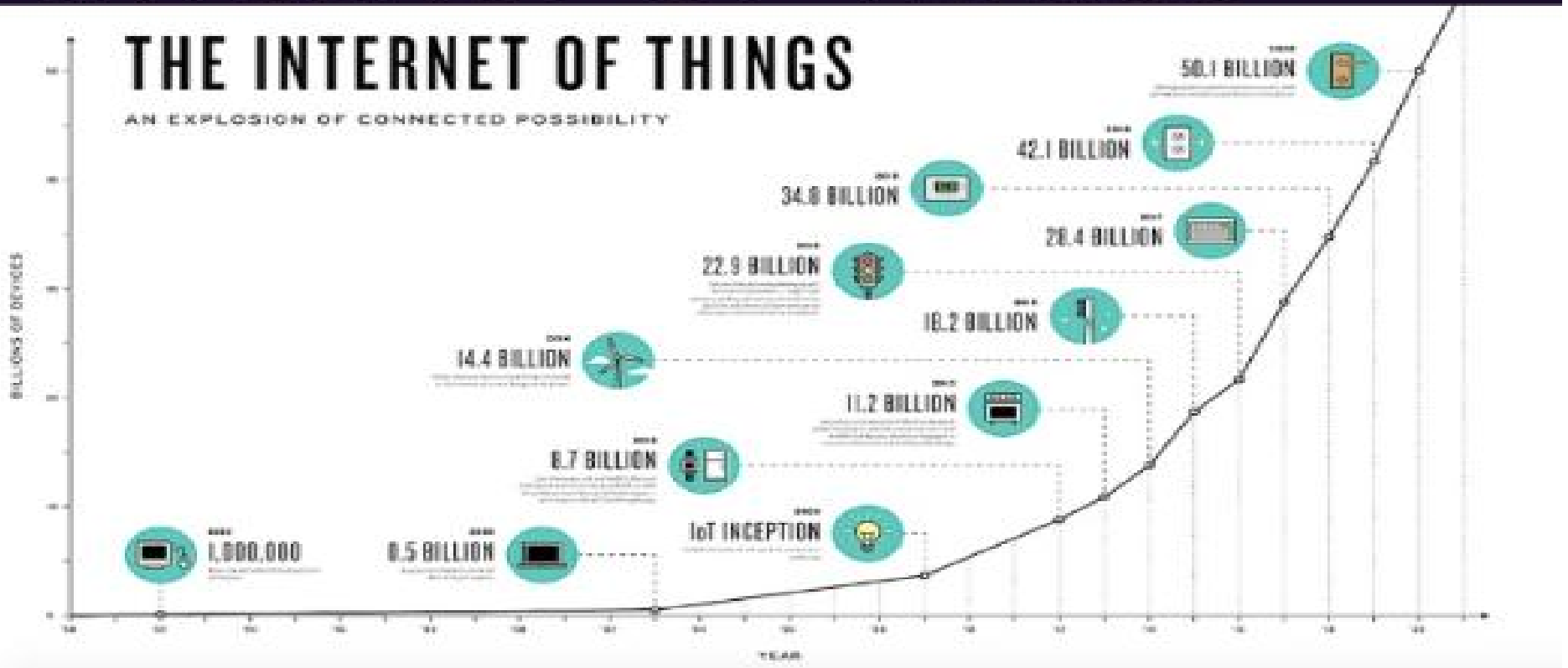
Source: Industry interview.

Industry 4.0 results from the emergence of four technologies that are disrupting the manufacturing sector.



McKinsey&Company

INTERNET OF THINGS



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Industry 4.0 necessary to hike manufacturing share in GDP: Experts

PTI | Updated: Jan 28, 2017, 02.08 PM IST

5 Comments

A+

Summarising the session, DIPP Secretary Ramesh Abhishek said that to adopt 'Industry 4.0', India Inc has to adopt best global practices of manufacturing and it also requires investments.

VISAKHAPATNAM: Indian industry can not shy away from adopting Industry 4.0 and the country needs to focus on using green technologies and best global practices to increase the share of manufacturing in GDP, experts say.

The government is aiming to increase the share of manufacturing to 25 per cent of GDP from the present 17 per cent, with a view to creating millions of jobs and pushing the country's economic growth.

"To achieve this target, Indian industry has to adopt Industry 4.0 as it is important to boost manufacturing," Hospira Healthcare Managing Director Srini Srinivasan said, adding that

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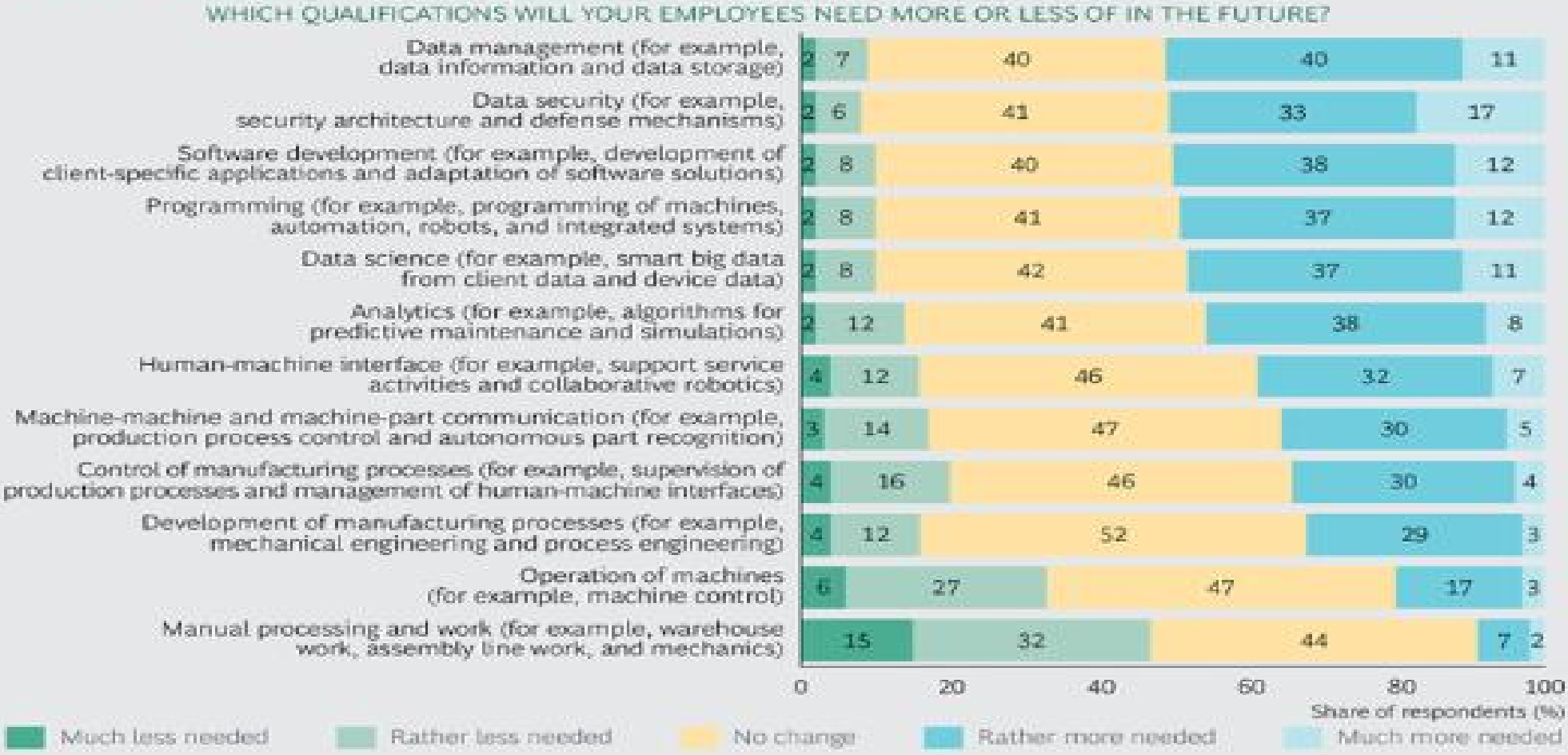
EXHIBIT 3 | Data and Software Skills Are Top Priorities



Source: BCG online survey of 312 German companies and 315 US companies, March 2016.
Note: Because of rounding, not all percentages add up to 100.

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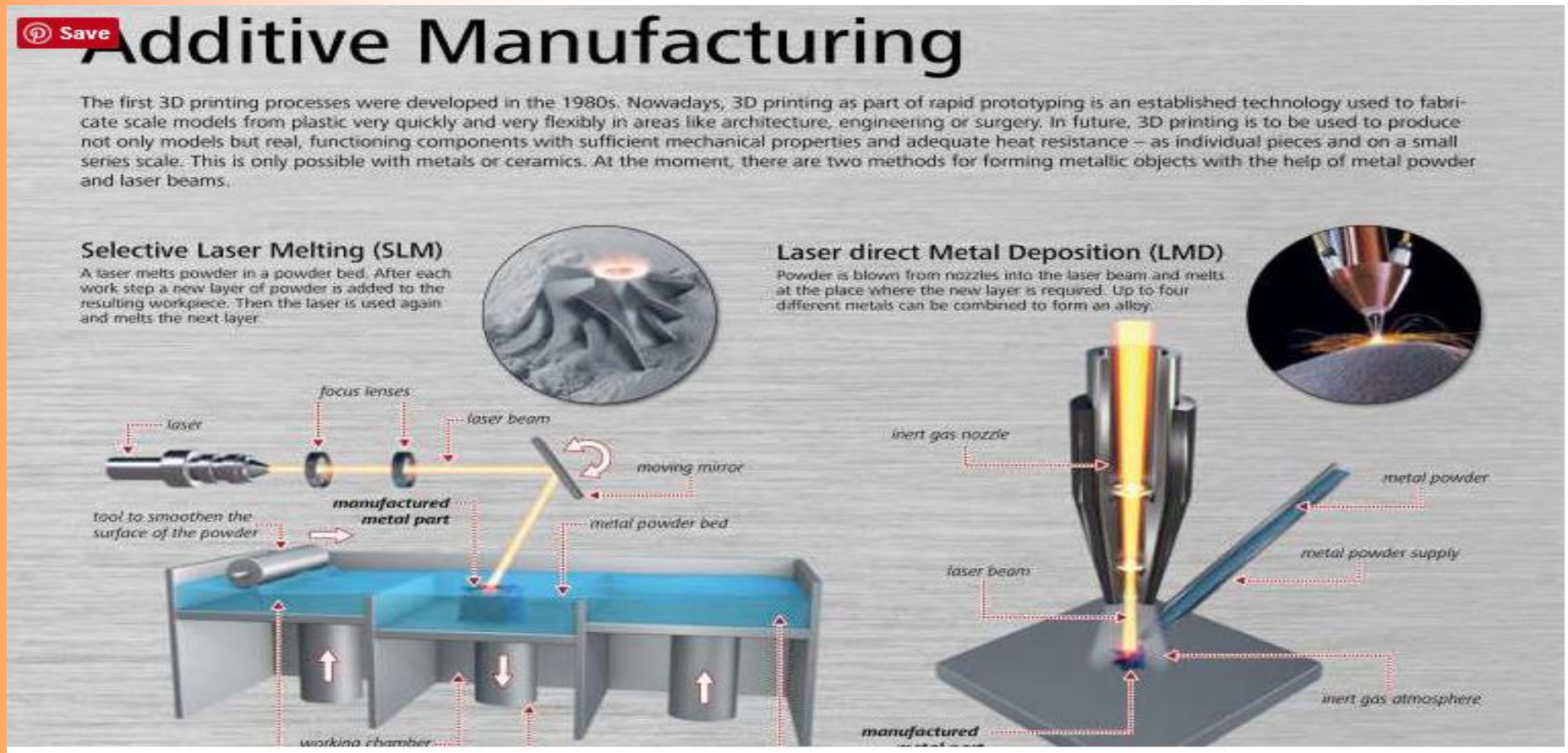

nfo graphics—Additive Manufacturing. Credit: Empa

For the fourth industrial revolution, the technique used for 3D printing will have to go one step further: from rapid prototypir Advanced Manufacturing, the production of lasting and functional components with defined mechanical and thermal prope products made from metals or ceramics.

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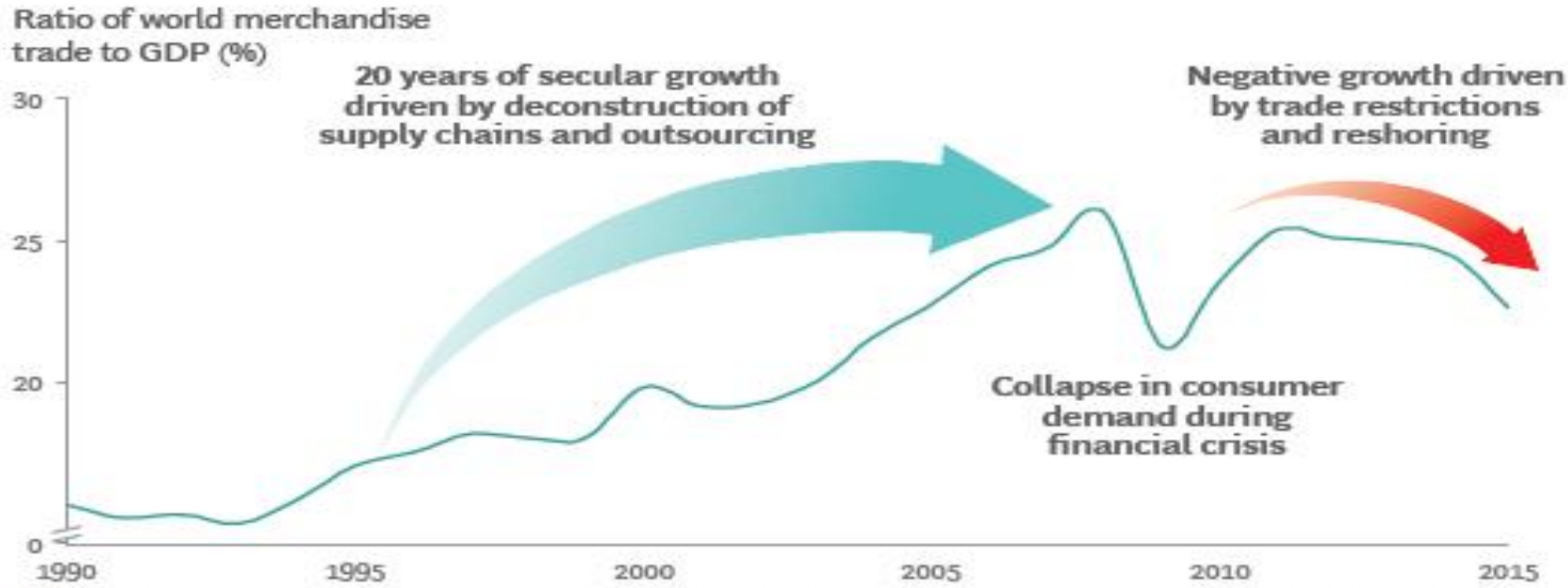
The slowdown in global trade is exerting pressure on manufacturing economies



The global manufacturing sector is likely to face obstacles over the next few years. Economies seem to be getting increasingly isolated and the gains from globalization seem to be reversing. Many developed countries have started implementing restrictive trade policies, including the US with their 200%+ anti-dumping duty against steel from China, and 90%+ from other countries. Political developments such as Brexit is another sign of de-globalization. Countries with strong local markets, including India, will likely continue to do well, while export-oriented manufacturers could face challenges.

Source: World Trade Organization.
Note: Merchandise trade to GDP ratio is estimated as merchandise trade (average of exports and imports values) divided by GDP, measured in nominal dollar terms at market exchange rates.

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India's recent manufacturing performance has been below par

Manufacturing production growth
year-on-year change (%)

The last 12 months have been quite poor for the Indian manufacturing sector. After starting off well in the first half of FY16 and peaking in October 2015 with an output growth of ~10%, the sector has seen a decline. The maximum growth since October last year has been only 2% with 7 out of 11 months showing a negative y-o-y growth.

Source: Ministry of Statistics & Program Implementation; Government of India.

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THERE IS SOME GOOD NEWS

The Indian manufacturing sector has performed well over the long term

The Indian manufacturing sector is a perfect example of a reliable, steady workhorse. The sector has shown steady results with a Compounded Annual Growth Rate (CAGR) of 13% (in nominal terms) over 25+ years. In the process, it has grown faster than most other economies, with 1 rupee of output in 1990 increasing to 21 rupees today. The only notable exceptions are the Chinese manufacturing and Indian service sectors.

Source: Euromonitor; World Bank.

Slowdown in the capital goods has been most concerning

	Basic Goods	Consumer Goods	Intermediate Goods	Capital Goods
	Petroleum fuel, Cement, Basic metals etc.	*Electronic products, Passenger cars, Two wheelers, Apparel, Processed food products etc.*	*Metal products, Cotton yarn, Plywood etc.*	*Commercial vehicles, Light and heavy machineries etc.*
FY12-15	▲ 4%	▬ 0%	▲ 2%	▼ 2%
FY16	▲ 4%	▲ 3%	▲ 3%	▼ 3%
FY17 (Apr-Aug)	▲ 4%	▲ 1%	▲ 4%	▼ 21%

While the overall performance has been poor, what could hurt manufacturing most overtime is the contraction in capital goods. Capital goods, an indicator of economic investment has de-grown by over 20% so far this year. Over 40% of demand in capital goods was fulfilled through imports, while capacity utilization across sectors was only 60-70%. While private consumption in the capital goods sector saw an even sharper fall, public sector and government demand provided much needed respite through investments in the infrastructure sectors of power, rail, oil & gas, and roads.

Source: Ministry of Statistics & Program Implementation; Government of India.