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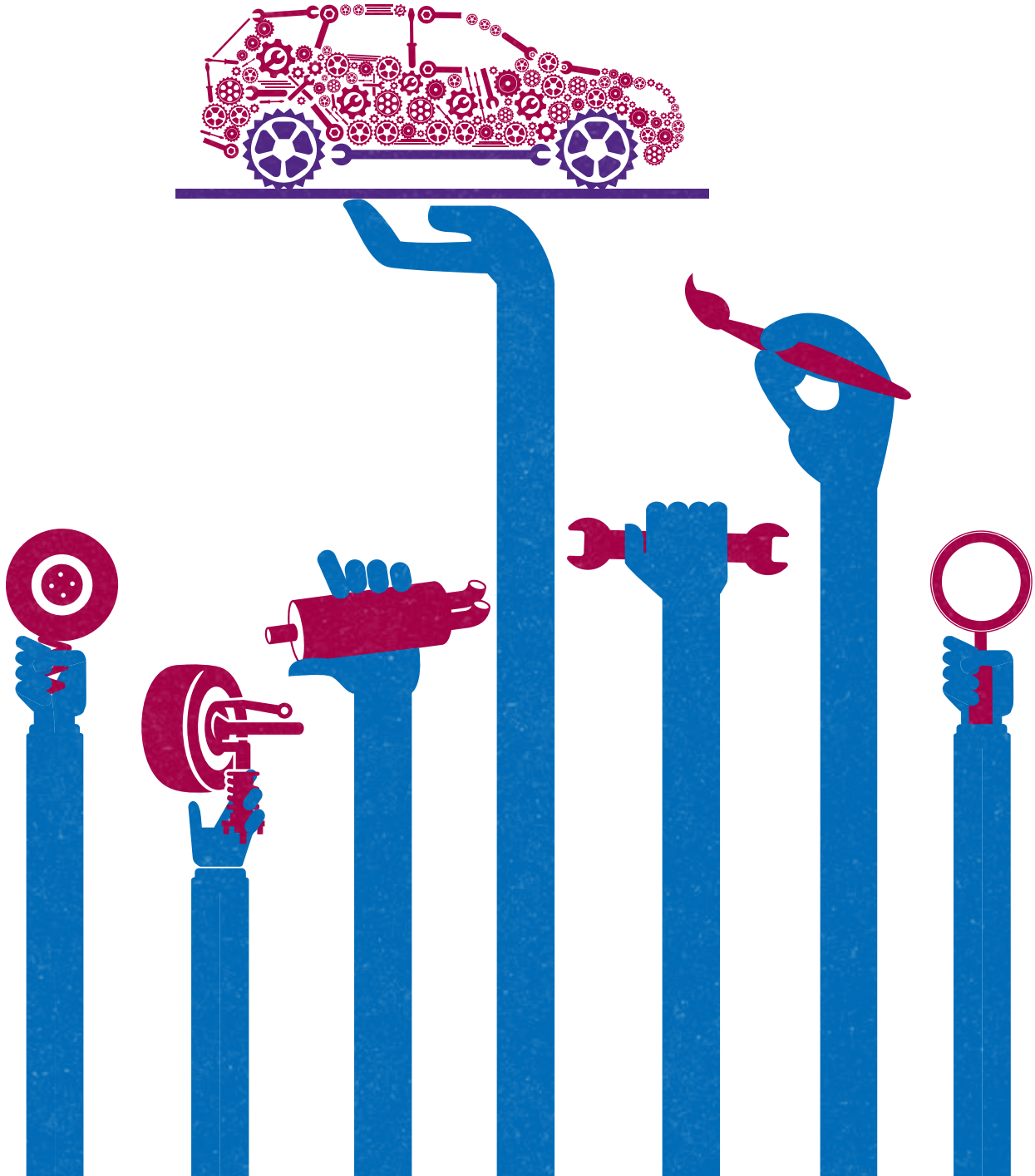
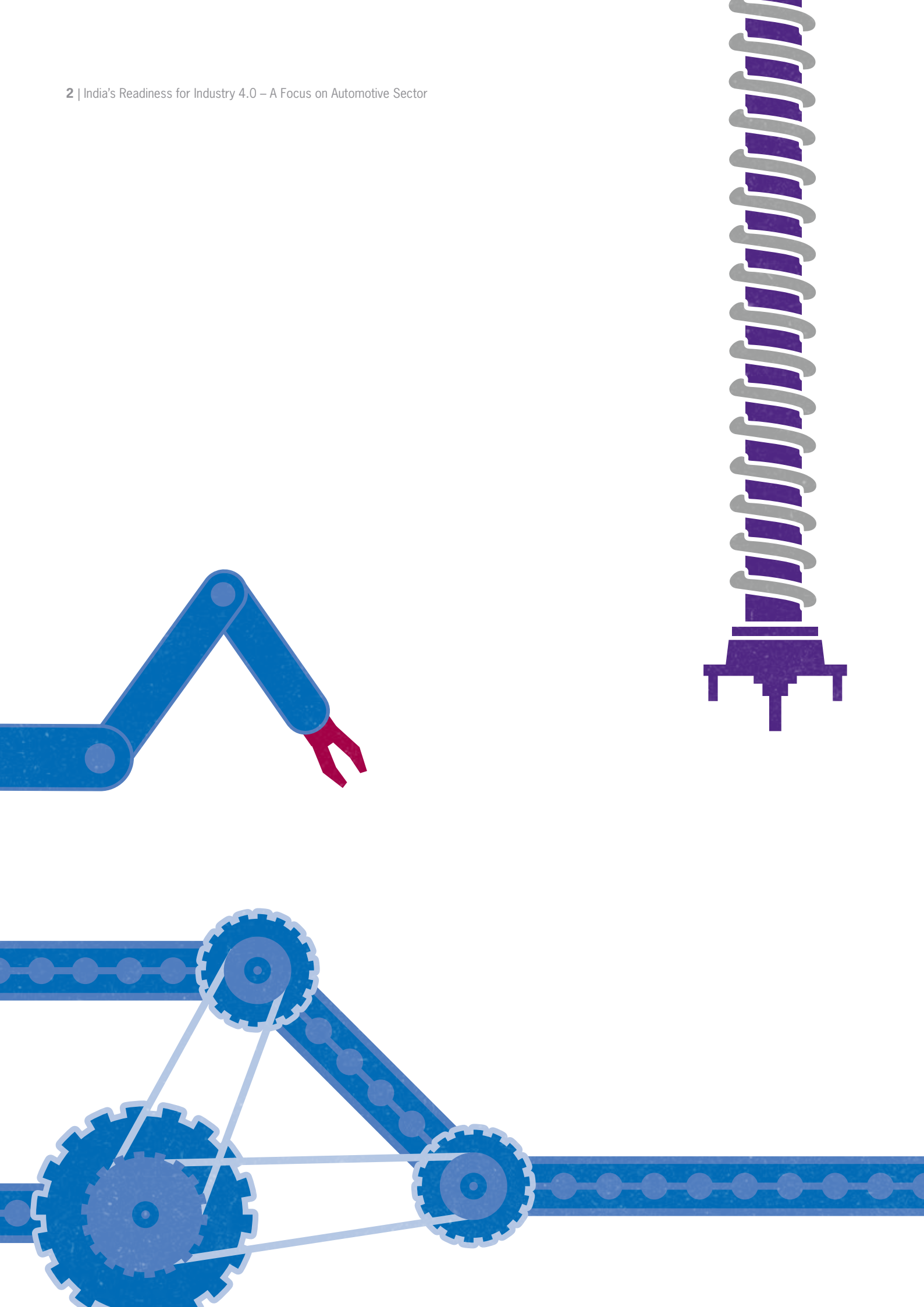
Confederation of Indian Industry

India's Readiness for Industry 4.0

A Focus on Automotive Sector





Foreword

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The complete manufacturing ecosystem is undergoing a phenomenal shift with technological advancements happening at a fast pace. The need to understand and adopt the advanced manufacturing techniques is the need of hour. In current times, Industry 4.0 is talked about at various levels. Automotive sector being the key driver for many technological advances, is now looking and exploring the ways to understand and internalise the same.

The Government of India's push to manufacturing through the "Make in India" initiative has garnered considerable attention from the industry and brought the spotlight back on the manufacturing sector. It is now formulating a National Policy for Advanced Manufacturing, which would be one of the key tools to attain its objective of increasing the contribution of manufacturing output. Consideration is being given to the framework for introduction of 'Industry 4.0'. There will be tremendous impetus towards modern manufacturing including advanced materials, advanced robotics and 3D printing, among others.

Industry 4.0 has many facets to it including the upcoming trend of automation and data exchange in manufacturing technologies, cyber-physical systems, the Internet of things, cloud computing and lot more. It creates what has been called a "smart factory". In smart factories, machinery, storage systems and production are capable of carrying out complex tasks, exchanging information and giving instructions to each other, without the need for human involvement. There is a need of a platform where different stakeholders can discuss the related issues and see how it may be used to the advantage of Indian Industry. Knowledge and timely adoption of upcoming trends is the key for success in this ever changing and competitive environment.

This Conference will be an ideal platform where all stake holders from Industry can come on a common platform and attempt

- To explore how advanced manufacturing both technologies and techniques can become the key for enhancing productivity, reliability and business strategy and of course, reducing costs and improving profitability.
- To learn from the experience of the companies which have adopted Manufacturing 4.0.
- To have an in-depth understanding of various aspects of advanced manufacturing and work at implementation in their organisations

The discussions during the Conference are expected to help all concerned understand and see how this advanced concept can help the industry become more competitive.

The Indian automotive sector, given its potential contribution to GDP and employment, presents a significant opportunity to be one of the biggest growth drivers for the economy. We need to emerge as a "world-class automotive manufacturing hub". For this there is a concerted effort from the Government and the automotive industry to create an enabling ecosystem. The country's key strengths such as a large domestic consumption base, a cost competitive value chain (that includes low design, testing and validation costs, frugal engineering capabilities and low labor costs) and strategic geographical location would go a long way to develop the country as a world class automotive manufacturing base.

Preface

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World over, the new term - 'Industry 4.0' is fast gaining momentum. This new, disruptive technology has recently found its curve of progression and has transformed and reshaped the way things are viewed in the manufacturing segment, which also includes the automotive sector. This business era, after Industry 4.0, is viewed as a basket of Information and Communications Technology (ICT)/ digitally-enabled technologies. These include developments in production equipment, smart finished products, data tools and analytics that use Internet of Things (which can include 3-D printing, prototypes, connected cars, product lifecycle management, cyber physical production systems among others.)

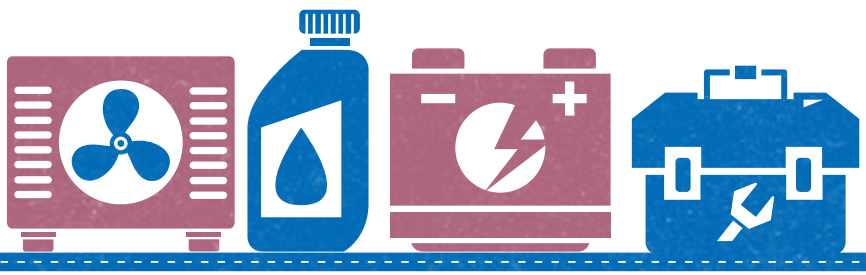
The Indian automotive sector is witnessing a boost and thrust from the Government of India which emphasises and focuses on introduction of new and revolutionary production processes into the Indian manufacturing system by keeping ICT at the heart of development. Along with this, there is also a great thrust from programmes/policies that include Make in India, introduction of GST and FDI policies (100 percent Foreign Direct investment is allowed under the automatic route in the auto sector).

By 2020, India is expected to become a major automobile manufacturing hub and the third largest market for automobiles in the world contributing approximately 25 percent of the GDP. With this vision, the massive expansion in the Indian automobile industry makes the country ready for the era of "Industrial Revolution 4.0" where manufacturing process can be integrated with growth drivers of Industry 4.0 and capitalise on the opportunity presented to Indian automotive market.

Grant Thornton India LLP, in association with CII, through this knowledge paper provides an analysis of Industry 4.0 at the global and domestic level. This showcases global readiness to take up Industry 4.0 and India's competitive advantage in the automotive sector as a response to the new disruptive technology and its components. It also highlights the perspective of various key stakeholders such as the government, OEM's and customer if Industry 4.0 was to be implemented in India.

We hope the report will encourage more discussions around the opportunities and challenges faced by this new era in manufacturing – a focus on Indian automotive sector that is likely to play a crucial role in the economic development of the country.

We hope you enjoy reading the knowledge paper and look forward to your responses.



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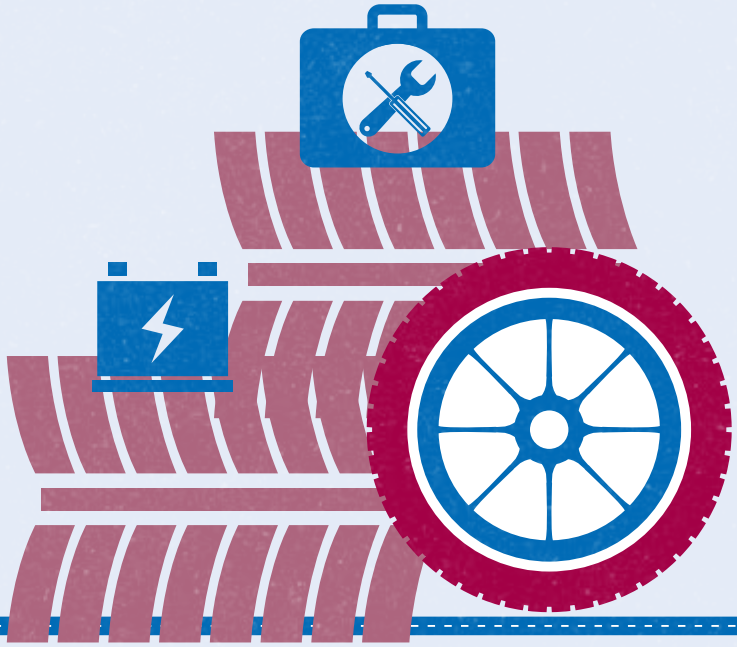


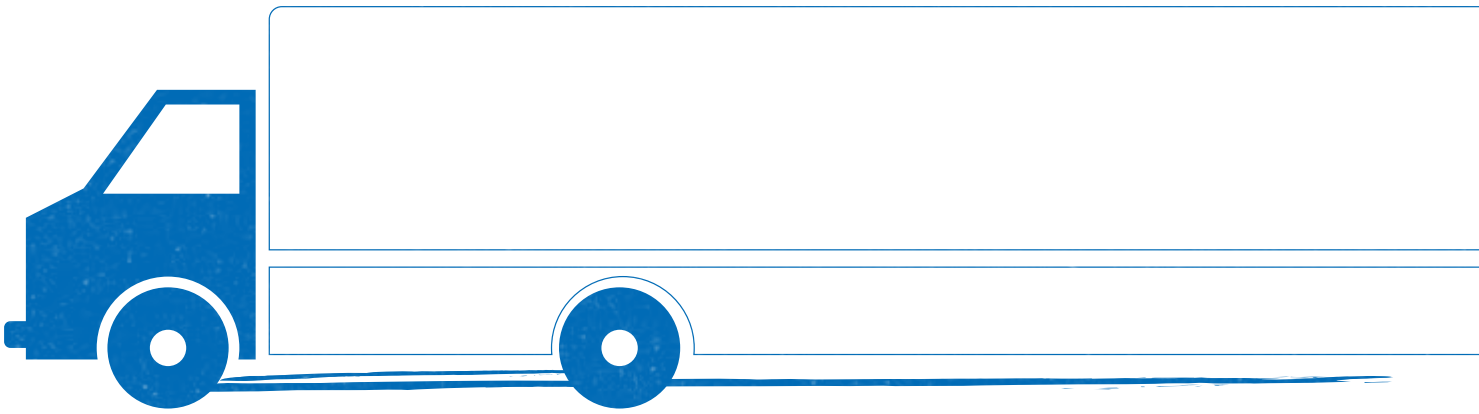
Industry 4.0

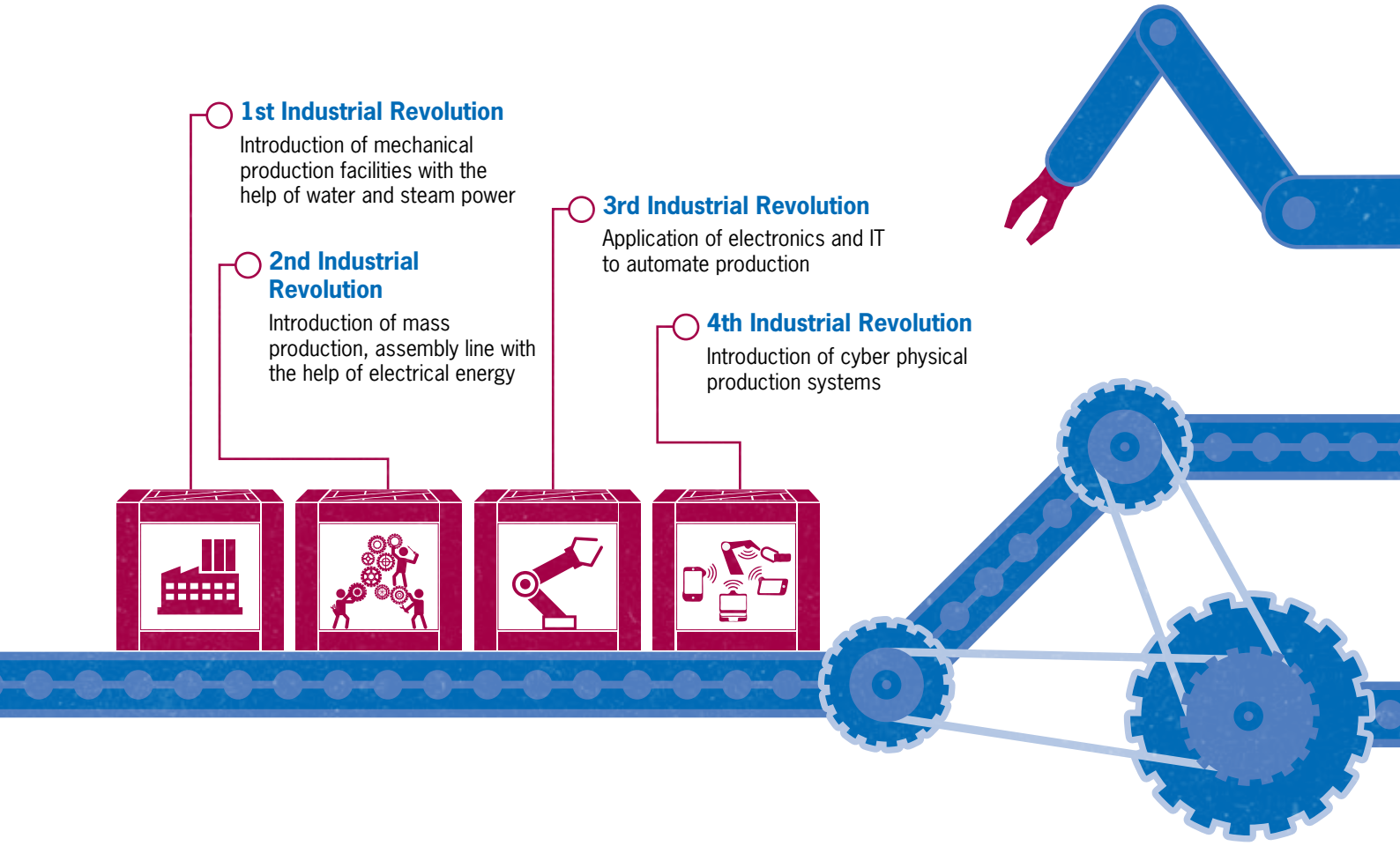
Definition:

Industrialisation started with steam and the first machines that mechanised some of the work that our ancestors did. Subsequently we had electricity, the assembly lines and the birth of mass production and then the third era of industry came in with the advent of computers and the beginning of automation when robots and machines began replacing workforce on those assembly lines.

Now we are expected to enter a new world of Industry 4.0, in which computers and automation will come together in an altogether a new way, with robotics connected remotely to computer systems equipped with machine learning algorithms that can control the robotics with minimum human support.

Industry 4.0 has highly intelligent connected systems that create a fully digital value chain. It particularly is based on cyber physical production systems that integrate communications, IT, data and physical elements and wherein these systems transform the traditional plants into smart factories. Here the objective is that the machines talk to other machines and products and information is processed and distributed in real time resulting in profound changes to the entire industrial ecosystem.





Industry 4.0 is all about optimisation of smart, flexible supply chains, factories and distribution models where machines capture and convey more data via machine-to-machine communications and to human operators. All this aims at enabling businesses to make quicker, smarter decisions, all while minimising costs.

The three key trends that are changing the way of life for industrial companies and their employees today are

Digitise:
Production processes in all sectors from high tech to industrial equipment are being transformed today through digital technologies.

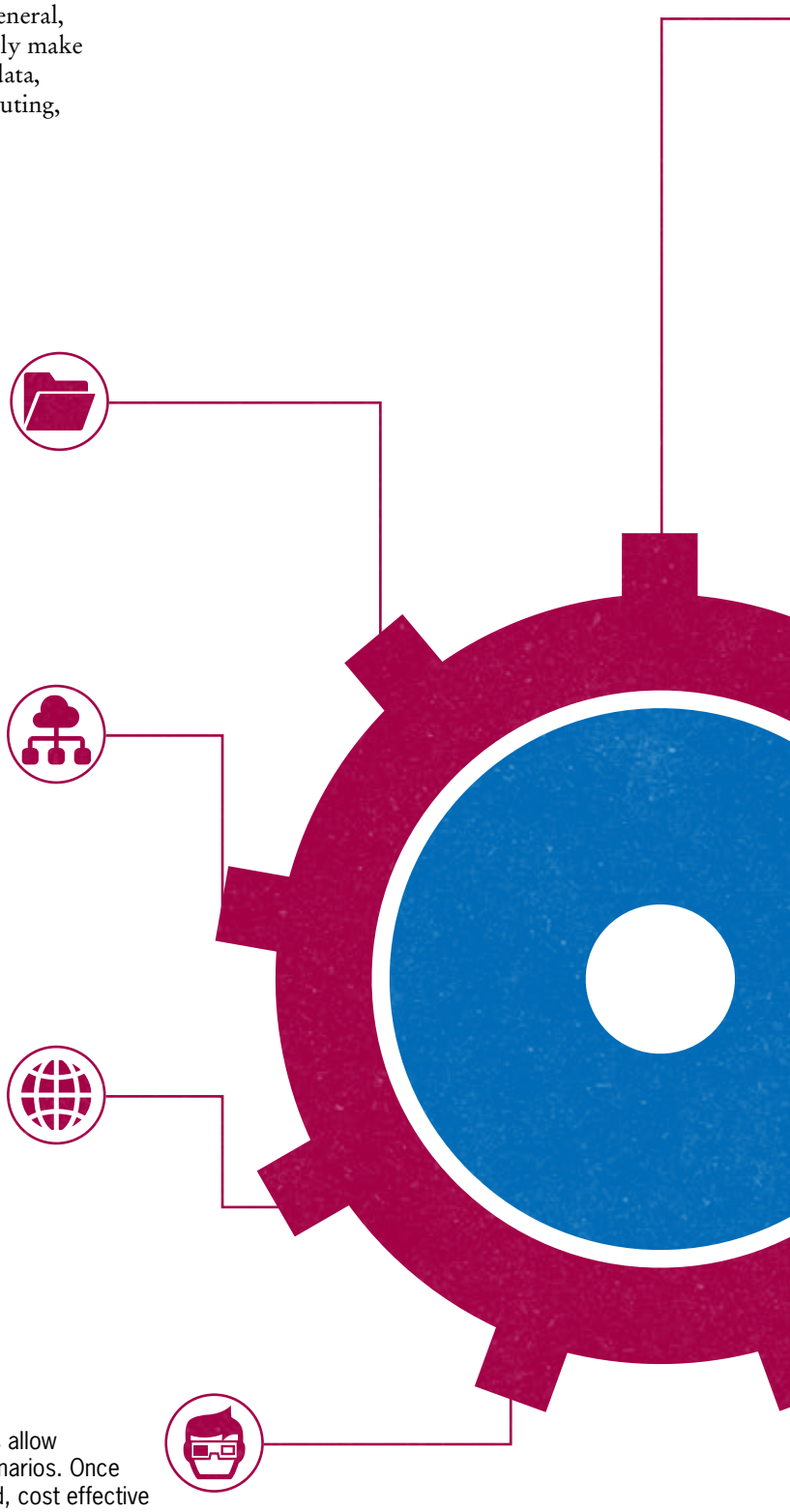
Industrialise:
Companies are already integrating these technologies to improve and evolve

Optimise:
State of the art manufacturers identify that enhancing the manufacturing process for even the simplest of the products presents new opportunities for growth.

Industry 4.0 is an initiative started by the German Government in 2006. The initiative's intention is to digitise the manufacturing sector in order to increase productivity. The German industry is expected to invest a total of €40 bn in Industry 4.0 by 2020.

Components:

The vision of Industry 4.0 is likely to be adopted worldwide and it might influence other initiatives and cooperative efforts. In general, there are nine key technological components that progressively make up the foundation of Industry 4.0: Autonomous robots, big data, augmented reality (AR), additive manufacturing, cloud computing, cyber security, IoT, system integration, and simulation.



Big data

One of the major challenges with data has been its quantum. Too much data makes it difficult to identify the relevant information and trends that can lead to some intelligent analysis. This is where "Big data" and analytics come in. They make it possible to identify the performance of an individual component and its operating restrictions in order to prevent future production issues and take preventative action.

Cloud computing

The industry has seen a large shift in utilising cloud solutions, and this will continue to grow. The cloud is being used for applications such as remote services, colour management, and performance benchmarking and its role in other business areas will continue to expand. With continuous advancements in technology, machine data and functionality will only continue to shift towards cloud solutions. The cloud allows for a much faster roll out of updates, performance models, and delivery options than standalone systems.

Internet of things (IoT)

The IoT is a key functionality in Industry 4.0 driven solutions. IoT is a system of interrelated computing devices, mechanical and digital machines, objects and people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. For instance smart watches in the market have turned our wrists into smartphone holsters by enabling text messaging, phone calls, and more. Devices such as Fitbit and Jawbone have helped revolutionise the fitness world. With the proper connections and data, the IoT can solve traffic congestion issues, reduce noise and pollution.

Simulation

The simulations of systems allow assessment of various scenarios. Once the scenarios are assessed, cost effective solutions can be developed, tested and implemented much quicker leading to reduced cost and time to market.

Autonomous robots

They are used to automate production methods across the various sectors and are powered by the concept of Internet of Things (IoT). This connects devices and computer machines to communicate with each other. Materials can be transported across the factory floor via autonomous mobile robots (AMRs), avoiding obstacles, coordinating with fleet mates, and identifying where pickups and drop offs are needed in real-time. By connecting to a central server or database, the actions of robots can be coordinated and automated to a greater extent than ever before. They can complete tasks intelligently, with minimal human input.

Augmented reality (AR)

Augmented reality grows in use by providing real-time information in an effective manner to allow humans to better integrate and interact with electronic systems. Examples can include the transmission of information on repairs for a part that can be viewed through different devices or the training of personnel using simulations and 3D views of the facility or equipment.

Cyber security

The security of information becomes paramount as we move away from closed systems towards increased connectivity from the IoT and cloud. Security and reliability enable the successful implementation of a truly modern and digitised production work flow, leveraging all of the benefits of a connected environment.

System Integration

Mostly systems are highly automated within their own operations and struggle to communicate with other systems. Standards and open architecture support the easy transfer of information both to the business and to the customer/end user. This can involve defining common languages for data exchange such as JDF for job information, CxF for colour information etc.

Additive manufacturing

This continues to become increasingly important for small-batch applications or for the production of individual parts or personalised products. This will be used either directly with the customer or by suppliers to improve designs with increased performance, flexibility, and cost effectiveness.

Evolution from current industrial scenario:

An industrial change is likely to be witnessed which could be fueled by the advancement of digital technologies. Prospectively, the fusion of physical and virtual worlds into a cyber-physical system may have a huge impact on every element of manufacturing and automotive sector.

In comparison to Industry 3.0, the traditional industries foresee unprecedented degree of integration between information, communication and manufacturing systems at their disposal, including:

- Smart sensors that knit together an industrial IoT, allowing real-time data collection during production processes;
- Ubiquitous broadband, allowing large amounts of data to be transmitted between people, machines and production sites;
- Cloud computing, allowing the instant storage and availability of date at any location, and;
- Big data analytics, allowing huge volumes of data to be processed collaboratively

It can be precisely said that Industry 4.0 is a convergence of disruptive digital technologies that are set to change the manufacturing sector beyond imagination, driven by astonishing rise in data volumes, system integrations and connectivity, emergence of advanced analytics and business intelligence capabilities, machine learnings, improvements in the transfer of digital instructions to the physical world.

Companies may evince interest to initiate the efforts to digitise factories as is seen at Siemens, Bosch, Daimler, Deutsche Telekom and Trumpf. Among others, the introduction of Industry 4.0 can lead to sensor packed products; connected to the internet in order to provide better products and services to their customers.

Impact on the automotive sector

Despite the broadness of the term, most agree that Industry 4.0's impact on the automotive industry will be significant. It has the potential to disrupt both processes and products. There could be a 360 degree change in the way the sector is operating now.

Industry 4.0 entails to handle massive volumes of data using business intelligence software to interpret, address and transfer that data to other parts of the business, back to the enterprise resource planning (ERP) system or supply chain partners.

In consonance with Industry 4.0, automotive manufacturers and suppliers could majorly be confronted with increasing complexities such as

- Increasing numbers of products and options,
- Shorter technology cycles,
- Increasing pressure to innovate and global supply networks.
- Constant competitive pressure to cut down their time to market.
- Changing customer preferences w.r.t performance characteristics, safety features, entertainment options etc.
- Technologically enhanced vehicles, like 'connected cars' and
- Better fuel efficiency

Automakers need to increase the number of feasible build-able combinations and require manufacturing processes that can handle large variations. A study of various simulations is the need of the hour. Direct interactions of OEMs with customers will help OEMs to understand and analyse customer preferences and shall help them to strategise a better market approach.

Industry 4.0 is expected to bring forth the idea that advances in automotive and will help the industry focus on key functional pillars such as technology, integration/ collaboration and processes. It includes some mega trends that are expected to be key enablers for the automotive industry's transition majorly Cloud computing, Big Data and Cyber Security.

Global readiness towards Industry 4.0

The advancement in technology has brought people, businesses, countries and the overall global market place closer than ever before and this trend with no doubt will continue to accelerate over time.

A holistic research by World Economic Forum (WEF) is used to demarcate the adoption of Networked Readiness Model by various countries. WEF investigated different countries and scored them on a seven-point scale. The key countries harnessing information technology are as follows:

Networked Readiness Index 2016	Global Rank*
Singapore	1
Finland	2
Sweden	3
Norway	4
United States	5
Netherlands	6
Switzerland	7
United Kingdom	8
Luxembourg	9
Japan	10
Hong Kong SAR	12
Korea, Rep.	13
Canada	14
Germany	15
Malaysia	31
China	59
Thailand	62
Sri Lanka	63
India	91
Pakistan	110

Networked readiness Index is a key indicator of how countries are doing in the digital world. It depends on whether a country possesses the drivers necessary for digital technologies to meet their potential, and on whether these technologies are actually having an impact on the economy and society. The digital revolution may change the nature of innovation, which is increasingly based on digital technologies and on the new business models it allows.

The 2016 Index has highlighted a number of key issues such as-

- increasing pressure to innovate technology,
- trailing out of rapidly growing digital population by businesses and companies,
- developing of new types of behaviour,
- leadership and governance mechanisms etc.

to adopt digital technologies and to capture the growing market.

Notably, India's rank on the Network Readiness Index in 2013 was 61. In 2016, India ranked 91 out of 139 countries. At 91, India was ahead of Pakistan (110) and Bangladesh (112), but behind Sri Lanka (63), Malaysia (31), and China (59). Singapore topped the rankings for second year in a row. The US was placed at 5th position.

The WEF's report makes it very clear that there is huge gap between developed nations and developing ones because of many factors. It says that the digital economy has divided the developed countries and developing nations into two segments. The top-ranked developed nations such as the U.S, and Singapore ranking is almost unchanged. But many developing nations, especially India saw a drop in ranking.

Though it seems convincing that Industry 4.0 can become a success story for Germany's engineering sector; however, the detailed study for "Industry 4.0 Readiness" may further do its part in this effort to highlight the challenging milestones that many companies must still pass on the road to Industry 4.0 Readiness.

Readiness: Industry 4.0

It is necessary to assess the Industry 4.0 readiness of industrial enterprises as manufacturing sector is currently facing substantial challenges. These challenges are in regard to disruptive concepts such as the IoT, cyber physical systems or cloud-based manufacturing. Subsequently, increasing complexity on all firm levels creates uncertainty about respective organisational and technological capabilities and adequate strategies to develop them.

A Foundation for mechanical engineering, plant engineering, and information technology of German Engineering Federation (VDMA) has coined a six dimensional model to assess the readiness of the enterprises, wherein VDMA experts and some industry representatives served in an advisory capacity in the development of the study. The potential, especially for Germany´s mechanical engineering industry and plant engineering sector, is indeed great, both for providers and for users of technologies across the spectrum of Industry 4.0. But there are still many unresolved questions, uncertainties, and challenges. The readiness study seeks to address this need and offer insight. It also highlights the challenging milestones that many companies must still pass on the road to Industry 4.0 readiness.

Six Dimensional Model

As per the current understanding of Industry 4.0 the readiness of the enterprises can be assessed on the below mentioned six dimensions:

01 **Strategy and organisation**

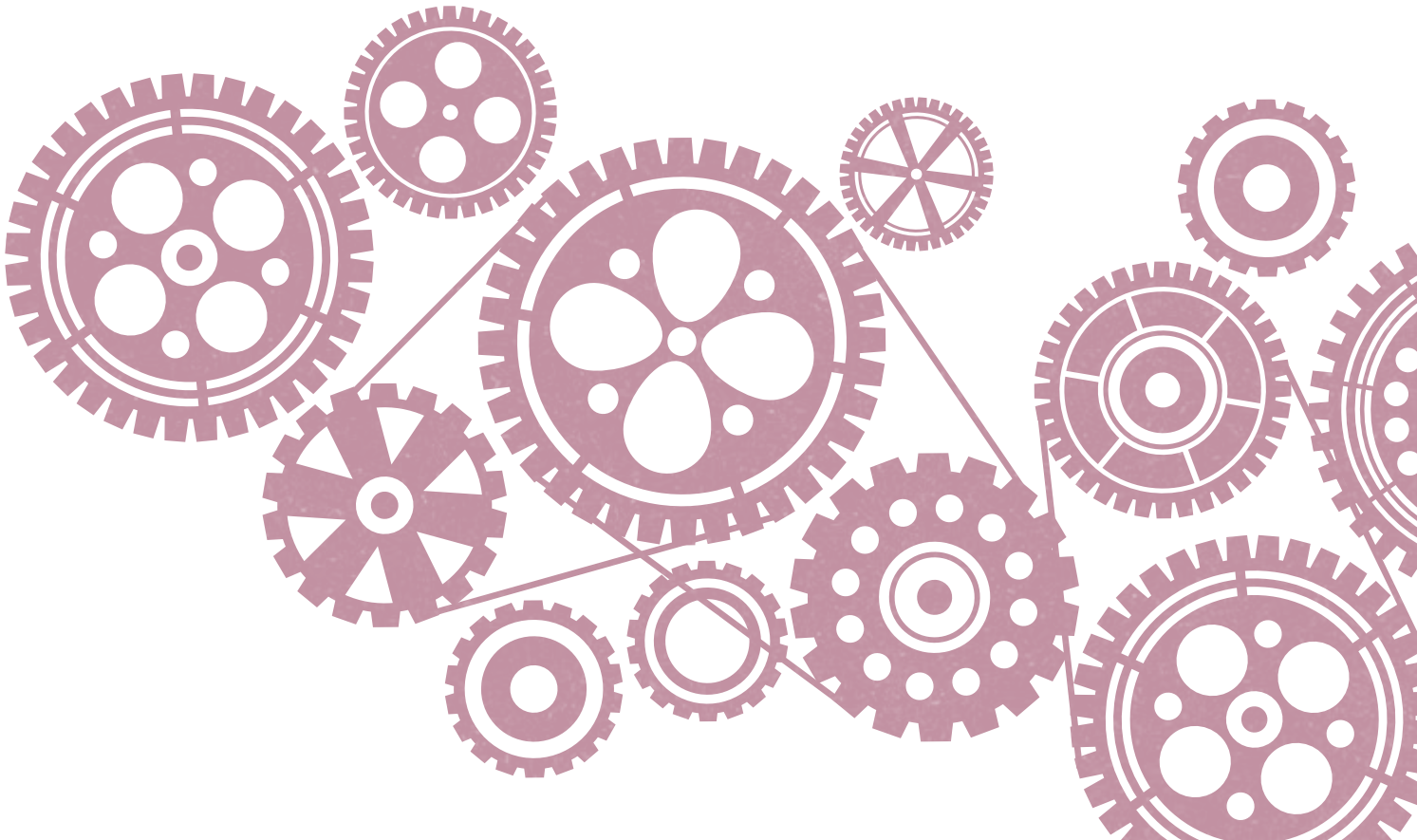
02 **Smart factory**

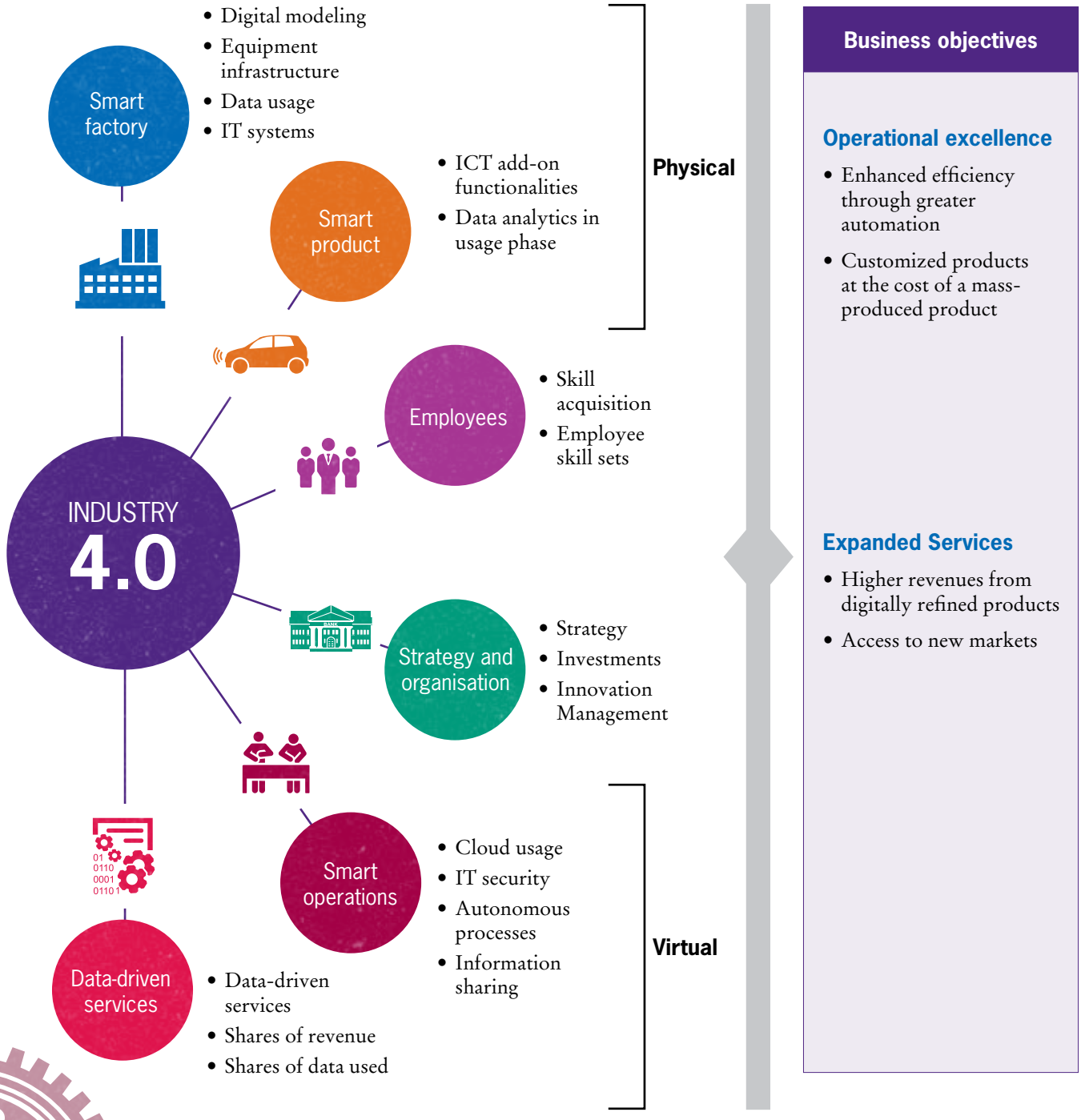
03 **Smart operations**

04 **Smart products**

05 **Data-driven services**

06 **Employees**




Smart factory
• Digital modeling
• Equipment infrastructure
• Data usage
• IT systems
Smart product
• ICT add-on functionalities
• Data analytics in usage phase
Physical
INDUSTRY 4.0
Employees
• Skill acquisition
• Employee skill sets
Strategy and organisation
• Strategy
• Investments
• Innovation Management
Smart operations
• Cloud usage
• IT security
• Autonomous processes
• Information sharing
Data-driven services
• Data-driven services
• Shares of revenue
• Shares of data used
Virtual
Business objectives
Operational excellence
• Enhanced efficiency through greater automation
• Customized products at the cost of a mass-produced product
Expanded Services
• Higher revenues from digitally refined products
• Access to new markets

A key point in this understanding is that the first two dimensions (smart factory and smart products) relate to the physical world, while the other two dimensions (smart operations and data driven services) represent the virtual representation of physical dimensions. According to this concept, Industry 4.0 can be called as the fusion of the physical and virtual worlds. The six components of readiness model are elaborated below -

1. Strategy and organisation

Industry 4.0 offers a new opportunity for developing altogether new business models apart from improving the current processes through the use of digital technologies. The current openness and the cultural interaction can be examined using the following criteria –

- Existing knowledge strategy implementation of Industry 4.0
- Review strategies through a system of indicators for better operation
- Measure the enterprise Investments relating to Industry 4.0
- Understand the use of technology and innovation management
- Understand the current state of research and development

2. Smart factory

The smart factory is a production environment in which the production systems and logistics systems primarily organise themselves without human interventions. It relies on cyber physical systems (CPS) which links the physical and virtual worlds by communicating through an IT infrastructure/IoT.

A company's progress in the area of the smart factory can be measured using the following four criteria:

- Digital modelling
- Equipment/component infrastructure
- Data usage
- IT systems/infrastructure

3. Smart operations

The technical requirements in production and its planning which are necessary to realise the self-controlling work piece are known as smart operations. Industry 4.0 readiness for smart operations can be determined by the following –

- Information sharing
- Cloud usage
- IT security
- Autonomous processes

4. Smart product

Smart products are the foundation for the 'smart factory' and 'smart operations' and are critical components of a unified 'smart factory' facilitating automated, flexible and efficient production. Physical components are equipped with technical components such as sensors, RFID, communication interface etc. to collect data on their environment and their own status. Readiness in the area of smart products shall be determined by looking at the ICT add-on functionalities of products and the extent to which data from the usage phase is analysed.

5. Data driven services

Companies evolving from selling products to providing solutions substantiates data driven services which are used to align future business models to enhance the benefit to customers. The after sales services business is based on the evaluation and analysis of collected data and reliance on enterprise wide integration. The physical products themselves must be equipped with physical IT so they can send, receive, or process the information needed for the operational processes. Readiness in this area can be determined using the following three criteria:

- Availability of these services
- Share of revenue derived
- Share of data used

6. Employees

Employees help companies realise their digital transformation. And readiness in this dimension can be determined by analysing employee's current skills and the ability to acquire new skills as employees are most affected by the changes in technology in an organisation; directly impacting their work environment. This requires them to acquire new skills to get well equipped with the digital workplace.

Thus, the above model will help to assess the company's readiness on various critical parameters and analyse the potential gaps which needs to be addressed in order to adopt Industry 4.0.

Leading Countries and Segments

Industry 4.0 started in Germany. The momentum is gradually picking up in the United States, Japan, China, the Nordic countries and the United Kingdom to bring this into the system. **Companies all over the world are expecting to dramatically increase digitisation over the next five years. By 2020, the US aims to achieve 74 percent digitisation from the current levels of 32 percent, Asia Pacific to 67 percent from current 36 percent and the Europe, the Middle East and the Africa to 71 percent from current 30 percent.**

How is Germany getting ready for Industry 4.0?

Automotive industry is one of the pioneers to implement Industry 4.0. The boundaries between IT sector and automotive sector is getting blurred. Car manufacturers are increasingly looking to provide additional connected services in the vehicle and are expecting an automated and a connected car market worth US$160 bn by 2020 – four times the level of the market size of 2015-16.

With the Government rolling out Digital Strategy 2025, Germany's efforts with digitisation go beyond Industry 4.0. This is a step guide to a successful digitisation. It focuses on modernising manufacturing through Industry 4.0 research and innovation. It also concentrates on providing an international playing field and strengthening data security while adhering to existing and incoming regulatory compliances such as the EU's General Data Protection regulation.

Funding for running these projects and to do the research and development around these projects is one of the major challenge that industry can face in implementing these projects.

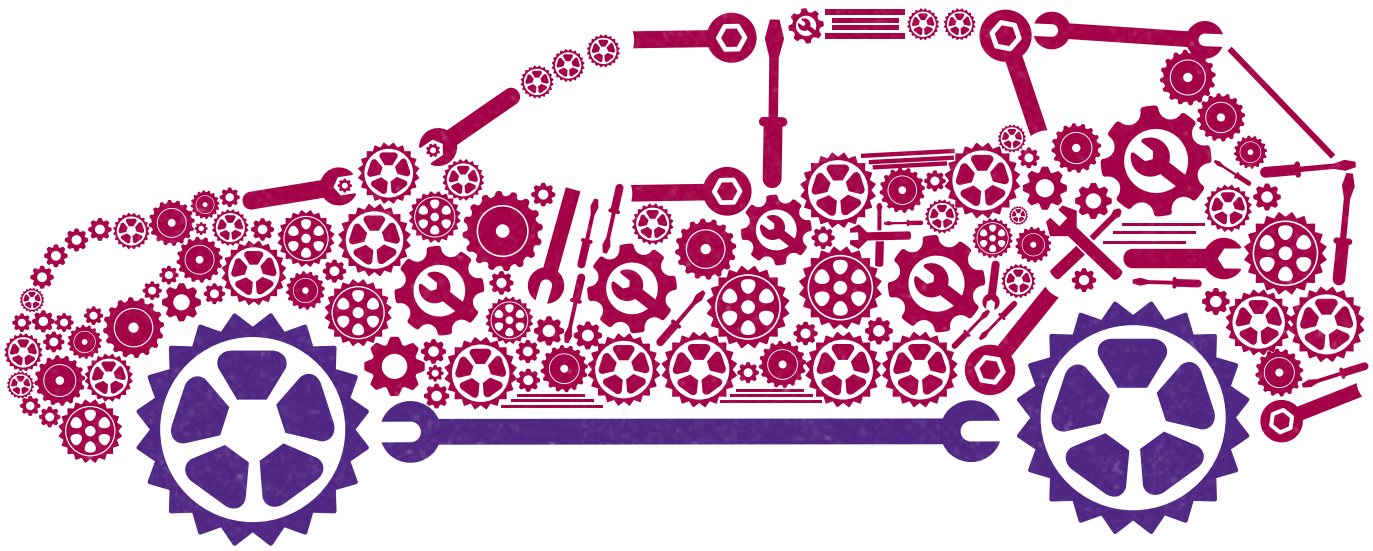
In order to tackle the challenges coming along Industry 4.0 the Federal Ministry is providing education and resources to SMEs which are currently unaware of the benefits of Industry4.0. The Ministry is also providing support schemes where SMEs (Subject Matter Experts) can test IoT use cases in a safe environment.

There are issues which are to be resolved such as skills shortages, lack of standards and security concerns. The primary focus of Germany will be on –

- Finding new options for implementing Industry 4.0 than creating new business models
- Develop recommendations for industry and government
- Mobile SMEs

In order to accept and adopt this new trend, partnerships will be key for the progress. Germany has signed Industry 4.0 MoUs (Memorandum of Understanding) with countries such as China and Japan. In addition to this Industry 4.0 is to be formalised through an agreement with France's Alliance d'industrie du futur (collaborating on standardisation, test beds, use cases, education).

Many countries across the globe are attracted towards the concept of Industry 4.0. Following is a glimpse of other countries which are trying to embrace Industry 4.0:



USA

The US Government has taken several initiatives to embrace industry 4.0.

- It has built National Network for Manufacturing Innovation (NNMI). This consists of regional hubs that will accelerate development and adoption of cutting-edge manufacturing technologies for making new, globally competitive products.
- To increase the domestic manufacturing competitiveness, the National Additive Manufacturing Innovation Institute aims to accelerate the adoption of additive manufacturing and 3D printing technologies in the US manufacturing sector.
- Other initiatives and installations such as Design Innovation Institute (DMDII), American Lightweight Materials Manufacturing Innovation Institute (ALMMII), Clean Energy Manufacturing Innovation Institute for Composites Materials and Structures and Materials Genome Initiative, National Export Initiative (NEI) etc have been initiated.
- 'Startup America' - a White House initiative to celebrate, inspire, and accelerate high-growth entrepreneurship throughout the nation.

Vietnam

- Manufacturing strengths include: strategic location, younger population and lower costs than China
- Vietnam is fast becoming the preferred base of operations for companies looking to set up overseas manufacturing facilities, replacing China and Taiwan as the preferred manufacturing location in Asia
- Vietnam is well positioned, post the Trans-Pacific Partnership and Free Trade Agreement (FTA) with the European Union, to allow investors to utilise its cheap workforce and close proximity to existing Asian based supply chains
- Vietnam's manufacturing contribution to FDI is US$ 14.5 bn in 2015
- Most of the Vietnam's industries are still at the second revolution which does not mean they don't have electronics or IT products, but they are still weak in quality and quantity
- Manufacturers are looking support from the government to extend help and form policies and reforms which encourage adoption of new technologies and investments

Philippines

- Manufacturing sector contributes 22 percent to GDP as in December 2016 and aims to grow to 30 percent by 2020
- It is expected to be one of the fastest growing automotive markets in Southeast Asia after 2020 with annual sales capable of growing at least 10 percent
- The government has introduced Comprehensive Automotive Resurgence Strategy programme because of which by 2020, the country is aiming to become a major automotive market in Southeast Asia as domestic sales are expected to continue grow while local production is seen ramping up

UK

- Only 8 percent of the UK manufacturers have a significant understanding of Industry 4.0 processes despite 59 percent recognising that the fourth industrial revolution will have a big impact on the sector.

India

- According to IBEF, the Government of India has set an ambitious target of increasing the contribution of manufacturing output to 25 percent of Gross Domestic Product (GDP) by 2025, from 16 percent currently.
- IoT, being one of the most important aspects of Industry 4.0 for India, is expected to capture close to 20 percent share in global IoT market in the next five years. According to IBEF forecast, the IoT market in India is projected to grow at a CAGR of more than 28 percent during 2015-2020.
- Government of India has taken initiatives such as Green Corridors and 'Make in India'

China

- The 13th Five Year Plan (2016-2020), adopted in March 2016 by the Chinese Government, aims to implement 'Made in China 2025' and 'Industry 4.0' initiatives simultaneously. Made in China 2025 aims for much higher levels of locally made content in core components and materials, increasing the levels to 40 percent by 2020 and 70 percent by 2025.
- Industry 4.0 is expected to increase China's productivity by 25 to 30 percent and lower unforeseen production losses by 60 percent

Today, in an Industry 4.0 factory, machines are connected as a collaborative community. Such evolution requires the utilisation of advance prediction tools, so that data can be systematically processed into information to explain uncertainties, and thereby make more "informed" decisions.

Innovations and new developments

Cyber physical system based manufacturing and service innovations are two inevitable trends and challenges for manufacturing industries. Following are the major innovations in the automotive industry:

a. Connected cars:

Connected cars are vehicles connected to mobile networks and provide wide range of mobility services. It is a vehicle which is able to optimise its own operation and maintenance as well as provide convenience and comfort of passengers using on-board sensors and internet connectivity. It is believed that while the total cost of ownership of vehicles might remain stable for consumers, the dramatic increase in vehicle connectivity may surge the value of the global market for connectivity components and services to **€170 bn by 2020 from just €30 bn currently. By 2030 it is expected that there will be over 400 mn connected cars on the roads globally, up from 23 mn from the levels reported in 2013.** This dramatic acceleration as a result of connectivity has the potential to significantly alter the competitive landscape. With this changing landscape, almost 25 percent buyers from Brazil, China, Germany and the United States already prioritise connectivity over features such as engine power and fuel efficiency.

Acceptance of such cars in several other areas is still a challenge given the regional differences, digital safety and digital privacy. Also the new car buyers are hesitant to shell out extra dollars for connectivity features.

Various industries have already included the concept within their own systems. For example, **insurance** cost depends on the driven distance (pay as you drive) of on your driving pattern (Pay How You Drive). **Smart watches** inform and alert drivers in real time about car's function, traffic, driver's bio-metrical conditions etc. **GPS** takes into account in real time alerts and information coming from drivers, traffic and infrastructures. The **application Geo** localise the closest parking space and information about parking charges etc.

b. Automated driving:

Autonomy is probably the term that best describes the destination point of technology industry's trend line. Real time decision making is getting automated at an ever increasing pace. And the auto industry is no exception and therefore, 'autonomous driving' is only the obvious next step.

Autonomous vehicles are those in which operation of the vehicle occurs without direct driver input to control the steering, acceleration and braking. Autonomous vehicles are designed so that the driver is not expected to constantly monitor the roadway while the vehicle is operating in self-driving mode. Autonomous vehicles use a combination of technologies to detect their surroundings, including radar, GPS, odometry and computer vision. Autonomous driving technology features such as auto-braking, automatic parking and adaptive cruise control are already present in cars and fully autonomous vehicles are currently undergoing road tests by which the autonomous car market is expected to reach US$ 42 bn by 2025.

Many companies are taking initiatives for developing this technology. Some examples:

An American global search engine is working on developing autonomous car technologies and have built its own self-driving car prototypes. They have also developed the technology used in three major automakers.

Another American multinational automaker headquartered in Dearborn, Michigan is working on 'ride the green wave' technology that could probably end stopping at red lights several times a day. The green light optimal speed advisory uses information on traffic light timings from a roadside unit to display to the driver, the best speed to travel at to get a green light at the next traffic intersection.

An American worldwide online transportation network company headquartered in San Francisco, California made an acquisition of an autonomous truck startup for US$ 680 mn in August 2016 has also started trials for self-driven taxis in Pittsburg, United States.

Other notable examples are –

- A Chinese e-commerce company with a motor corporation launched a sports utility vehicle featuring smart technology in 2016.
- A German luxury vehicle manufacturing company is all set to produce fully autonomous cars by 2021.
- An American multi-national corporation invested US$ 500 mn in another American ride-sharing company, to develop an integrated network of on-demand autonomous vehicles.

c. Product lifecycle management (PLM)

Product lifecycle management (PLM) is the process of managing the entire lifecycle of a product from inception, through engineering design and manufacture, to service and disposal of manufactured products. It integrates people, data, processes and business systems and provides a product information backbone for companies and their extended enterprise. PLM has been about breaking the silos between engineering, manufacturing, sales and marketing, service and support. Industry 4.0 will bring PLM to an extra level of integration and complexity. It is a gradual process as it will require:

- New collaboration networks that are more spontaneous and flexible.
- Rapidly scalable solutions which are based on user-centric and on-demand collaboration, instead of document-centric data exchanges.
- Openness and IP management.
- Replacement of all legacy solutions which are not integrated by new technology solutions that embrace consumer IT innovations, technologies and cross-industry and cross-organisational learning.

The big idea is that it may allow companies to involve their customers more closely in the production process and to react faster on changing market requirements. Also, the ideal factory envisages a self-controlling production process, in which production reacts autonomously to changes or faults and takes appropriate measures. This shall bring systems engineering, production IT, and business systems to a new level – leveraging business benefits from an increasingly integrated product lifecycle management (PLM).

d. Cyber physical production systems (CPPSs)

Cyber physical production systems are a consequence of the far-reaching integration of production, sustainability and customer-satisfaction forming the basis of intelligent network systems and processes.

At present, we find ourselves at the beginning of this fourth stage, which is characterised by CPPS. Cyber physical systems provide the basis for the creation of an IoT, which combines with the Internet of Services to make Industry 4.0 possible. They are 'enabling technologies,' which make multiple innovative applications and processes a reality as the boundaries between the real and virtual worlds disappear. The interplay between high performance software based embedded systems and dedicated user interfaces which are integrated into digital networks create a completely new world of system functionality.

Cyber physical systems are expected to represent a paradigm break from existing business and market models, as revolutionary new applications, service providers and value chains become possible. Industry sectors including the automotive industry, the energy economy and, not least, production technology for example, may in turn be transformed by these new value chain models.

e. 3D printing, computer aided engineering and prototypes

3D printing, also known as additive manufacturing (AM), refers to the processes used to synthesise a three-dimensional object in which successive layers of material are formed under computer control to create an object. 3D printing technology may have significant impact on several touch points in the auto value chain including the design cycle, replacement parts for customer service and even customer co-design of their vehicles. If up until now, the 3D technology was used just to print certain car parts, nowadays an entire vehicle can be printed from scratch in 44 hours.

The auto industry is envisaging a time where a customer can go online, order a new car or have it designed to his personal specifications and have it shipped to his house in less than two days.

Additive manufacturing enables a continuous factory production for individual parts and thus, prevents losses that take place during a normal production process. Also, speed is another factor to take into consideration, because a faster process means more continuity to the design and the overall development process.

When it comes to design flexibility the possibilities are far vaster with 3D printing. Automakers can develop some more customised features, such as lightweight lattice structures, fancier geometries, parts made of more than two materials, hollowed structures that have electrical wiring going through them etc. and thus, auto dealers can offer more variety to an ever growing consumer base.

In a 3D technique, nothing that is not needed is produced, so the material usage is reduced significantly. Automotive companies use recyclable materials that have a low rate of fuel emission to build 3D cars. 3D printed cars are expected to have a very low carbon print and the fabrication process requires only a small amount of electricity, compared to the traditional process.

Undoubtedly this industry is still in development that needs time to improve. But with technology advancing so rapidly these days, it's not hard to imagine that 3D printing should be accessible to many very soon.

f. Seamless mobile device connectivity via Wi-Fi:

The smartphone applications that help drivers track vehicle performance and perform diagnostics, as well as check on location, mileage and even fuel mileage are soon expected to become standard. Wi-Fi connectivity shall also enable software upgrades and new features to be streamed directly to the vehicle. One thing helping to drive the acceptance of Wi-Fi in the connected vehicle is 5G Wi-Fi. Based on the latest 802.11ac standard, 5G Wi-Fi allows drivers and passengers to easily sync and stream content within the automobiles, from portable devices straight to the in-vehicle infotainment system and rear-seat displays. It also enables high-speed Internet and cloud connectivity through LTE telematics or directly from a hotspot connection.

g. Near field communication (NFC)

Near field communication (NFC) is a radio frequency identification (RFID) based technology that enables secure transmission of data between devices in close proximity to one another. Usually it is associated with mobile payments or contactless transactions. More recently, however, it has found traction within the automotive industry. Its ability to allow easier pairing between the car and a mobile device such as a smartphone or tablet is just one example of how it can be used. Another possible example of an NFC-based application is a digital key that could be synced with the car by simply tapping it to an integrated sensor inside the vehicle. And this is only the beginning. Automotive components supplier Continental is currently testing NFC technology on electric rental vehicles. With this application, user profile, authentication, and vehicle/diagnostic information can be easily exchanged via an NFC-enabled smartphone and an NFC reader attached to the windshield. Once the reader verifies authorised access, it starts the engine. With the help of a mobile application, users can even select and reserve a rental vehicle, book a spot at a car-charging station, and locate their vehicle. And thus, usage of NFC technology is largely expected to be adopted by the automakers.

h. Integrated GNSS

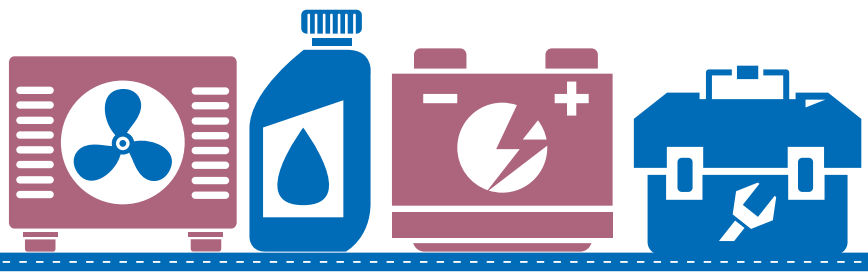
Drivers have been enjoying the driver assist features of the Global Navigation Satellite System (GNSS) for years via their smartphones. GNSS technology is even the brains behind the security product, which helps police recover stolen vehicles. Today, however, standalone GNSS devices are offering a whole new array of features for the automotive after-market, such as integrated real-time traffic routing options with audible text-to-speech driving directions and location based point of interest searches which is beneficial to the consumers. According to one recent study by the Virginia Tech Transportation Institute, drivers using GNSS navigators experienced less stress, felt safer, were more in control of their vehicles and more alert, and travelled more efficiently.

i. Automotive Ethernet

The popularity of Ethernet has now given way to Automotive Ethernet, with its promise to deliver high bandwidth in car connectivity at affordable rates and with lower weight cabling than other more traditional connectivity methods. Such benefits make it especially appealing for deploying high end infotainment features and capabilities like advanced driver assistance, surround view parking, a rear view camera and lane departure warning, in a much broader range of vehicles than just the luxury class.

Another area, where automotive Ethernet may play a large role, is security. More connected cars on the road means there will be a need for high levels of network security. By leveraging Automotive Ethernet as the car's network backbone, network security features such as device/message authentication and message encryption can all be used to help protect the car from malicious attacks and installation of any non-service-approved devices.

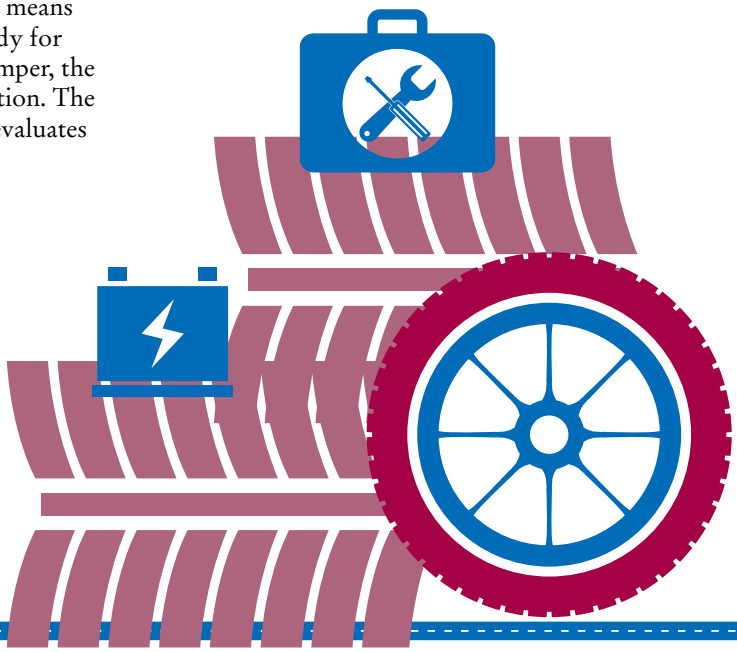
Industry 4.0 is enabling a new era of manufacturing intelligence and analytics focusing on end-to-end digitisation of all physical assets and integration into digital ecosystems with value chain partners encompassing a broad spectrum of technologies throughout the world.



Initiatives taken by leading industrial enterprises

Leading industrial enterprises are launching initiatives or even pilot projects towards Industry 4.0. Few of them are mentioned as follows -

- **A German luxury vehicle manufacturer** has taken an active role in the promotion of Industry 4.0 through its involvement in some of the German government's research projects. These include Cyber Physical Production Systems (CyPros), which aim to improve productivity and flexibility through the integration of intelligent systems in factories, which promotes flexible robot-based automation solutions.
  - To ensure that the company can innovate rapidly in this area, it has set up a range of in-house technology projects across several plants in Germany and the US. One of the most recent and futuristic examples is the use of **Google Glass devices** which is an optical head-mounted display designed in the shape of a pair of eyeglasses. It displayed information in a smartphone-like hands-free format. This technology is currently being used in the production of pre-series vehicles which serve as a kind of prototype to allow the company to discover any flaws before full production.
  - The **'smart glasses'** are fitted with a camera that allows employees to take photos and record videos which they can add to their reports to achieve greater accuracy than handwritten notes. Two-minute video clips can be stored on the company's servers for subsequent discussion with engineers. In addition, personnel can communicate by voice and sign off test plans while still at the vehicle.
  - The company worked with a **systems and innovation research institute of Germany,** to develop **the gesture control system.** A number of different gestures can be recognised, for example a wiping motion which means that the bumper has no quality issues and is ready for assembly. To register a fault with part of the bumper, the tester points his or her finger at the relevant section. The camera registers the gesture, then the program evaluates it and stores the information for follow up.
  - The company uses a 'big data' approach to energy efficiency achieved through the introduction of an intelligent energy management data system (iEMDS), which was piloted at Spartanburg for the production of **CUVs (crossover utility vehicle) and SUVs models.** The system is based on intelligent electricity meters, which constantly measure the energy consumption of production facilities and robots so as to align them with the company's central 'big data' network.
  - It is also running ergonomics projects in relation to Industry 4.0. The vehicle-maker introduced a flexible **'finger cot'** which protects workers against excess strains on the thumb joints while carrying out certain assembly activities. This initiative is in pilot stage at the plant in Munich, Germany. Developed in cooperation with the Department of Ergonomics at the Technical University of Munich, each finger cot is a unique item, designed and customised to fit the size and shape of a worker's hand – and made using 3D printing.
  - The car maker has also done a preliminary work for the futuristic application of collaborative robots which was provided by the Innovation Management Production team at its Research and Innovation Centre Developed over a period of two years. The project was carried out in close cooperation with **a manufacturer of smaller flexible industrial robot arms, based in Odense 'Collaborative Robotics'** which produces new generation of safe, more user friendly robots which work more closely alongside humans in assembly line as a team.



- **Further, a leading German Automotive manufacturing company specialising in tyres, brake systems, interior electronics, automotive safety etc. with revenue of €39.2 bn** has recently set up its High Performance Technology Centre (HPTC). It announced a €45 mn investment to set up a 'factory within a factory'. All machinery in the HPTC is completely networked via sensor systems and software. This reliance upon 'Industry 4.0' data exchange enables the full documentation of every step in the process and how materials behave during processing. The benefits derived from this set up will be that the company can carry out even ultra-short production run testing on the conventional tyre making machinery used across. Changes to individual materials and production steps and to vulcanisation temperatures and times can be simulated, and then their impact on the finished tyre can be investigated in vehicle tests.
- For another **German multinational automotive manufacturing company headquartered in Wolfsburg, with revenue of €213.292 bn (2015),** a vision for Industry 4.0 includes mobile machinery, with robots cruising around factories and deciding on their own what they'll do next. The company has finished a prototype car where each part has RFID chips or similar technology for traceability. A big motivator for 4.0 effort is managing the increasing complexity of manufacturing

  The company partnered with the largest engineering company in Europe headquartered in Berlin and Munich with a revenue of €75.63 bn to use its PLM Software solutions to completely integrate engineering processes. The software is one of the key solutions in company's virtual vehicle program helps reduce development time, improve product and process quality and increase communication of product and process data between departments, plants and external engineering partners.

  The company also partnered with **another manufacturer for collaborative robots.** It integrated an industrial robotic arm with them to collaborate directly with employees. The six-axis robotic arm has an integrated safety mode, which allows it to collaborate directly with people without any protective guards which optimises the ergonomic working processes in the plant.
- **A Systems and innovation research institute of Germany,** a major technology partners for various manufacturers such as BMW, OPEL, BOSCH, BorgWarner and many others has given priority to new methods and technologies of digital engineering and their extensive use in the development, production and operation of products and manufacturing systems.

The institute has come up with an exciting idea of **Robots with Sensitive Skin.** In future, manufacturing will involve both humans and robots, who will contribute their particular capabilities and work in a shared work area. The researchers developed a prototype of **sensor skin for a luxury car manufacturer.** Like human skin, the sensor skin also consists of several layers. A patented, matrix sensor cluster with a multitude of single sensors detects contact. If a force acts on one of the single sensors, it changes its electrical resistance. Thus, a robot outfitted with the sensor skin not only senses when it is touched but also senses the touch location. The experts additionally integrated capacitive sensor elements in the sensor skin. They create an electrical field in their environment.

Industry 4.0 is expected to be a huge boon to companies that fully understand what it means for them. Change of this nature will transcend company's boundaries where they operate.

This segment gave us an insight on the global approach towards Industry 4.0, the readiness, the initiatives taken by various countries & major automobile giants and the innovations & developments impacting the automotive sector. The focus in the forthcoming segment will be laid on the importance of the fourth industrial revolution on the Indian economy, the major steps taken by the OEMs, government and the customers to adapt the new trend and recent technological developments.

Importance of Industry 4.0 for Indian automotive sectors

Is India ready to leapfrog into Industry 4.0?

According to International Yearbook of Industrial Statistics 2016- published by UNIDO with its ranking going up by three places, India has now been ranked sixth among the world's 10 largest manufacturing countries.

India is no exception to this global trend and is steadily increasing its share of Global Manufacturing GDP. All leading countries are embarking on major initiatives to promote manufacturing by adopting the advancements in Internet and Information Technology arenas. German government announced "Industry 4.0" while governments in China and India have their own focused programs, "Made in China 2025" and "Make in India" respectively. Idea is to encourage multi-national, as well as national companies to manufacture their products in India. With a plethora of crippling regulations and under-developed infrastructure, the Government is focusing more on enabling policies and improving infrastructure for certain key sectors.

According to IBEF, the Government of India has set an ambitious target of increasing the contribution of manufacturing output to 25 per cent of Gross Domestic Product (GDP) by 2025, from 16 per cent currently.

There is no escape from integrating principles of Industry 4.0 with the "Make in India" initiative, if Indian Manufacturing has to win against global competition. India has a unique opportunity to innovatively pave its own road to Smart Manufacturing. It can skip several steps that other countries adopted in their evolution from an agrarian society to their current stage of development. Industry 4.0 is expected to transform manufacturing in India by bringing operational efficiencies to manufacturing industries like automotive, electrical and electronics.

The major area of focus shall be the technological advancement across various industries. IIOT (Industrial Internet of Things), 3DP (3 dimensional printing) 3D sensors, social software, augmented reality, location awareness are considered to usher in the next era of smart production. These automation technologies collectively are moving the manufacturing industry towards the next phase of technological advancement.

Industry 4.0 is a holistic automation, business information, and manufacturing execution architecture to improve industry with the integration of all aspects of production and commerce across company boundaries for greater efficiency.

Internet of Things, being one of the most important aspects of Industry 4.0 for India is expected to capture close to 20 per cent share in global Internet of Things (IoT) market in the next five years. The global market is expected to touch US$ 300 bn by 2020. The IoT industry is a proposed development of the Internet in which everyday objects are likely to have network connectivity, allowing them to send and receive data. According to IBEF forecast, the IoT market in India is projected to grow at a CAGR more than 28 per cent during 2015-2020.

Major Indian states are taking initiatives to adapt to Industry 4.0. Andhra Pradesh has taken an initiative to capitalise on the IoT potential in the country. The state government has approved the first-of-its-kind IoT policy with an aim to turn the state into an IoT hub by 2020 and tap close to 10 per cent market share in the country.

The Indian government has created Green Energy Corridors to bring in more renewable energies, to make smart grids that will support the variable input of renewable energies and create storage. India has committed over US$ 1 bn in this initiative and has started projects in many states, such as Andhra Pradesh, Rajasthan, Tamil Nadu, Gujarat, and Himachal Pradesh.

India's first smart factory, moving from automation to autonomy, where machines speak with each other, is being set up in Bengaluru. It is making progress at the Indian Institute of Science's (IISc) Centre for Product Design and Manufacturing (CPDM) with an investment from The Boeing Company. A smart factory, armed with data exchange in manufacturing and the Internet of Things (IoT) is the future and experts are calling it revolution Industry 4.0. Reports peg the smart factory industry to touch US$ 215 bn by 2025 and all major economies are likely to accept it.

Various Indian companies are increasing their focus and partnering with other companies for developing new IoT and M2M solutions, the Digital India initiative from the Government of India is expected to enhance the focus on IoT in tackling the domestic challenges.

The Indian automotive industry has also taken some notable steps towards industry 4.0.

Bajaj Auto was one of the first automotive enterprises to initiate automation in the industry. It commenced the process of automation in 2010, today it uses 100-120 "Co-bots" (Collaborative Robots) in its production facilities. Maruti Suzuki manages 7 process shops and 5 assembly lines by around 1,700 robots. Ford has managed to operate the assembly lines and body shop of its Sanand Plant by 437 robots. Hyundai has also taken steps to minimise its labour cost by utilising over 400 robots in Sriperumbudur Plant. The production lines of Tata Nano consist of over 100 robots in the Sanand Plant of Tata Motors. Other enterprises such as Renault are doing some rather interesting work in the field of automation of business process to prevent the accidents.

As a result, companies are warming up to the idea of connected machines. While Industry 3.0 simply was about the automation of isolated machines, Industry 4.0 concentrates on the end-to-end digitisation of all physical assets and their integration into digital ecosystems with value chain partners". Essentially, the new paradigm is about the integration is evidenced by 2016 Annual Meeting of World Economic Forum, held at Davos where "Fourth Industrial Revolution" was the key topic.

India's competitive landscape

The manufacturing landscape is changing. Countries are constantly being challenged on technical capabilities and manufacturing value adds. Specifically, India faces competition from China and Europe and there is a risk of her being crowded out by the increasing technical capabilities of these regions as they are focusing on medium-value segment where India has always been prominently operating. Historically, China has focussed on the low technology-low manufacturing value add space while Europe has focussed on high technology – high value add segment. India's manufacturing zone of comfort has been in the middle, both on the technology and value add axis. Now, a significant push from China to move up from the low technology – low value add zone and expand into the medium technology zone has been noted, thereby expanding the market for Chinese companies. Concurrently, there is a push from Europe to move down from the high technology – high value add zone and expand into the medium technology zone thereby expanding the market for European companies.

This is leading to a crowding out effect impacting India's manufacturing base in addition to increasing competition from emerging manufacturing bases like Vietnam, Turkey and Taiwan. At the same time it might give India an opportunity to become the second destination for other countries. Should India look at Industry 4.0 as an additive advantage for manufacturing and a lucrative investment destination by other countries?

India's advantage over China

For more than 20 years now, India and China have been competing for the major share of global manufacturing. India's manufacturing contribution to GDP still is a mere 16% compared to 36% for China. There is, however, an opportunity to turn the tide in India's favour as China's shrinking labour arbitrage and strengthening Yuan against the US Dollar has encouraged investors to look towards more cost-effective destinations like Vietnam, Indonesia and India.

India's advantage is its ample supply of skilled technical labour and low cost of manufacturing. Already Havells, Godrej, Bosch and other large manufacturers have shifted units to India.

India's strengths over others :

- A growing working population and an expanding middle-class are expected to remain key demand drivers. GDP per capita has grown from US$ 1,432.25 in 2010 to US$ 1,500.76 in 2012, and is expected to reach US$ 1,869.34 by 2018
- India has the world's 12th largest number of high-net-worth individuals, with a growth of 20.8%, the highest among the top 12 countries
- Disposable incomes in the rural agri-sector shows increasing trends
- There is a presence of a large pool of skilled and semi-skilled workers and a strong educational system
- Favourable government policies like lower excise duties, automotive mission plans, the constitution of NEMMP (National Electric Mobility Mission Plan 2020), FAME (Faster Adoption and Manufacturing of Hybrid land Electric Vehicle) are advantageous for the sector.

As a result, Indian Auto industry occupies a prominent place on the canvas of the Indian economy. Due to its deep forward and backward linkages with several key segments of the economy, automotive industry has a strong multiplier effect and is a critical driver of economic growth. A sound transportation system plays a pivotal role in the country's rapid economic and industrial development. The well-developed Indian automotive industry ably fulfils this catalytic role by producing a wide variety of vehicles: passenger cars, light, medium and heavy commercial vehicles, multi-utility vehicles such as jeeps, scooters, motorcycles, mopeds, three wheelers, tractors etc.

India is expected to become a major automobile manufacturing hub and the third largest market for automobiles by 2020. It is the sixth largest producer in the world with an average annual production of 24 mn vehicles in 2016. India has the fifth largest passenger vehicle and commercial vehicle market contributing to 7.1 % of India's Gross Domestic Product (GDP) by volume.

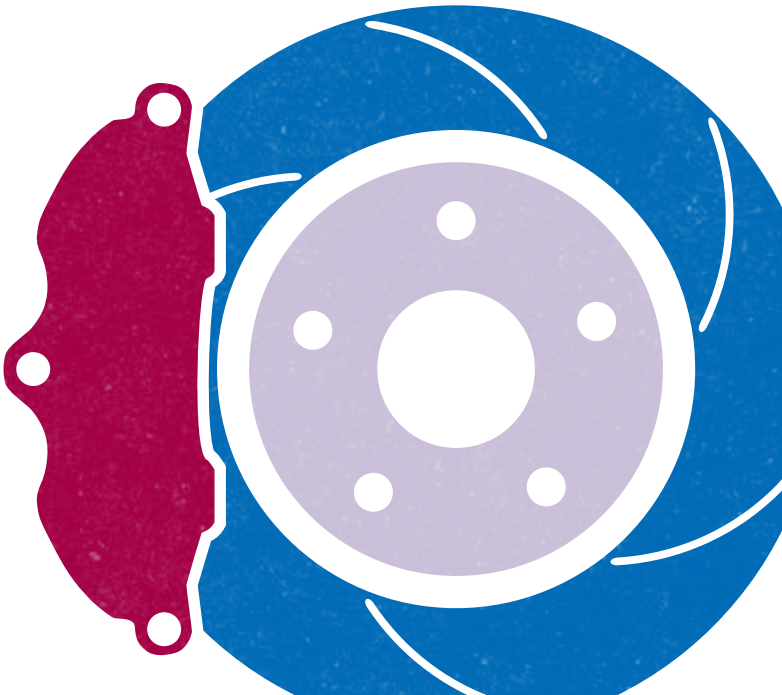
India's automotive industry is well-positioned for growth, servicing both domestic demand and, increasingly, export opportunities both demographically and economically.

Reasons to invest in Indian Automotive and Auto Component Industry

- By 2026, India is expected to be the third largest automotive market by volume in the world.
- Tractor sales in the country are expected to grow at Compound Annual Growth Rate (CAGR) of 8-9% in the next five years, enhancing India's market potential for international brands. Two-wheeler production has grown from 8.5 mn units annually to 15.9 mn units in the last seven years. Significant opportunities exist in rural markets.
- The emergence of large automotive clusters in the country: Delhi-Gurgaon-Faridabad in the north, Mumbai-Pune-Nashik-Aurangabad in the west, Chennai- Bengaluru-Hosur in the south and Jamshedpur-Kolkata in the east.
- Global car majors have been ramping up investments in India to cater to growing domestic demand. These manufacturers plan to leverage India's competitive advantage to set up export-oriented production hubs.
- An Research & Development (R&D) hub: strong support from the government in the setting up of National Automotive Testing and R&D Infrastructure Project (NATRiP) centres. Private players such as Hyundai, Suzuki, GM are keen to set up an R&D base in India.
- Electric cars are likely to be a sizeable market segment in the coming decade
- An emerging global hub for sourcing auto components.
- Geographically closer to key automotive markets like the ASEAN, Japan, Korea, Europe and huge domestic market.
- Cost competitive as compared to other manufacturing countries.6th Largest vehicles manufacturer in the world that produced 23.9 mn vehicles in FY 16. Favourable trade policy with no restrictions on import-export.
- Favourable government policy with 100% FDI allowed through automatic route.
- Presence of enabling infrastructure like automotive training institutes and auto design centres, special auto parks and virtual SEZs for auto components.

Steps to make India a leading manufacturing hub

India is on the threshold of major reforms and is poised to become the third-largest economy of the world by 2030. In the words of our Hon'ble Prime Minister, India offers the 3 'Ds' for business to thrive— democracy, demography and demand. Adding to that a tech-savvy and educated population, skilled labour, robust legal and IPR regime, and a strong commitment to regulated liberalisation, India is a destination that global investors cannot overlook. India's manufacturing sector has evolved through several phases - from the initial industrialisation and the license raj to liberalisation and the current phase of global competitiveness. Today, Indian manufacturing companies in several sectors are targeting global markets and are becoming tough global competitors. Many are already amongst the most competitive in their sectors. Talking about the automotive industry specifically the equipment manufacturers, the government and the customer plays a major role in shaping the industry.



a. OEMs and component supplier's perspective

The need for customer services has increased with several non-automotive companies eyeing the consumer engagement channels beyond the point of vehicle sale. OEMs lose significant opportunities with respect to product planning, newer services, and time-to-market reaction with the lack of customer/vehicle data feedback. Direct interaction between an OEM and customer/vehicle will help the former understand and gauge customer preferences and reduce several inefficiencies.

Practices such as global sourcing of intellectual capital, collaborating with world class institutions and teaming up within the industry and national institutions to sustain an innovation culture are rare in automobile industry. The most vital of these collaborations is at the OEM-Tier I level, to make it long-term and build the confidence in the supplier community to invest in the necessary technologies. India is bucking the general trend of collaboration at the OEM-Tier I even now.

The North American market, led by the big three (GM, Ford & Chrysler) created their own Tier I majors including the likes of Magna, Delphi, Johnson Controls, Lear, and TRW, that are technology leaders in the world today. Similarly, the big five in Europe – Volkswagen, Renault, Fiat, BMW and Daimler – drove innovations in Bosch, ZF, Continental, Valeo and Faurecia, among others. Toyota, Honda and Nissan spawned Denso, Aisin and Yazaki as technology suppliers. Now Hyundai is following suit in Korea with Mobis.

The resurgent Chinese economy has seen Tier I suppliers invest in creating a technology base. India, however, seems to be ignoring the benefits of long-term OE partnerships with suppliers to create value, and continuing the practice of switching suppliers to pursue that easily available "low cost – we-will-manage-quality-later" commodity.

Talent creation also does not come cheap and has a long gestation period. Again, scale plays a role and the OEMs and large Tier I suppliers have started to show the way by hiring world class talent in leadership roles. Paucity of management and technical talent, together with few skill up gradation programmes for workers, which are all stifling the industry growth, need attention. Productivity will be realised only if we have the talent to manage technology, and subsequent scale created by our R&D investments.

Interestingly, for the last four years, the industry is still clocking at a sluggish growth in terms of vehicle units, and successes are seen in pockets at the vehicle model level rather than at the segment or industry level. Honda Activa, Mahindra Bolero, Maruti Suzuki Swift and Hero Splendor continue to do well consistently with double digit growth because these products clearly meet the market needs.

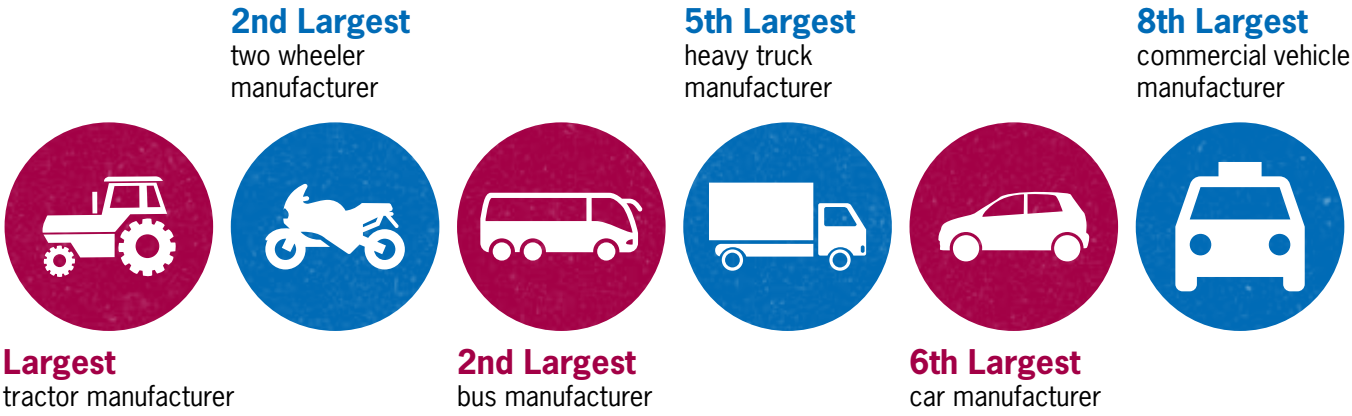
Industry 4.0 is a melange of many futuristic and advanced concepts and technologies which have the potential of transforming the production scenario in the 21st century mainly comprising of a 'connected shop floor' where data is collected from various sensors and other input devices to be used for predictive maintenance, better control and long term analysis. "Any smart device or sensor in the field today has a lot of data related to the device or sensor itself. But so far, this data is not accessible beyond this device.

A German auto component manufacturer is set to implement smart manufacturing at all its 15 manufacturing centres in India. This is in line with its global strategy of embracing Industry 4.0 or connected industry that combines manufacturing with Internet of things and technology. For India to be complaint with Industry 4.0 the company has a three pronged strategy -first, to learn and transfer know how from European counterparts, second to develop customised solutions for India and third to lead the Industry 4.0 development globally and compete with the best in class

b. Government's perspective

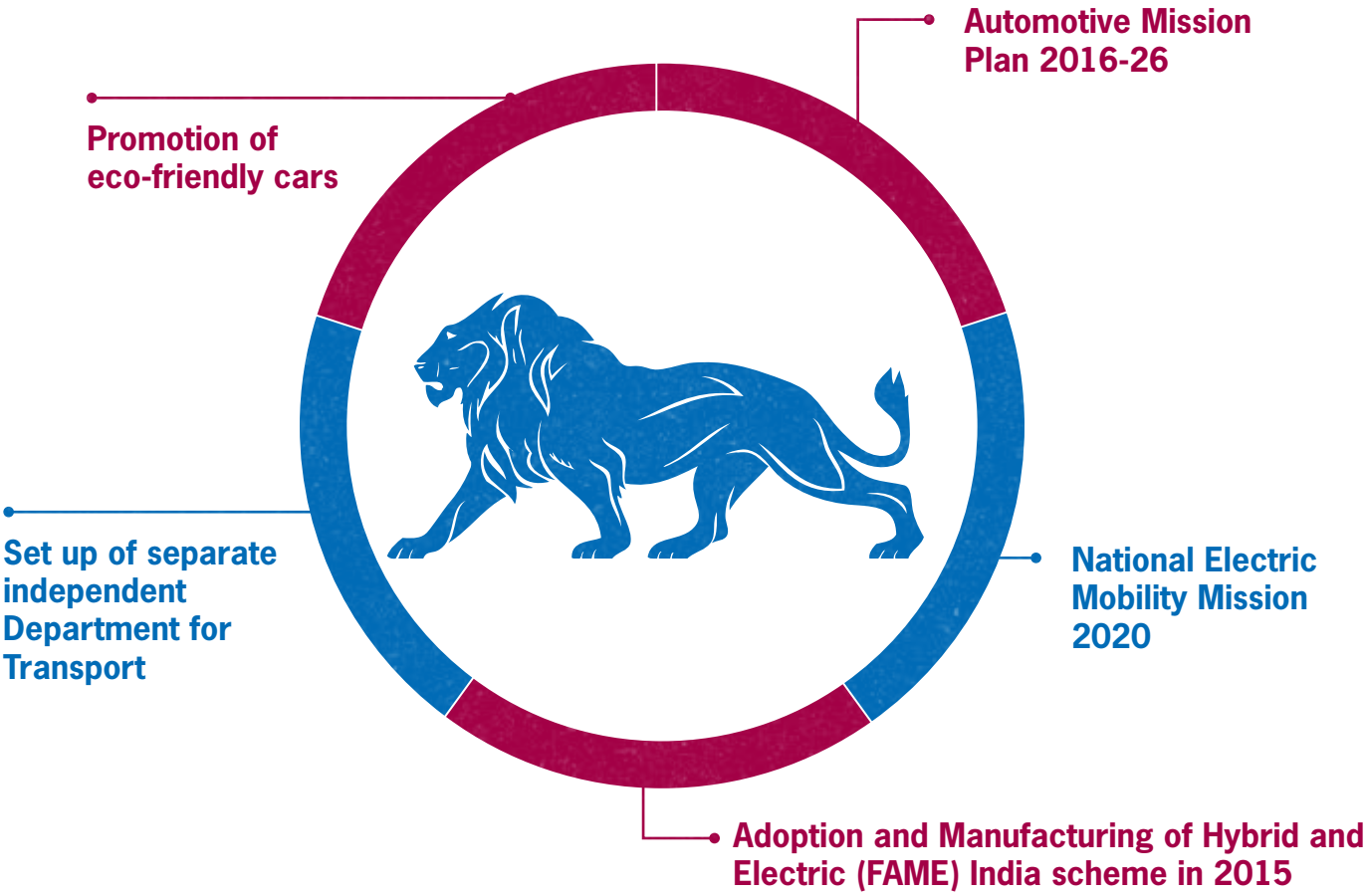
The automobile sector of India is one of the largest in the world and accounts for over 7.1% of India's gross domestic product (GDP). It also contributes to nearly 22% of the country's manufacturing GDP. The sector was first opened to foreign direct investment (FDI) in the year 1991 during the liberalisation of the Indian economy and has come a long way since.

The country is also currently the 6th largest market in the world for automobiles and is expected to become the world's third-biggest car market by the year 2020. As per the Automotive Components Manufacturers Association of India (ACMA), the world standings for the Indian automobile sector are as follows:



It can be reasonably concluded that India has emerged as one of the key global players (both as a consumer and a producer) in the automobile industry. It has witnessed tremendous growth, especially in the last few years and has become a base for global manufacturers. Volkswagen, Nissan, Renault, General Motors, Ford, Honda, Suzuki, Hyundai, Daimler, BMW, Skoda, Audi are all present in India and are manufacturing and assembling locally.

Mercedes-Benz recently decided to make the entry level GLA-class Sport Utility Vehicle (SUV) in India. Japanese two-wheeler manufacturer Honda Motorcycle and Scooter India (HMSI) opened its 4th and world's largest scooter plant in Gujarat while Chrysler has planned to invest US$ 513.5 mn in Maharashtra, to manufacture Jeep Grand Cherokee model.



The Government of India aims to maintain this upward growth trend of the automobile industry and has launched several initiatives to achieve the same.

Government's new initiatives & vision for the future

- The Automotive Mission Plan 2016-26 (AMP 2026) is one such initiative. It clearly lays out the government's collective vision on how the automotive sector should grow regarding size, contribution to national development, technological maturity, global competitiveness and institutional structure. It aims to make India among the top three automotive industries in the world and increase exports exponentially to reach 35-40% of overall output. It also intends to increase its contribution to the GDP to over 12 %, generating 65 mn more jobs as well as increasing the size to US$ 300 bn by 2026
- Another initiative launched by the government was the Faster Adoption and Manufacturing of Hybrid and Electric (FAME) India scheme in 2015 with a capital outlay of US$ 122.3 mn. It is based on NEMMP (National Electric Mobility Plan) 2020 road map and covers all segments i.e. two, three wheelers, cars, LCVs, buses, and all forms of hybrid and pure electric vehicles.
- With the emergence of 5 large automotive clusters in the country i.e. the Delhi-Gurgaon-Faridabad in the north, Sanand-Halol and Mumbai-Pune-Nasik-Aurangabad in the west, Chennai-Bengaluru-Hosur in the south and Jamshedpur-Kolkata in the east, India is fast on its way to becoming the primary global automobile manufacturer. The Government of India is more than willing to lead this charge and assist this sector in every way to help it achieve its full potential.
- Union Minister of Road, Transport and Highways announced that the government proposed to set up a separate Transport Department comprising of experts from automobile sector, alternative fuel, emission etc. The department will not only oversee the automobile sector requirements like emission norms and safety issues but would also look at exports and other aspects.
- Planning to promote eco-friendly cars in the country i.e. CNG based vehicle, hybrid vehicle, and electric vehicle and also made mandatory of 5% ethanol blending in petrol.
- In order to make India a production hub in the world, the government is taking various reforms and announcing various schemes to bring further FDI in the country. Being the sixth largest producer of automobiles in the world, the Indian automobile industry is likely to be the key beneficiary of Make in India program. According to data released by Department of Industrial Policy and Promotion (DIPP), the Automobile industry attracted foreign direct investment (FDI) worth US$ 15.06 bn during the period Apr 2000 to March 2016 period.

Over the past few months, many global automobile companies have intensified their investment activity in India in particularly in this industry not only to meet the growing domestic demand but also to get the low cost manufacturing advantage. Some of the major investments and developments in the automobile industry in India are as follows:

- Japanese 2W manufacturer has opened its fourth and world's largest scooter plant in Gujarat, set up to initially produce 600,000 scooters per annum to be scaled up to 1.2 mn scooters per annum by mid-2016.
- American car maker has unveiled its iconic car in India and will make its debut in 2016
- An Auto Manufacturing company is in discussion with Government of India to bring electric and hybrid technologies to India as the government plans to reduce air pollution caused by vehicles.
- Global auto major plans to manufacture in India two families of engines by 2017, a 2.2 litre diesel engine codenamed Panther, and a 1.2 litre petrol engine codenamed Dragon, which are expected to power 270,000 Ford vehicles globally.

Impact of Make In India, FDI &Sector policies, Union Budget 15-16 and Goods and Services Tax

Make in India

"Make in India" is an initiative of the GoI to encourage multinational as well as domestic companies to manufacture their products in India. India made this announcement globally as the partner country at the 2015 Hannover Messe, Germany. India intends to leverage Industry 4.0 concepts and new technology in initiatives for manufacturing, smart cities, and overall infrastructure as part of the country's Digital India initiative.

Germany, is a crucial partner for India, especially for the Make in India programme and the success of its companies depends on disciplined processes that suits its stakeholders. The needs and strengths of both countries are complementary: In India, German companies are among the largest employers, and Germany is the second largest destination for Indian investment in Europe. India needs to develop and enhance the skill of its population, and develop an advanced manufacturing base. For this, a new level of collaboration is required. Major German companies are already participating in Make in India. German companies like Bosch and Mercedes are setting up R&D centres in India for their worldwide operations. This goes a long way to make a skilled India.

Incentives under Make in India:

R&D Incentives:

Industry/private sponsored research programs:

- A weighted tax deduction is given under section 35 (2M) of the Income Tax Act. A weighted deduction of 150 % is granted to assesee for any sums paid to a national laboratory, University or Institute of Technology, or specified persons with a specific direction, provided that the said sum is used for scientific research within a program approved by the prescribed authority
- A weighted tax deduction of 150% under section 35 (2AB) of the Income Tax Act for both capital and revenue expenditure incurred on scientific research and development (Expenditure on land and buildings are not eligible for deduction).
- Concessional excise duty of 6% has been extended without any clause in Union Budget 2015-16 for manufacturers of batteries supplying to producers of electrically operated vehicles.
- Exemption from Basic Custom Duty (BCD) on lithium ion automotive batteries for the manufacture of lithium ion battery packs for supply to manufacturers of hybrid and electric vehicles.

State incentives:

- Apart from the above, each state in India offers additional incentives for industrial projects. Incentives are in areas like rebates in land cost, relaxation in stamp duty exemption on sale or lease of land, power tariff incentives, a concessional rate of interest on loans, investment subsidies/tax incentives, backward areas subsidies, special incentive packages for mega projects.

Export incentives:

- Support to major markets has been given to the auto components and automobiles sectors under the new "Merchandise Exports from India Scheme" (MEIS).

Area-based incentives:

- Incentives for units in SEZ/NIMZ (Special Economic Zone and National Investment Manufacturing Zone) as specified in respective Acts or the setting up of projects in special areas like the North-east, Jammu & Kashmir, Himachal Pradesh & Uttarakhand

FDI Policy:

100% Foreign Direct investment (FDI) is allowed under the automatic route in the auto sector, subject to all the applicable regulations and laws. The automobile industry has attracted Foreign Direct Investment (FDI) worth US$ 15.06 bn during the period April 2000 to March 2016, according to data released by Department of Industrial Policy and Promotion (DIPP).

Goods and Services Tax (GST)

Due to multiplicity of taxes and elaborate compliance obligations the current Indirect tax regime in India provides for a complex tax environment The automobile industry has its own challenges such as unique market approach, longer investment cycle, dependency on vendors and component makers, substantial outsourced processes, etc.

India finally seems to implement a much-awaited tax regime post assent to the Constitution Amendment Bill on Goods and Services Tax (GST) in September 2016 by the President, a major step towards rolling out the new indirect tax regime which the government wants to bring into effect.

The GST stands for one singular tax to be imposed on all goods and services in the country and will replace all forms of indirect taxes that we, as consumers, are paying for right now. Once the GST gets implemented, it will absorb many of the currently levied state, central government and local body taxes. The biggest difference is that GST will be charged at the place of consumption rather than production.

Some positives & some negatives towards the Model GST Law relevant for the automobile sector are summarised below:

Advantages to Automobile industry of India:

1. **360 degree ease of doing business:**
   The new simplified and uniform tax structure will reduce the cascading effect of tax-over-tax and provide a 360-degree ease-of-doing business for the complete automobile ecosystem, be it suppliers, manufacturers, dealers and most importantly customers who will get the benefit.
2. **Cost advantage to local manufacturers:**
   GST implementation is likely to favour those automobile companies who manufacture their products in India. The locally manufactured vehicles are expected to get a cost advantage owing to lower taxation. For automobile companies relying on the CBU (Completely Built Unit) route, where no benefits are expected to be received.

3. **Quicker movement of new vehicles:**
Currently, all states have levied many indirect taxes on the movement of goods like entry tax, purchase tax, state VAT, cesses and surcharges. So all trucks carrying new vehicles from the factory to the dealers have to pass through multiple checkpoints on their route to pay taxes to the states. With GST implementation movement of goods is expected to become easier and faster.

4. **Boost to electric vehicle industry:**
The implementation of GST could also provide a much needed boost to the electric vehicle industry. Currently, the tax levied by state governments on green vehicles vary between 0 to 5%. Only Uttar Pradesh, Punjab and Bihar charge more than 14%. Road tax is almost nil in majority states. If we consider the average VAT levied on green vehicles across India, it comes up to approximately 4%. Automakers are expecting that the government should keep it either at par or at a lower rate than the current tax structure, for a certain period. If the government manages to do the task, it will definitely revive the electric vehicle industry in India.

5. **Fall in vehicle prices**
Currently the excise duty for vehicles is divided into four slabs, in which the smallest tax rate is applicable to small cars. With GST implementation, taxes levied by the centre like excise duty and state levels taxes like sales tax, road and registration tax would all be summed into one. The vehicle prices are expected to decrease and they might become more affordable with expected rise in demand.

There are much more advantages attached with the implementation of GST as it would create a 'One Market' industry in the future.

Challenges of GST

1. **Valuation disputes -** The Automobile industry has seen significant disputes under central excise valuation like:
   - Sale below the cost for market penetration,
   - Inclusion of State Industrial Promotion Subsidies retained by the manufacturer,
   - Deductibility of post-sale discounts from value under excise,
   - Valuation of demo cars, treatment of PDI charges and other dealer reimbursements,
   - Advertisement charges recovered from dealers etc.,
   - Sales through marketing companies and mutuality of interest.

The Model GST law continues with the concept of 'transaction value' which is a welcome measure however the powers for rejection of the transaction value are very wide, and could lead to significant valuation disputes.

2. **Job work -** The job work process is the backbone for automobile industry operations. The Model GST law treats 'job work' as a service and seeks to maintain existing excise procedures for the job work transactions, i.e. non-taxability of job work transaction and providing credits to the principal for supplies to job worker, 180 days condition for bringing back goods after job work, etc. However, some more clarity is needed in the conceptual framework for job work else will pose a challenge. For example:
   - Is job worker engaged in exempted or non-taxable supply?
   - Does 'job work' include situations where the job worker adds his own materials, or should all the materials belong to the principal?
   - Whether the input tax credit in respect of inputs, capital goods and input services received by job worker is eligible in the hands of the job worker or the principal?
   - Intra-State vs Inter-State job work – Whether provisions relating to supply and procedure for job work apply to both, intra-State and inter-State job work activities?

3. **Credits on vendor tooling -** Developing tools/ moulds for manufacture of parts of automobiles is a common practice in the automobile industry for vendors. Typically, the ownership of such tools is transferred to the OEMs, and the cost is also recovered from OEMs. However, the tools are physically located in the vendor's factory for manufacture of parts. Under the Model GST law, the definition of 'capital goods' covers only those goods which are used at the place of business of supply of goods.

Thus, only goods which are used in the place of business of OEM seem to be eligible for GST credit in the OEM's hands. This definition would pose a challenge to the OEMs in availing credits relating to tools located in the premises, on which cost is recovered by the vendors. This could possibly result in increase in the cost of tooling and the cost for manufacture.

4. **Time of supply for payment –** At present, under the excise law, duty is paid at the time of removal of the vehicles manufactured. VAT is paid at the time of sale of vehicles. The Model GST law specifies that the time of supply of goods shall be at the earliest of:
   - Date of removal of goods,
   - Date of which goods are made available to recipient,
   - Date of invoice,
   - Date of receipt of payment with respect to the supply,
   - Date of receipt of goods as shown in the books of accounts by recipient.
   - Under the existing law, receipt of advance towards supply of goods is not a taxable event, both under Central Excise and VAT law.

However, under the Model GST Law, receipt of advance is sought to be treated as a taxable event. Considering the practice of 'cash & carry' followed by vehicle manufacturers and also the dealer network following advance for supply with its customers, the change in the timing of supply would result in significant changes in the cash flow, and also procedural changes for manufacturers and dealers.

5. **Dealer incentive schemes –** In the current scenario, dealer incentive schemes are not subject to VAT, but there are issues on applicability of service tax on dealers, depending on the terms of each scheme. According to the industry these schemes are in the nature of post-sale discounts but not an independent service by dealers to the manufacturers.

   The Model GST law does not provide as to whether these incentives or discounts are subject to GST. The issue of whether these incentives/ discounts would impact the price and credits, or will these be kept out of GST (in the VAT chain), needs to be addressed, since the original supply would have already suffered GST and the buyer would have taken the input tax credit. Further, the another aspect that needs to be clarified is, in case such schemes are subject to GST, whether the same would be treated as a service or goods.

6. **Lack of clarity on subsuming of cess -**Various cesses like automobile cess, NCCD, tractor cess and infrastructure cess were applicable to the Automotive Industry. Now the Government intends to subsume all Central and State cesses into GST. However, the Model GST law and the constitutional amendment bill does not clarify whether these several cesses would be subsumed into GST or not.

7. **Input Tax Credit -**Capital goods are defined in the same manner as in existing CENVAT Credit Rules. Thus only the goods falling within specified Chapters to Model GST law will be considered for input tax credit. Also the inputs and inputs services definition provides few exceptions. Thus it appears that, restrictions on input tax credit will continue under GST as well. Further, a nexus of goods and services received is also required to be established with outward supplies. Accordingly, nexus-related litigation could continue under GST.

8. **Stock in the hands of dealer on the transition date possible double taxation -** The credit balances admissible under current structure can be carried forward under GST. For procurements made by dealers on payment of excise duty and CST for stock lying in hand, CST and excise duty are not admissible as credit under current scenario. Accordingly, with introduction of new model, the taxes/ duties included in stocks in hand with dealers have to be allowed. If these are not allowed under GST structure, then such stocks would suffer tax again, i.e. excise duty and CST paid, and CGST and SGST on supply after the appointed date. It is still not clear whether there would be a dual tax structure for small and big cars.

9. **Lack of clarity on MOU incentives -** State economy faces multiplier effect due to the significant investments by automobile companies. States generally provide various incentives including Investment Promotion Subsidies (IPS). Automobile manufacturers avail special benefits from the State Government in the form of State Investment Promotion Subsidies (IPS). This is given in the form of refund of VAT/ CST paid, or as a loan. Under GST regime, taxes move from state of Origin to state of Consumption. It would significantly reduce flow-back of IPS as Origin state does not get credit of inter-state sales. IPS gets impacted by shift in place of supply, but this issue does not arise under GST law. There would be severe effect on project viability for some mega automobile projects unless there is a compensation mechanism to the States or to the OEMs with regard to the impact on the IPS due to GST.

In spite of few concerns in draft model of GST law including some of the key aspects highlighted above, which need to be addressed, Automobile industry is looking forward to GST introduction.

Another major area of concern is restrictions and conditions on eligibility to tax credits on assets used for business. Also the credit mechanism should be more liberal.

With GST implementation the overall economic activity is expected to surge, leading to better GDP growth that should be able to push demand for vehicles across different categories. The impact of tax cascading is likely to go away leading to reduction of overall cost of manufacturing of vehicle. All taxes on input paid is expected to be offset with the output liability of GST.

c. Customer's perspective

Automotive industry is a brilliant example of witnessing the changes due to Industry 4.0. In the past, for each model of car, there were perhaps three or so "trim levels" and a choice of colour. Today, especially towards the higher end of the market, there is a long options list, from which people choose a range of add-ons and configurations, many of which are based on electronic technology. Theoretically, the number of unique configurations for each model runs into the millions, but all of these can be implemented at the final production line as a series of simple alternatives at each production stage. Industry 4.0 can be seen as an evolution in technology leading to a revolution in automobile industry. The benefits to the customer are many and widespread.

India is a young country. Nearly two-thirds of Indians are under 35; half are under 25. By 2020, India is expected to be the youngest country in the world, with a median age of 29 years, compared with a median age of 37 years in China at that point. India's large youth population could potentially make India the biggest consumer market and the biggest labour force in the world.

India's youth who dominate its 130 mn strong urban mass, earning US$ 3,200 (Rs.21,361) on average per month, is expected to be the key driver of the country's consumption story in the next 5-10 years. India has a young tech savvy and educated population which creates a consumer market deeply tied into mobility and connectivity. The consumer growth today is driven by not only life's essential needs (food, clothing and house) and but by growing consumption trends spanning eating better, looking better, mobility, connectivity, having more fun, well-being and luxury.

Indian market is ready to absorb the global trends as 86% India's Generation Y uses mobile phones, 78% has access to Internet and 75% has accounts on social media. With these mentioned statistics it is very imperative that the Indian youth is far more educated and aware than ever before. They are keen to acquire the newest technologies in the market and show interest in utilising the components of Industry 4.0. India is witnessed to be a dynamically driven country and welcomes new technologies introduced every now and then. Thus, if Indian automakers deter to provide them with the latest technologies it is likely to impact the auto sales internally and may drive influence towards global manufacturers.

Developments/components that will support India

Fourth industrial revolution, encompasses a wide spectrum of technological advances across the value-chain. It is considered an information revolution, which is the superimposition of big data, connectivity and information on top of industrial automation.

a. Convergence of disruptive technology

Digital transformations are being witnessed since the beginning of 20th century in all aspects of society and economy. The trend is affecting the overall process of manufacturing of goods. Industry 4.0 provides relevant answers to the new concepts of internet of things, big data and 3 D printing.

Automotive 4.0 is an exciting environment in which important changes in technology & customer preferences drive disruptive growth in various sectors of the economy through

- Autonomous Driving - Autonomous or driverless driving is expected to completely revolutionise the automotive industry
- Connected Cars - Connected cars take advantage of connectivity through Internet of Things" (IoT) and enables a new driving experience
- Car Sharing - Car sharing includes renting of cars for short periods of time, often by the hour and has revolutionised individual mobility, by making it more advantageous to not own a car, but pay per use
- Digital Customer Interface - Direct access to customers through digitisation will revolutionise the customer access and vision.
- Big Data and IoT - Big data and Internet of Things (IoT) will support manufacturing companies to run networked production systems via broader connectivity and management of data

b. Safety concerns and measures – R&D: - Front end structures with adjustable impact properties, Advanced driver assistance systems, Active safety systems, others

Safety assistance systems is associated majorly with passenger vehicles and on some level with commercial vehicles. Developed nations across North America, Europe and Asia were the first to look into such driver assistance systems for two wheelers, especially motorcycles with high power output. However, trends are changing now with the implementation of minimal safety systems, in the form of anti-lock brake system (ABS).

The European Commission has made it compulsory for all new type of motorcycles above 125 cc displacement to be equipped with ABS, which is projected to be implemented soon in India. India is a role model to a number of countries in Asia in the adoption of safety systems for two-wheelers, especially motorcycles.

Front end structures makes a substantial contribution to the safety of vehicles. However, today, alternative power-train configurations lead to significant changes in packaging space occupation and mass distribution within the vehicle, making front end impact system design more complex.

Front end designs uses deep drawn or extruded components, utilise non-linear causal relationships between material, component design, structural stiffness and energy absorption capacity.

Front End structures are designed to meet the safety challenges faced by the automotive sectors such as :

- Adjustability of the necessary impact behaviour for the respective powertrain type without the need to modify complex, tool-specific components,
- Front end structure with reduced dependence on the support function and packaging space occupation for the selected powertrain type

In order to drop the number of accidents or to minimise its impact, today's vehicles are equipped with Advanced Driver Assistance Systems (ADAS). ADAS has been successful in countries having more disciplined driving culture. With the increasing motorisation in developing nations such as India, there is a growing need to examine how these systems should be designed for innovative and emerging markets.

Indian market have different driving habits than those of developed countries and hence pose a challenge to the ADAS designers. In order to address the need, a detailed research is required to discover the most common traffic issues facing Indian drivers, how those issues differ from drivers in countries with better developed driving culture, and how these differences will mandate re-structuring of ADAS.

ADAS has multiple systems to help the driver in the driving process. When designed with a safe Human-Machine Interface, it maximises car and the road safety. It is designed to inform the driver about the driving paradigm, provide the recommendations in critical scenarios, enable the driver to delegate the tasks to the vehicle.

The new concept for implementing the customer requirement based ADAS is, where a real intelligent vehicle is operated in a virtual environment. This is suitable for various types of ADASs: Adaptive Cruise Control, Stop & Go,Blind Spot Systems, Forward Collision Warning, Pre-crash Systems and Fully Autonomous Vehicles.

Automotive safety systems are gaining lot of consideration from automakers as well as customers in order to protect the driver and passengers. Active safety features are electronic and computer controlled components which are entering all aspects of modern vehicles right from navigation system to advanced infotainment system.

In addition to comfort and convenience from electronic advancements, more opportunities exist to be explored in global automotive active safety system market. Global automotive active safety system market on the basis of product type is segmented as tyre-pressure monitoring system, lane departure warning, adaptive cruise control, night vision system, driver monitoring, anti-lock braking system and blind spot detection.

With growing economy and increasing disposable income in emerging economy such as India, is expected to be potential growth region in automotive active safety system market.

c. Adaptation and innovation in connected mobility segment

Innovations and changes are inevitable part of automobile industry. A US-based technology giant, in India invited startups to make demos of communication platforms for connected vehicles with the help of India's first incubator dedicated to connected transport. The intend was to understand how simulated experiences, of driving a connected vehicle, could be introduced into the real world.

India's leading vehicle manufacturer, announced plans to bring Android-enabled infotainment systems in its flagship models by an alliance with Automotive Alliance. Android Auto will enable Android phone users to seamlessly connect to a compatible car and use customised apps and services that will be accessible on an in-dash screen. After the integration with Android Auto, the company will have in-car access to Google maps, personalised services, and online applications through an infotainment screen.

The connected car features mainly revolves around integrating the smartphone features and giving a seamless end-user experience by utilisation of loads of information/ content through appropriate applications. Also, there are more fundamental connected services that can enable better serviceability, efficiency and maintenance that can make an immediate impact on the adoption by the end consumer. Emergency/breakdown services, eco-routing, dynamic traffic information, early warnings related to vehicle health, etc. can largely benefit the customer. When consumers will see the value in the services/content, they will be more than willing to pay for what they are getting.

There are many hindrances today like reliable connectivity, big data and the associated costs for the technology/ solutions for transiting connected cars in India from Niche to mainstream. However these are well on their way towards maturity. The combination of changing Indian macro and micro economic, political and business scenarios has given the impetus for embracing this technology.

Ecosystem players are also reaching a maturity level sufficient enough to offer the "connected experience" seamlessly to the connected car customer.

d. Internet of Thing s- Developments/ components that will support India

The internet of things is budding exponentially and is reaching different verticals and industries. India is one of the countries where a lot of innovation is happening around IoT across different verticals and technologies. The IoT ecosystem in India is mainly driven by 3 players: Government, Industry and Start-ups.

Government's objective is to create an IoT industry in India of US$ 15 bn by 2020. One of the key initiatives of the Government is to build smart cities across the country. Major aspects of a smart city in automotive sector being focused by the Government are: Smart parking, Intelligent transport system, Tele-care ,Woman Safety Smart grids, Smart urban lighting, Waste management, Smart city maintenance, Digital-signage and Water Management etc.

Key initiatives taken by Government is the formation of Centre of Excellence on Internet of Things as a joint initiative with NASSCOM. As part of this joint initiative, Government plans to nurture and grow the IoT ecosystem.

Another major player in this ecosystem is the Industry. IoT will transform how companies do business when they grab onto its innovations. IoT offers better control of companies' logistics. The use of the data can also enables the industries to offer their customers near real-time tracking of shipments.

IoT applications are massive and it will be used in consumer, agriculture, environmental, medical, retail, military, automotive and industrial need. IoT components include Sensors, power management devices, amplifiers, signal acquisition devices, micro-controllers, processors, battery monitoring ICs, and low power RFICs.

Transport and automobiles sector is one of the biggest vision in India. Connected Transport systems are growing rapidly. Major value propositions identified in connected transport:

- Opportunities in on-board diagnostics for both B2B and B2C businesses
- Embedded wireless connections are new to India, the smartphone users are the target market
- Third-party servicing, which can integrate a range of services and products from OEMs and service providers and ensure smooth maintenance of connected transport services

Automobile industries are chief adopters aiming to feature-rich, harmless and cost effective products and services. Transforming strategies that are being worked upon currently are:

- Usage Based Insurance (UBI) – It supports the device incorporated in vehicles to capture data and transmit it to the IoT platform which is then managed by UBI platform.
- Intelligent Emergency Calling (e-Call) – It enables cars to automatically call emergency services in case of a serious crash.
- Stolen Vehicle Tracking (SVT) – It helps to track the stolen vehicle via a connected network.

Few innovations in Iot in progress for transforming Indian automotive sector done by the companies are :

- An online truck booking service provider wants to revolutionise India's transport and logistics by introducing an online framework and structure for the transportation of goods.
- A popular rider assistant and activity tracker for motorcycle riders and commuters developed an artificial intelligence based connected helmet that promotes safety and keeps the rider informed of the risk on his route. The helmet is equipped with Bluetooth for connectivity, rear view camera and GPS and navigation display.
- India's leading motorcycle and scooter manufacturer took initial steps towards IoT by GPS enabling its fleet, getting real time data of truck location and linking that with its sales and distribution data to take actions as may be required. This also helped its dealers and sales teams to get real time information on location of goods.

Startups also plays key role in current technological driven economy. Bangalore, Mumbai, Pune and Hyderabad are the four major cities where startups are making a breakthrough. These are silently disrupting and innovating thereby breaking and creating newer realms each day within the IoT space.

India is making progress and have exciting years to look forward to. The synergistic working of Government, Industry and Startups will drive the eco-system to new heights.

e. Big data and analytics

Big data — in combination with the Internet of Things (IoT), a domain where the majority of gadgets, machines, and humans are connected to the internet and to each other — promises a future where all important decisions about business, life, and society would be taken majorly on the basis of data.

Getting things connected in an IoT world is good, but that in itself does not generate value. Real value comes from areas such as analytics improving the yield of a manufacturing line, or providing predictive maintenance and high-value assets like wind farms or energy stations.

India is one of the most populated country in the world and hence a mine for data analysts to research, collect and analyse data. The momentum that big data analytics has gained in India, has facilitated the launch of 'Big Data Initiative' by the Indian government to build a sustainable eco-system that brings in a strong partnership across the industry players and government. The Indian government has launched a Big Data Initiative, with the following aims:

- Promoting and developing big data science, technology and applications in India and developing core generic technologies, tools and algorithms for broader applications in the government
- Understanding the current status of the industry in terms of opportunities, varied players providing services across sectors, market size, SWOT analysis, current skill levels available etc.
- Carrying out market landscape surveys to assess the future opportunities and demand for skill levels in next 10 years
- Conducting gap analysis in terms of skills levels and policy framework
- Surfacing a strategic road map and action plan clearly outlining of roles of various stakeholders in the economy with defined timelines and outcome for the next 10 years.

f. Cyber Security- Developments/components that will support India

India's national security architecture faces a difficult task in cyberspace. India's infrastructure is subject to four kinds of digital intrusions: surveillance, which involves intruding into systems to steal information of strategic or commercial value; cybercrime, referring to electronic fraud or other acts of serious criminal consequence; attacks, intended at disrupting services or systems for a temporary period; and war, caused by a large-scale and orderly digital assault on India's critical installations.

Securing the cyberspace has become an important precedence for governments, businesses and citizens across the world. In line with the Prime Minister's vision of making India a cyber-security expert nation and his recent exhortation to the industry NASSCOM has created cyber security task force. This taskforce aims to make India a global hub for providing cyber security solutions including cyber security products and services. The taskforce will focus on the four key pillars of Industry development, Policy enablement, Technology development and Skill development. The vision of the taskforce aims to build the cyber security industry in India from the 1 percent market share to 10 percent by 2025.

India should not hesitate to build its aggressive cyber capabilities. This would involve the development of software designed to intrude, intercept and exploit digital networks. India currently has a top layer of agencies performing cyber operations — the National Technical Research Organisation, the National Intelligence Grid, and the National Information Board etc.

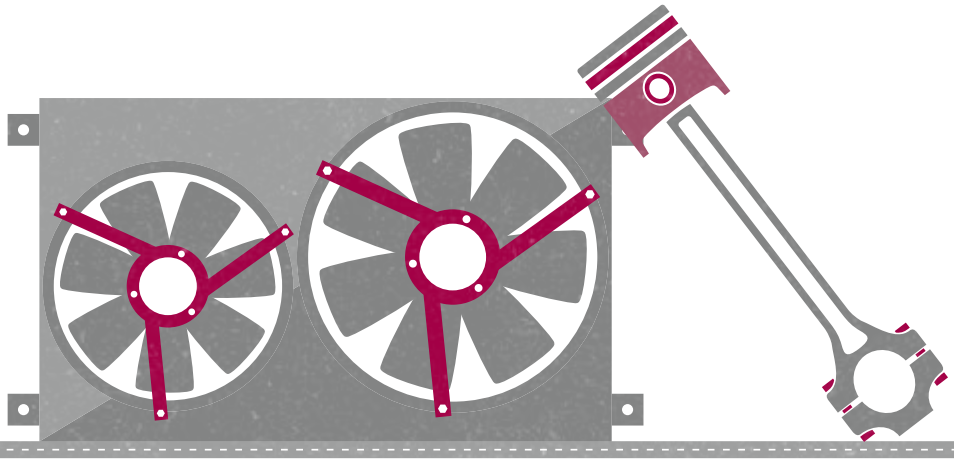
With recent innovations in technology and increasing volumes of data being stored and used, organisations are under extreme pressure to secure sensitive data from all types of external and internal threats.

In relation to cyber security threats, the automotive industry senses the same cyber pain as other industries. They are endangered by phishing and breached by Advanced Persistent Threat.

The automotive industry aims for a connected future, security should be integrated as a part of any design principle corresponding to business strategy, and not treated as an investment concern.

A cyber-secure architecture uses IT security needs as a design standard and not as an added layer that increases complexity, which, in turn, facilitates greater multichannel integration, supporting modularity and protected Application Programme Interface to permit integration among varied partners.

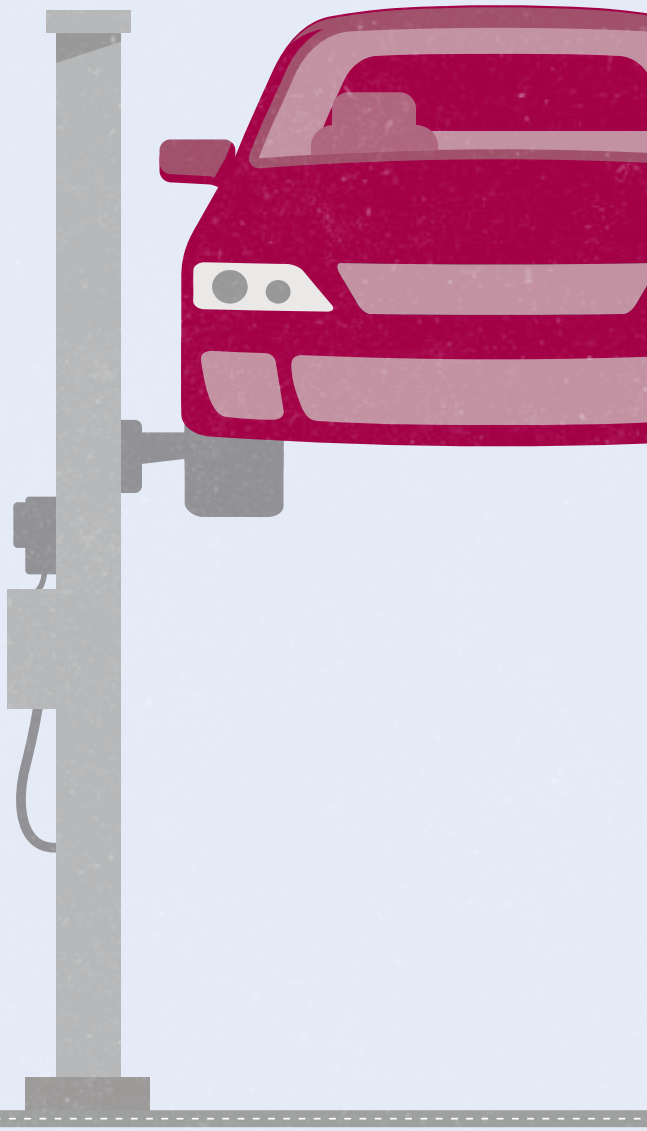
The automotive sector needs to grow with security protocols at customer and value chain touch points for a broad resistance against a larger business threats. The future could see a connected ecosystem that assimilates new technologies and services, and look at investments as an optimistic tactic to tackle both vehicle- and infrastructure-level security apprehensions.



Conclusions

Industry 4.0 will revolutionise manufacturing around the globe, as did the first three industrial revolutions. With global supply chains and highly interactive markets, this revolution will be vastly different from the previous ones: being much faster and generating results that were heretofore unexpected. It will highlight the fact that small changes in one area of the manufacturing ecosystem will create significant ripples throughout the ecosystem, due to connectivity throughout the supply chain and the speed at which information propagates. Furthermore, Industry 4.0 will enable information to flow not only from manufacturer to product, but between producers, products and, most importantly, customers. The ability to embrace Industry 4.0 and use the opportunities that will rapidly (and, in many instances, unexpectedly) present themselves will be a key to success in the new global market. Enabling that innovation to proceed from a concept to a mass-produced product will be critical for success; and ensuring a talent pool in the manufacturing workforce that can move those innovations rapidly forward will be equally important. India has a number of programs to enable innovation and ensure the talent pipeline for manufacturing. Some are well established, and others are quite new and very innovative. It is clear that Industry 4.0 presents tremendous opportunities, and this fact highlights the need for a highly trained and flexible workforce and production capacity that can answer the needs of tomorrow as well as those of today.

In closing, it is appropriate to quote Eric Hoffer (1902-1983), a 20th century American philosopher: "In times of change, learners inherit the earth; while the learned find themselves beautifully equipped to deal with a world that no longer exists." This statement was true in the 20th century and is certainly true today. However, with the ever accelerating pace of technology innovation, it will become increasingly pertinent in the future. India stands ready for that future: not only to participate, but also to lead!



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Glossary

- **ACMA -** The Automotive Component Manufacturers Association of India is the apex body representing the interest of the Indian Auto Component Industry.
- **ADAS -** Advanced Driver Assistance Systems, are systems to help the driver in the driving process. When designed with a safe Human-Machine Interface, they should increase car safety and more generally road safety.
- **AMP-** The Automotive Mission Plan 2016-26 is the collective vision of Government of India (Government) and the Indian Automotive Industry on where the Vehicles, Auto components, and Tractor industries should reach over the next ten years in terms of size, contribution to India's development, global footprint, technological maturity, competitiveness, and institutional structure and capabilities.
- **CPDM -** The Centre for Product Design and Manufacturing was established to pursue excellence in teaching, research and industry interaction in the area of Design. The Centre is the only place in India pursuing an active research programme in Design spanning the broad areas of Design Theory and Methodology, Human Factors in Design, PLM and, Vehicle Design, Simulation and Testing.
- **CUVs -** Crossover utility vehicle is a vehicle built on a car platform and combining, in highly variable degrees, features of a sport utility vehicle (SUV) with comfort from a luxurious vehicle. CUV usually has more riding comfort and more fuel efficient than SUV's.
- **CxF –** Colour Exchange Format is a universal file format for digital colour communication. It is a new standard allowing seamless, worldwide, digital communication of all commercially significant aspects of colour
- **Cyber Physical Systems (CPS) -** A cyber-physical system (CPS) is a mechanism controlled or monitored by computer-based algorithms, tightly integrated with internet and its users. In cyber physical systems, physical and software components are deeply intertwined, each operating on different spatial and temporal scales, exhibiting multiple and distinct behavioural modalities, and interacting with each other in a myriad of ways that change with context.
- **DIPP -** Department of Industrial Policy & Promotion was established in the year 1995, and in the year 2000 Department of Industrial Development was merged with it. This department is responsible for formulation and implementation of promotional and developmental measures for growth of the industrial sector, keeping in view the national priorities and socio-economic objectives.
- **FAME -** Faster Adoption and Manufacturing of Hybrid and Electric vehicles in India - is part of the National Electric Mobility Mission Plan. In April 2015, to promote eco-friendly vehicles, the government launched the FAME India scheme, offering incentives on electric and hybrid vehicles of up to Rs 29,000 for bikes and Rs 1.38 lakh for cars.
- **Finger cot -** A finger cot is a medical supply used to cover one or more fingers in situations where a full glove is unnecessary. Like medical and rubber gloves, finger cots are made from a variety of water-tight materials including latex, nitrile rubber, and vinyl.
- **GNSS -** A satellite navigation system with global coverage is termed a Global Navigation Satellite System (GNSS). It is a system that uses satellites to provide autonomous geo-spatial positioning. It allows small electronic receivers to determine their location (longitude, latitude, and altitude/elevation) to high precision (within a few metres) using time signals transmitted along a line of sight by radio from satellites.

- **GPS –** It is a global navigation satellite system (GNSS) that provides geolocation and time information to a GPS receiver in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites. The GPS system operates independently of any telephonic or internet reception.
- **Green Energy Corridors -** The Green Energy Corridor Project is an upcoming project which aims at synchronising electricity produced from renewable sources, such as solar and wind, with conventional power stations in the grid.
- **HPTC –** High Performance Technology Centre. HPTC often refers to the application of HPC to engineering problems and includes computational fluid dynamics, simulation, modelling, and seismic tomography in the various industries
- **Industrial Internet of Things" (IoT) –** It is the use of Internet of Things (IoT) technologies in manufacturing activities. IIoT incorporates machine learning and big data technology, harnessing the sensor data, machine-to-machine (M2M) communication and automation technologies.
- **JDF –** Job Definition format is a technical standard being developed by the graphic arts industry to facilitate cross-vendor workflow implementations of the application domain. It is an XML format about job ticket, message description, and message interchange.
- **NASSCOM -** The National Association of Software and Services Companies is a trade association of Indian Information Technology (IT) and Business Process Outsourcing (BPO) industry. Established in 1988, NASSCOM is a non-profit organisation. NASSCOM is a global trade body with over 2000 members, of which over 250 are companies from the China, EU, Japan, US and UK.
- **NATRiP-** National Automotive Testing and R&D Infrastructure Project the largest and one of the most significant initiatives in Automotive sector so far, represents a unique joining of hands between the Government of India, a number of State Governments and Indian Automotive Industry to create a state of the art Testing, Validation and R&D infrastructure in the country.
- **NEMMP -** The National Electric Mobility Mission Plan 2020 is one of the most important and ambitious initiatives undertaken by the Government of India that has the potential to bring about a transformational paradigm shift in the automotive and transportation industry in the country.
- **Network Readiness Index -** The World Economic Forum's Networked Readiness Index (NRI), also referred to as Technology Readiness, measures the propensity for countries to exploit the opportunities offered by information and communications technology (ICT). It is published in collaboration with INSEAD, as part of their annual Global Information Technology Report (GITR). The report is regarded as the most authoritative and comprehensive assessment of how ICT impacts the competitiveness and well-being of nations
- **NFC -** It is a short-range wireless connectivity standard that uses magnetic field induction to enable communication between devices when they're touched together, or brought within a few centimeters of each other.
- **NNMI -** Network Node Manager is a program that helps a network administrator view and manage the conditions in a computer network.
- **OEMs -** Original Equipment Manufacturer is the original producer of a vehicle's components, so OEM car parts are identical to the parts used in producing a vehicle.
- **PLM –** Product lifecycle management is the process of managing the entire lifecycle of a product from inception, through engineering design and manufacture, to service and disposal of manufactured products
- **RFID -** Radio-frequency identification uses electromagnetic fields to automatically identify and track tags attached to objects. The tags contain electronically stored information.
- **SEZ/NIMZ** stands for Special Economic Zone and National Investment Manufacturing Zone respectively. These Zones have been earmarked under National Manufacturing Policy. These are Industrial Townships with available infrastructure. On the other hand, SEZ stands for Special Economic Zone, where businesses get some sort of tax benefits
- **Smart factory, smart operations, smart products,-** They have the ability to improve processes through self-optimisation and autonomous decision-making. The processes impacted will include , factory and production planning, product development, logistics, enterprise resource planning (ERP),manufacturing execution systems (MES), control technologies, individual sensors and actuators in the field

- **Smart glasses –** They are fitted with a camera that allows employees to take photos and record videos which they can add to their reports to achieve greater accuracy than handwritten notes.
- **SUVs -** Sport Utility Vehicle is a type of 4-wheeler which can run in almost all types of Roads, They have very spacious interiors and sturdy exterior, which makes them one of the best option for on or off-road driving.
- **SVT -** A Stolen Vehicle Tracking system that combines the use of automatic vehicle location in individual vehicles with software that collects these fleet data for a comprehensive picture of vehicle locations.
- **UBI -** Usage-Based Insurance also known as pay as you drive (PAYD) and pay how you drive (PHYD) and mile-based auto insurance is a type of vehicle insurance whereby the costs are dependent upon type of vehicle used, measured against time, distance, behaviour and place.
- **UNIDO -** United Nations Industrial Development Organisation is the specialized agency of the United Nations that promotes industrial development for poverty reduction, inclusive globalisation and environmental sustainability. Its mission is to promote and accelerate inclusive and sustainable industrial development (ISID) in developing countries and economies in transition.
- **VDMA -** The Mechanical Engineering Industry Association (Verband Deutscher Maschinen- und Anlagenbau – VDMA) has its headquarters in Frankfurt am Main, Germany. The Association represents the interests of the companies in the mechanical engineering industry towards policymakers and society, as well as towards business, the scientific community, public authorities and the media.
- **World Economic Forum (WEF). -** The World Economic Forum (WEF) is a Swiss nonprofit foundation, based in Cologny, Geneva. It is an international institution for public-private cooperation.
- **3D printing –** It is as an additive manufacturing (AM), used to synthesize a three-dimensional object in which successive layers of material are formed under computer control to create an object.

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

CII is a non-government, not-for-profit, industry-led and industry-managed organisation, playing a proactive role in India's development process. Founded in 1895, India's premier business association has over 8000 members, from the private as well as public sectors, including SMEs and MNCs, and an indirect membership of over 200,000 enterprises from around 240 national and regional sectoral industry bodies.

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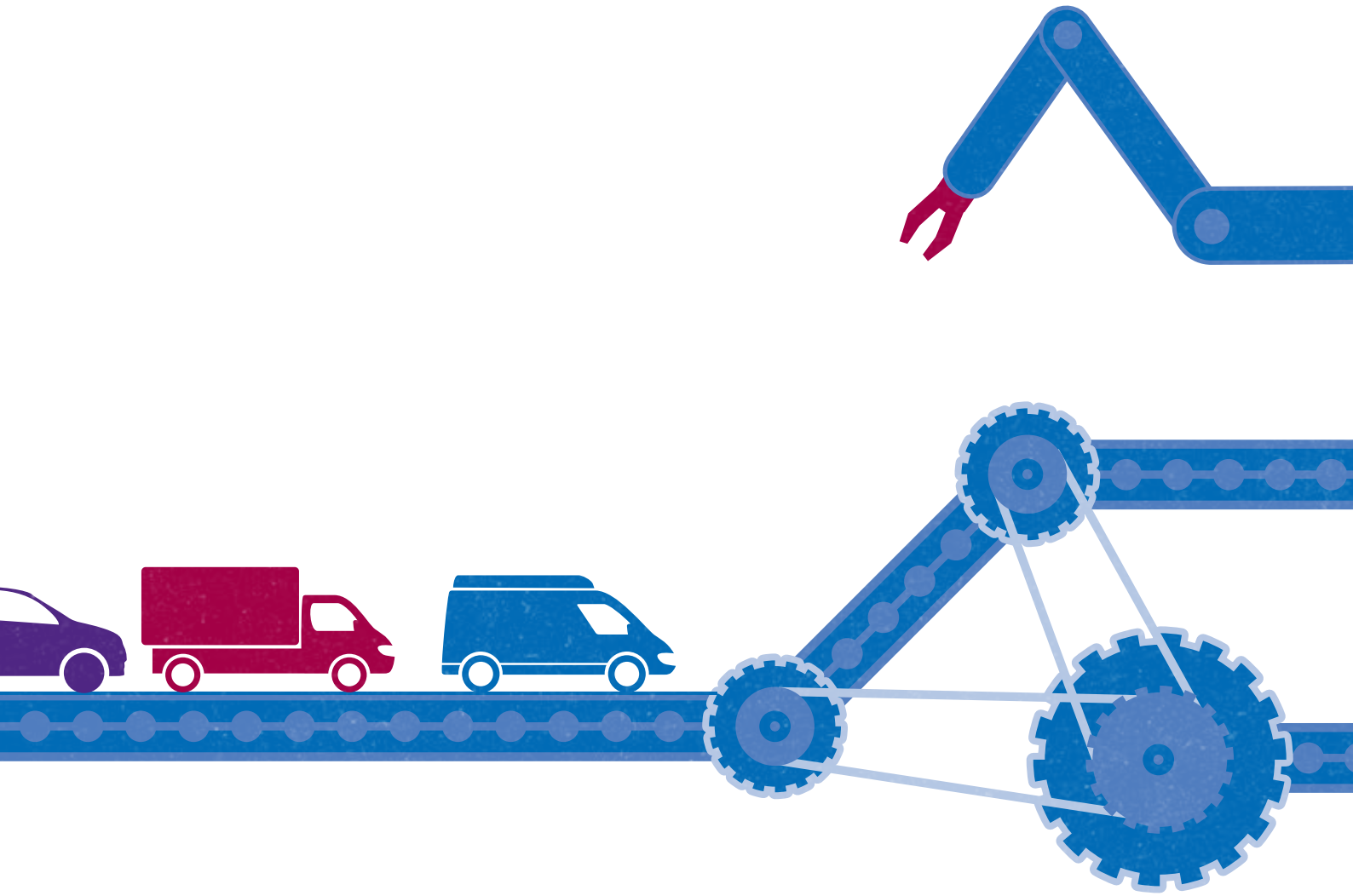

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