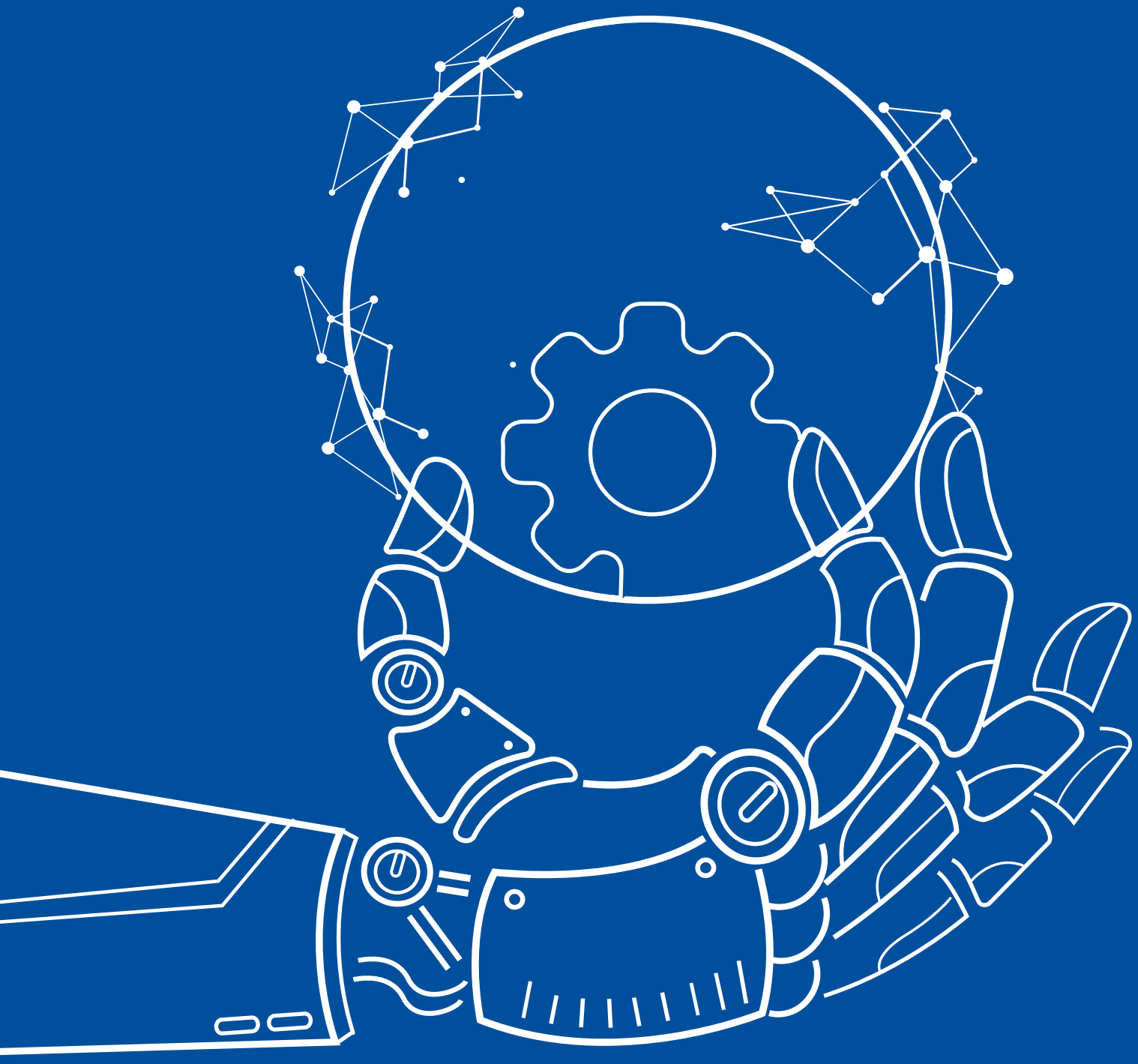
Artificial Intelligence in India - Vol. 4



FRIEDRICH EBERT STIFTUNG

Industrial Revolution 4.0 and the Impact on Automotive Sector

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Industrial Revolution 4.0 and the Impact on Automotive Sector

December 2019

Preface

"After all, we make ourselves according to the ideas we have of our possibilities."
V.S. Naipaul

There is no doubt that the technological advancement has become the game changer of our times. From the Industry 4.0 discourse launched in Germany in 2011 to the scientific advisory report presented to the former US president Barrack Obama on big data and privacy concerns in 2014, to India's NITI Aayog Artificial Intelligence for All strategy of 2018. A lot of debates have culminated in the questions about the Future of Work in the context of the International Labour Organisation's Centenary in 2019. Triggered by the disruptive forces of technology based start-ups and new business models, a new race for innovations and war for talents has arisen and with it, a new form of global and fierce competition.

Technology has become the holy grail of progress though it did not take long to realise that there is a social dimension attached to it. The platform economy has had severe effects on the bargaining power of suppliers and workers. Data analytics opened a whole array of ethical questions regarding personal tracking and privacy. Further, technological upgrades create productivity gains by efficiency which in turn requires reduced human labour. This poses a particular threat to emerging economies,like India, which need to create new jobs on massive scale for its young and growing population.

The utopia around Artificial Intelligence in the times of jobless growth presents a whole new set of challenges. Is the Indian economy ready to ride the AI wave? Who will benefit from AI: investors, big tech, users, or society as a whole? What is and can be India's role in this global race for innovation? Is tech gender neutral? What about privacy and user protection? How to ensure decent work and social protection in this new age tech revolution? But mostly, how can we turn AI FOR ALL into a reality?

To foster this debate, the FES India Office has teamed up with several experts and organisations across the country to explore ground realities with the objective to understand how technology is already unfolding in selected sectors, draft scenarios of what might happen and to ensure proper safeguards are put in place at the right time.

Artificial Intelligence like any other technology is neither good nor bad. It is what we make out of it - the rules and regulations – which define the outcome of the game. Just like other countries, in India too, a mass scale application of AI is far from being established. It is still in a nascent phase and can be moulded into a success story. A success story in India AND Indian success story for all.

Patrick Ruether and Mandvi Kulshreshtha
December 2019
Friedrich-Ebert-Stiftung, New Delhi

Note of thanks

Friedrich-Ebert-Stiftung (FES) India office is thankful to its partner The Dialogue for preparing this research paper. The Dialogue is an emerging research and public-policy think-tank with a vision to drive a progressive narrative in India's policy discourse. The Dialogue has prepared two research papers for FES India. The present one is on Industrial Revolution 4.0 and the impact on Automotive Sector. The second one is on Industrial Revolution 4.0 and the impact on IT sector.

We are grateful to our colleagues at The Dialogue for preparing the research, drafting this paper and refining the manuscript to reflect our joint vision. We have to express our appreciation to all the experts and resources persons who participated in these labs, for their constructive contribution and valuable time during the course of this research.

Contents

List of abbreviations

AI	Artificial Intelligence
ASEAN	Association of Southeast Asian Nations
CAD	Computer Aided design and Drafting
CAGR	Compound Annual Growth Rate
CII	Confederation of Indian Industry
CKD	Complete Knock Down
FAME	Faster Adoption and Manufacturing of (Hybrid) and Electric Vehicles in India
FDI	Foreign Direct Investment
FY	Financial Year
EV	Electric Vehicles
HMSI	Honda Motorcycle and Scooter India
IIT	Indian Institute of Technology
ILO	International Labour Organisation
ITI	Industrial Training Institutes
IT	Information Technology
MSIL	Maruti Suzuki India Limited
MSMEs	Micro Small and Medium Enterprises
MTOC	Model, Type, Option and Colour
NATRiP	National Automotive Testing and R&D Infrastructure Project
NEMMP	National Electric Mobility Mission Plan
NIT	National Institute of Technology
NSDA	National Skill Development Agency
NSDC	National Skill Development Corporation
OEMs	Original Equipment Manufacturers
PwC	PricewaterhouseCoopers
R&D	Research and Development
SAARC	South Asian Association of Regional Co-operation
SIAM	Society of Indian Automobile Manufacturers
SSCs	Sectoral Skill Councils
STEM	Science, Technology, Engineering and Mathematics
US	United States (of America)

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Foreword

There are many nuances to the debate around Industry 4.0. The most heated are those around automation and its implications on the future of work. Nearly every manufacturing industry — automobiles included — will see the nature of work metamorphose substantially.

What does this mean for India, a labour surplus country? The World Bank's South Asia Economic Focus Spring 2018 report stated that between 2015 and 2025, India's working age population or those above the age of 15, is expanding by 1.3 million a month. There are sporadic calls to be "mindful" on how much to automate but companies will increasingly find automation easier to justify. There are a few reasons why.

One, price realisation is a challenge. There are only two levers to retain margins on a product: cost reduction or increase in the price of the product. Price increase is limited because of competition. Manufacturers across the world, therefore, are resorting to an unparalleled use of technology to beat costs. Two, adoption of Industry 4.0 will stop being an option — India has a productivity gap and she must catch up to global standards to remain competitive. Indian manufacturing's contribution to the country's GDP has remained stagnant at about 16 per cent for many years. In automobiles, the labour productivity is 10-15 per cent lower compared to countries such as Japan, Korea, and the US.

A third reason is the cost of automation. A few years ago, adoption involved heavy capex — now it is opex. There are many finance schemes. Low cost robots are being developed by Indian companies particularly targeting the small businesses. Last but not the least, is India's record of labour disputes, its archaic labour laws such as the Industrial Disputes Act of 1947. The cost of settling labour disputes can shoot through the roof. When the pros and cons are weighed, it could tilt the scales in favour of automation.

The implications of Industry 4.0 on India's labour market, and the nature of work, are equally massive. Earlier, shop floor jobs would have been needed in higher numbers. With automation, now one needs a larger number of engineers. Because designs and the machines are programmed and controlled by computers, maintenance jobs related to automation systems will grow. These jobs are more services-like as they provide support functions. Related to this phenomenon, is a mega-trend that will hit Indian manufacturing soon. The sharp lines between the blue-collar worker and the white-collar will collapse in many factories. The blue-collar role, overtime, will shrink and some roles could merge into white-collar functions. With Industry 4.0, there is a clear bias towards workers with higher skills and the super skilled jobs are no longer blue-collar.

Another implication is around trade unions. The power of collective bargaining is withering and is bound to wither further with automation. This is bad news for wages, and the working conditions of factory workers.

It is in this context that the report, 'Industrial Revolution 4.0 and the impact on automotive sector' is both timely and interesting. The policy recommendations couldn't be more precise. They harp on the need for up-skilling, the only panacea to exponential technologies disrupting our world, and our work. Most often in India, skilling starts too late, when the worker is an adult. The future of work demands that vocational training start early, in school. There got to be a focus on the 'maker's mindset' and higher critical thinking. One recommendation here is worth noting: "Education curriculum should be such which does not focus on rote-learning. Basic STEM skills and simultaneously human skills that robots cannot replace should be part of the educational curriculum".

Goutam Das
Senior Editor at Business To day
Author of *Jobonomics: India's Employment Crisis and What the Future Holds*

Acknowledgements

We would like to thank Centre for Internet Society's contribution and support towards shaping this research paper, from its conception to final execution. We would like to thank Mr. Ayush Rathi and Mr. Sunil Abraham for their regular guidance and support towards helping The Dialogue develop this research study. Our research builds from CIS' own research on this subject and their contribution has played a fundamental role towards guiding The Dialogue's research on this subject. This includes the research outline, methodology, and the stakeholders who helped The Dialogue develop an understanding the role of automation in the automotive sector in India.

Moreover, we would like to thank Ms. Rakhi Sehgal, who's contribution and knowledge in the automotive sector, from the stakeholder identification to familiarisation of the sector has been very helpful. Without her contribution this study would not have been possible.

The data presented and analysed in this report were collected during multiple tours of research in the automotive clusters of Gurgaon, Manesar, Dharuhera and Bawal (India). The research was conducted from April 2019 to June 2019 and was supported by Friedrich-Ebert-Stiftung, India. We gratefully acknowledge the generous support of these agencies. We are grateful to multiple labour union's personnel who allowed us access to the manufacturing plants during their working hours and explained the impact of automation on their roles.

Our heartfelt thanks to fellow civil society organisations, industry bodies, Government of India and public and private universities for sharing their views. We extend our gratitude to Mr. Gyan Tripathi, for his research assistance.

Here is a list of the stakeholders who were interviewed for the study:

Apoorva Kaiwar, IndustriALL, Global Trade Union
Arun Maira (Dr.), Former Planning Commission Member
Avik Sarkar (Dr.), Niti Aayog Head, Data Analytics Cell (erstwhile) Now - Professor Indian School of Business
Biswajit Bhattacharya (Dr.), Partner & Executive Director, IBM
Goutam Das, Journalist, Business Today
Labour Union Members - Maruti Suzuki Pvt. Ltd.
Labour Union Members - Mark Exhaust
Miranda Fajerman, International Labour Organisation, Labour Law and Labour Standards Specialist
Prabhat Chaturvedi, Retired I.A.S. Officer (Former Secretary, Labour and Employment - Govt. of India)
Radhika Radhakrishnan, Programme Officer, The Centre for Internet and Society
Rohan Seth, Program Manager, The Takshashila Institute
Rohit Gupta, Unit Head, New Product Development Asahi India Glass Limited
Santosh Mehrotra (Prof.), Centre for Labour Studies, Jawaharlal Nehru University
Saon Ray (Dr.), Senior Fellow, Indian Council for Research on International Economic Relations

Executive Summary

Industry 4.0 - the emerging disruptive technology-driven phenomenon is inevitable in light of the dynamic era we are in today and is likely to change the way industry players and the government looks at production. With the vision of the government to make India a major hub for automotive manufacturing, the opportunities presented by Industry 4.0 are enormous and need to be capitalised.

The research methodology here is qualitative in nature. The first stage began with conducting an exploratory research by way of document analysis. Based on the results of stage one, we undertook a simultaneous Qualitative and Quantitative Research in Manufacturing plants of Original Equipment Manufacturers (OEMs) and Auto-Component Sector (Tier I and Tier II suppliers). We interviewed the industry stakeholders-right from the plant heads to the trade union workers-and government bodies. The outcome of stage two has been analysed qualitatively and produced herein.

This report lays out the key stakeholders in the automotive industry of India, contextualises the work, by dividing it into tasks within the sector and co-relates it with the factors driving change in work in the sector. The last section summarises the impact of Industrial Revolution on the industry, individuals and collectives. Policy Recommendations are furthered along with a brief annexure on impact of electric mobility goals of the Government of India in the automotive sector.

Introduction

The Indian auto industry became the 4th largest in the world with sales increasing 9.5 per cent year-on-year to 4.02 million units (excluding two wheelers) in 2017. It was the 7th largest manufacturer of commercial vehicles in 2018. The Two Wheelers segment dominates the market in terms of volume owing to a growing middle class and a young population. Moreover, the growing interest of the companies in exploring the rural markets further aided the growth of the sector. There are 4 major automobile clusters in India namely: 1) Delhi – Gurgaon – Manesar – Neemrana, 2) Kolkata – Jamshedpur, 3) Chennai – Bengaluru – Hosur, 4) Mumbai – Pune – Nashik – Aurangabad.

India is also a prominent auto exporter and has strong export growth expectations for the near future. Automobile exports grew 14.5 per cent during FY 2019. It is expected to grow at a CAGR of 3.05 per cent during 2016-2026. In addition, several initiatives by the Government of India and the major automobile players in the Indian market are expected to make India a leader in the two-wheeler and four-wheeler market in the world by 2020.The Government of India encourages foreign investment in the automobile sector and allows 100 per cent FDI under the automatic route. The government aims to develop India as a global manufacturing centre and an R&D hub. Under the National Automotive Testing and R&D Infrastructure Project (NATRiP), the Government of India is planning to set up R&D centres at a total cost of US$ 388.5 million to enable the industry to be at par with global standards. The Ministry of Heavy Industries, Government of India has shortlisted 11 cities in the country for introduction of electric vehicles (EVs) in their public transport systems under the FAME (Faster Adoption and Manufacturing of (Hybrid) and Electric Vehicles in India) scheme. The government will also set up incubation centre for start-ups working in electric vehicles space. In February 2019, the Government of India approved the FAME-II scheme with a fund requirement of Rs 10,000 crore (US$ 1.39 billion) for FY 2020-22.

The automotive sector across the world is witnessing technological upgradation in the garb of Industrial Revolution 4.0 and the Government of India is catering to the same in India.

I. Industry 4.0 in the automotive sector in India

Almost all aspects of human life are today impacted by technological advancement. Automotive sector, which is quite a labour intensive sector for India is no exception. Different segments of the sector have witnessed different forms of technological upgradation. While the study elaborates on particular technologies having impacted particular tasks within the segment in the subsequent chapter, the automotive sector as a whole has seen deployment of the following technologies at different stages.

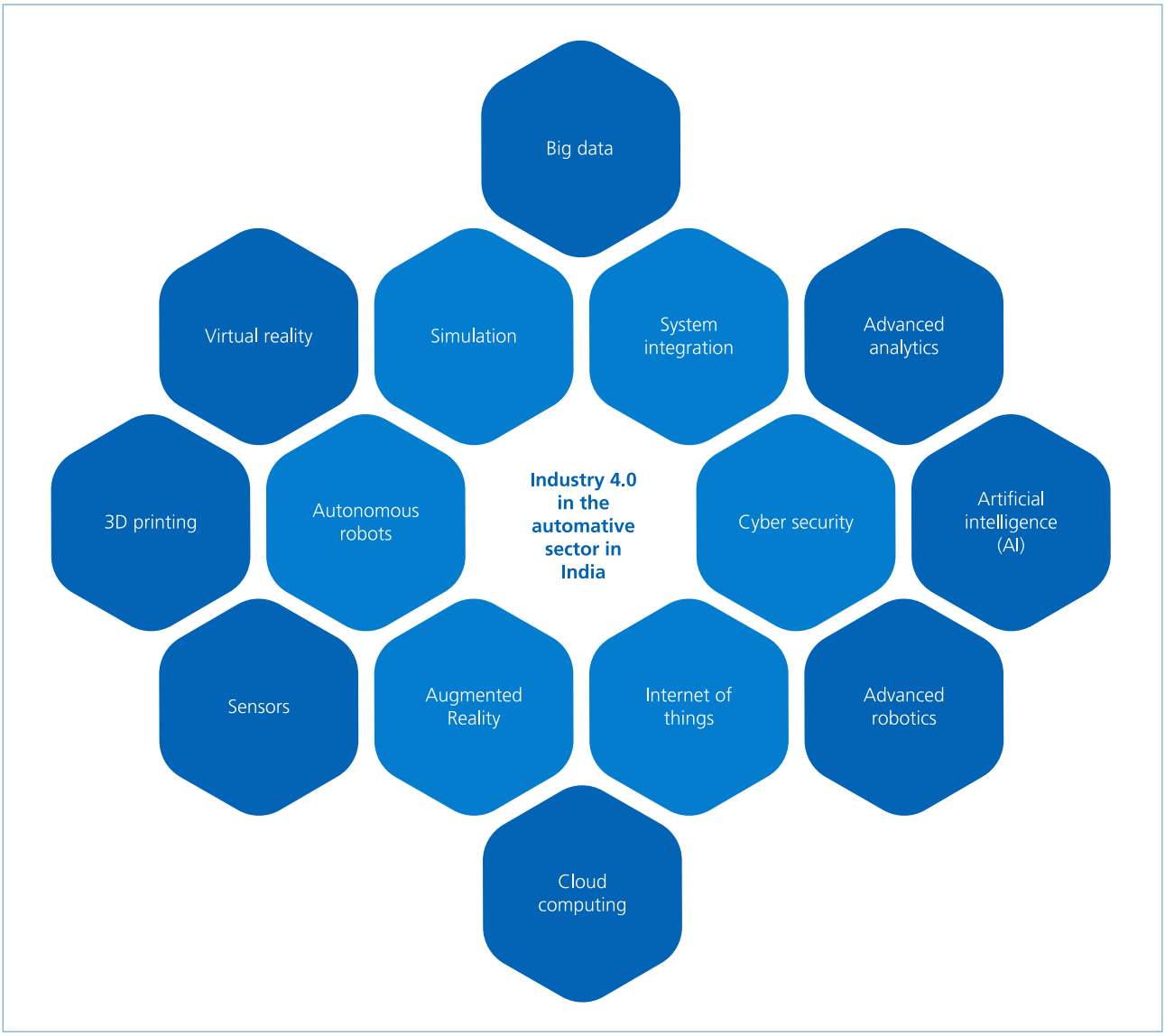

Figure 1.Emerging technologies in the automotive sector of India[1]

Penetration of emerging technologies in the automotive sector across different countries has been quite disparate. In India big data, AI, sensors and advanced robotics were found to be widely deployed.

II. Methodology

The present study was carried out in the following automotive belt of Gurgaon, Manesar, Dharuhera, Bawal, Tapukara and Neemrana industrial belt in Haryana and Rajasthan.

This is a significant 'node' or component of the Delhi-Mumbai Industrial Corridor (DMIC) and a significant investment destination in recent decades. The research is based on more than four months of qualitative survey from June 2019 to September 2019. The primary participants were employees from various sections, plant-level trade union officials and belt activists from the trade union, with some input from secondary literature, workers' journals, and information released by businesses and government.

The belt was chosen due to the following reasons:

• This development tale has its own underbelly – labour with job crises, unhealthy working circumstances, informalisation of periodic work, (sometimes irreconcilable) capital-labour disputes, and the dismantling of collective bargaining mechanisms, pro-capital mediation agencies, and labour law enforcement.

• Over the past two centuries, it has also been a prominent centre of labour unrest in our nation. The Gurgaon-Manesar and Dharuhera-Bawal automotive clusters in Haryana and across the state border into Rajasthan's Neemrana. They form an adjacent growing area of an industrial belt that houses one of India's biggest auto clusters.

• Its history is rooted in the process of liberalisation of the Indian economy since the 1980s, when a major reorganisation took place in the Indian automotive sector in cooperation with Japanese MNCs.

• After the completion of the study, a Focus Group Discussion was organised on 21stAugust 2019 with various interest groups and stakeholders mentioned in the next section. Suggestions and recommendations from this FGD have been incorporated in this report.

Figure 2: Major stakeholders in the automotive sector in India

III. Contextualising work in the automotive sector

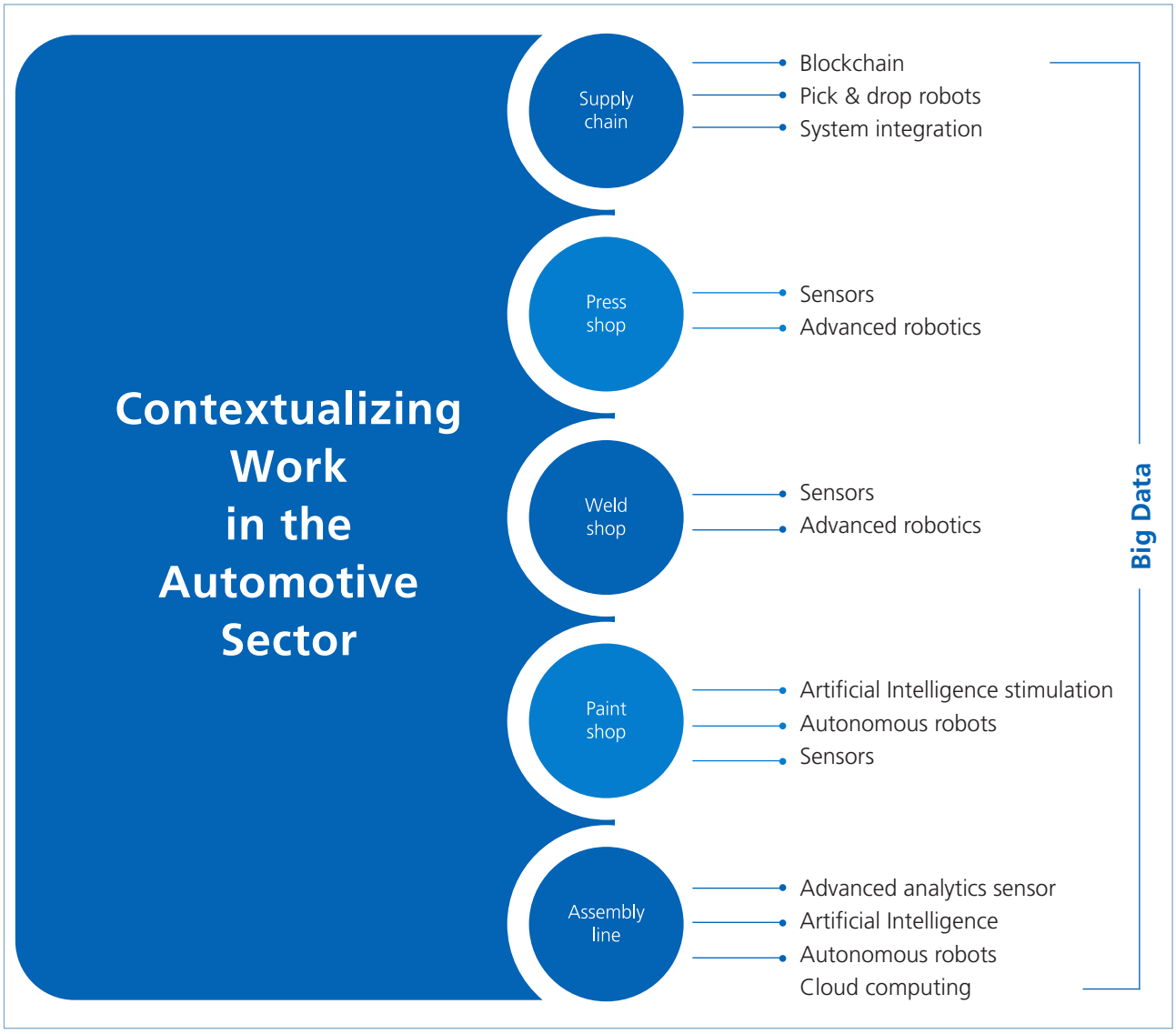

Figure 3: Contextualising use of Industry 4.0 technologies at each shop

In order to understand the change in job tasks and roles, there is a need to understand the full supply chain in a manufacturing plant. The manufacturing plant is divided into shop floors: press shop, weld shop, paint shop, assembly line and the final assembly/collection shop.

During the industry visit undertaken as part of this study, interactions were held with the plant heads, workers and trade union leaders who acquainted the study team with the deployment of Industry 4.0 technologies in particular shop floors.

1. Press shop

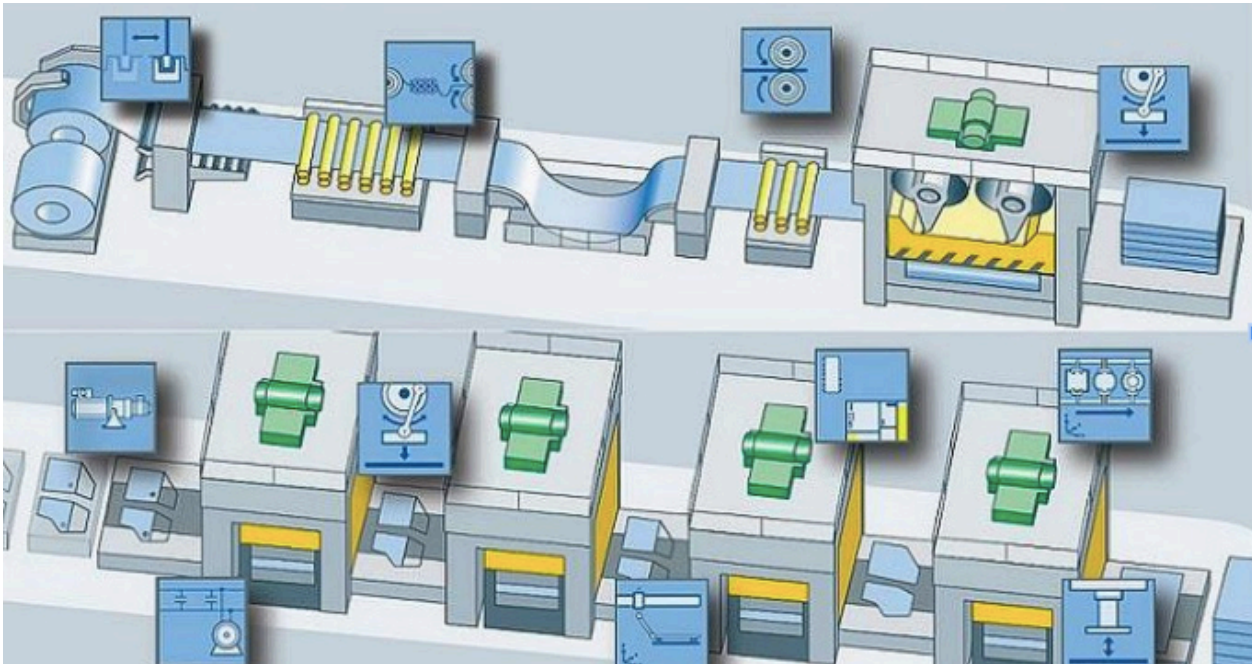

Figure 4: Press shop layout[2]

During the visit to a manufacturing plant, it was found that Pressing requires high forces to be accurately and safely regulated. Therefore, rather than manual labour, the pressing machine has robots installed. Earlier the worker on the pressing machine used to place a metal piece on the table, pressed the lever that brings down the lever arm and once the arm is pulled back, the piece is reshaped according to the needs. To ensure safety while pressing, sensors are installed nowadays to avoid any hazard. Another reason for bringing automation in this shop is the huge demands for complex geometries and customisation. This in turn enhances productivity of the plant as a whole.

One of the reasons for bringing automation in press shop is the huge demands for complex geometries and customisation.

2. Paint shop

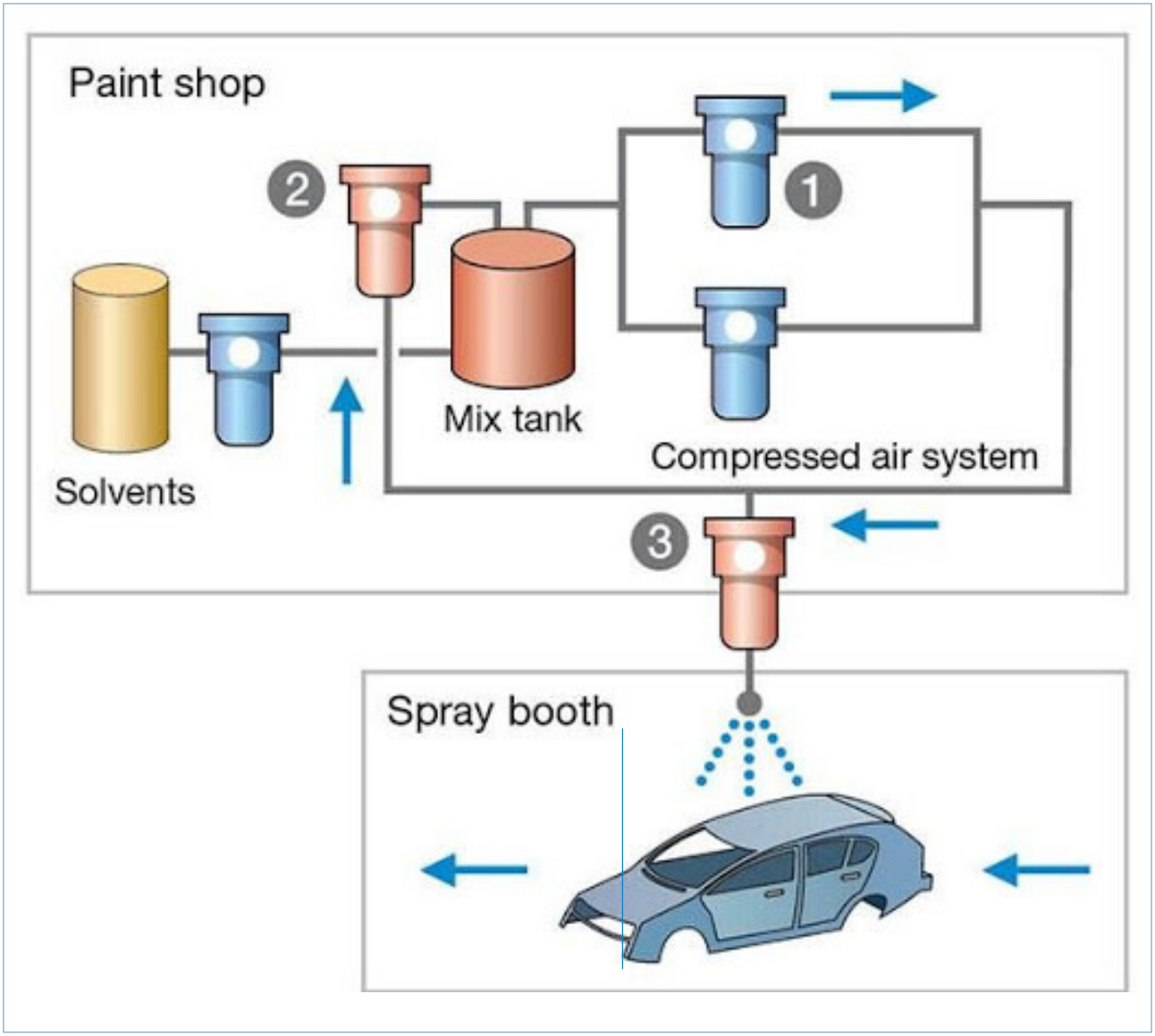

Figure 5: Paint shop layout[3]

During the visit to the manufacturing plant, it was found that the paint shop is entirely automated. The respondents stated that this is due to the fact, that the paint process requires ultrahigh precision and exact metering of product when it comes to the paint volume, the mixture ratio, and motion. Monitors installed outside the paint shop to keep a track of the finesse of the product. This results in the usage of Big Data and predictive analytics in the shop specifically along with Systems Integration and Computer Aided design and Drafting (CAD).

3. Body shop

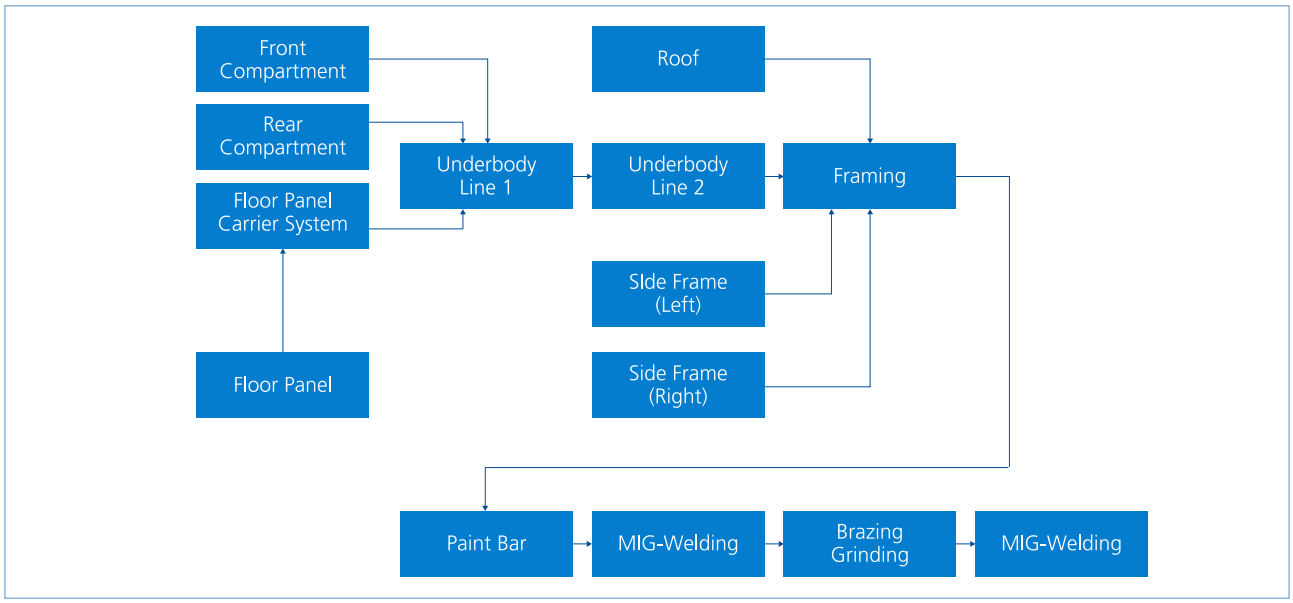

Figure 6: Body shop layout [4]

During the field visit, it was found that techniques like spot welding, soldering, screwing and gluing require high precision which robots can bring efficiency in. Therefore, modern robots do the job whereas only skilled employees maintain the machines. Henceforth, no requirement of human labour. In some of the plants, though the labours in this shop have been transferred to assembly line due to output demand but in smaller companies their job has got displaced.

4. Assembly line

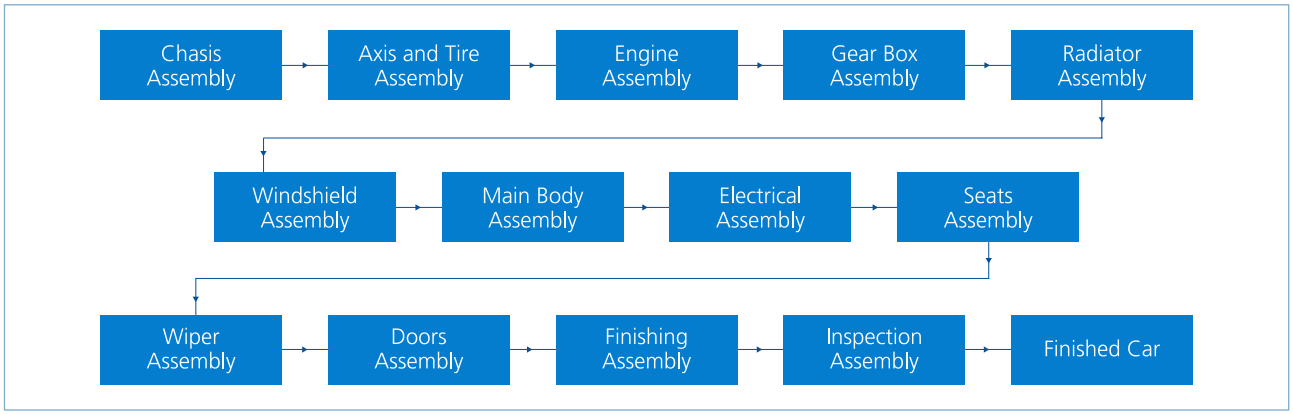

Figure 7: Assembly line layout [5]

The research provides that there are a lot more processes which are automated, though require a little human help too. Entire body production, which includes – front section of the vehicle, door mounting, soft and hard trimming (which means the assembly of seats/tires/ nuts and bolts etc..) and final finishing highly requires automation as the line moves fast. It was found that the assembly line is generally divided into multiple stations. For example, the hood station, the wheels station, the engine station. Generally, a skeleton of the car either works on a conveyor belt or is hung from a monorail where there is involvement of both man and machines.

IV. Findings and recommendations

Figure 8: Body shop layout

In Industry 4.0, the machine operating worker becomes the conductor, interacting with machines and robots, and continuously optimising their performance.

According to the majority of stakeholders approached during the study, automation may not necessarily reduce employment. A particular industry needs to be studied at micro-level and each and every task needs to be taken into consideration.

In an Industry 2.0 level or less, the operator is the commander. He operates the machines and based on his skills creates value using the machine tool. In Industry 3.0 level, operator is the captain programming the machines and maintaining the availability, wherein, most of the manufacturing companies are today in India. However in Industry 4.0, he is the conductor, interacting with machines and robots, and continuously optimising their performance.

One of the respondents, the plant head of a tier I supplier, differentiated the two kinds of technology industry requires: those that will be used on the shop floor to automate core manufacturing processes such as production, and those that will provide supporting services to make the production system more efficient. One of the stakeholders explained,

"Let's look at the automobile industry. Whether it is a taxi or a private car, it can still give direct employment to the driver. If automation has come in a particular automobile model, it may not replace any employment. But if manufacturing industry within an automobile is taken, then in case of automation, the number of people working on the machine will get reduced.. Thus, at different levels within the same industry, the impact of automation differs.

As a pragmatic visionary in the industry, a person would employ one more machine to increase productivity. India needs to have a long term vision because automation can generate indirect employment due to increased demand in the country. If the purchasing power parity remains strong, then in the above example, everyone can be employed on new machines installed, and even more."

1. Contractual relations

Automation will bring about a change in organisations, bearing its effect on employer-employee relationship. Changes in organisational structures, management processes and human resources management strategies would see a significant shift. More decentralisation could be seen which would lead to flatter organisational structure. Thus, people would act more like autonomous units, and would gain more authority over a period of time. The future workforce would have to get accustomed to unsettled life conditions especially the labour workforce – whose jobs are most susceptible to getting displaced.

Another difference is the nature of work which would define the employer-employee relationship. In the industrial society, the work was more repetitive, pressurised and specialised. But now this is taken care of by the emerging technologies. As a result, the Industry 4.0 world would see people doing multiple and bigger tasks which would be majorly managerial tasks and highly skilled. Therefore, if the industrial society required more manual tasks, the Industrial 4.0 world would require usage of knowledge or intellectual efforts. The work would not be hectic and would provide more freedom in terms of both responsibility and leadership. Since the existing workforce would prove to be surplus in future, the major challenge for the employer would be to retrain them.

The Industry 4.0 world would see people doing multiple and bigger tasks which would be majorly managerial tasks and highly skilled.

In automotive sector there are different types of workers working at a shop-floor level. Firstly, there are permanent workers who are on a payroll, then come trainee workers who are on a probation usually for two to three years and then made permanent. Thirdly, there are the apprentices who are there just for training for one year and lastly the contractual workers who form the majority of the shop force today. Due to wide segmentation between permanent and contractual labours and the legal rights given to them, employers have to walk a tightrope in terms of dealing with them. In automotive sector specifically huge differences can be seen in terms of amenities (salary, working conditions, canteen and transport facilities) between permanent and contractual labours. During the visit to one of the Industrial Training Institutes (ITIs) another type of worker was recorded, who are also known as 'NEEM (National Employability Enhancement Mission) Trainee' who are hired under the Pradhan Mantri Kaushal Vikas Yojana (PMKVY scheme) and are 12th pass certificate, are given a stipend and a certificate after completion of three years.

For an effective employer-employee relationship, labour laws need an overhaul and should not be only industry friendly. Currently, the employers can be targeted for doing an illegal job as Section 10 of the Contract Labour Regulation and Abolition Act, 1970 says that for core production processes and permanent nature of work, hiring of contractual workers is illegal. The respondents in the labour union remarked that the contract labour advisory committee has been constituted in the last year which could be a welcome step and fruitful for the employer-employee relationship.[6]

For an effective employer-employee relationship, labour laws need an overhaul and should not be only industry friendly.

2. Productivity

The fourth Industrial Revolution, like the earlier ones, is aimed at increasing returns on capital by reducing the cost of production. And in the context of countries in the Global North, where the supply of labour is much lower, this implies replacing labour by machine. On the other hand, countries in the Global South are faced with an excessive supply of labour. As such continued promotion of automation or AI would lead to higher unemployment and then to higher social costs.

Countries in the Global South are faced with an excessive supply of labour. Continued promotion of automation or AI would lead to higher unemployment and then to higher social costs.

The field visits to the shop floor and plant heads of OEMs disclosed the fact that there are many activities that are now displaceable by technology. Some are production activities and some are activities of coordination and instruction. Even the job of the supervisor or the instructor can be automated. So one has a picture of someone sitting inside a control room and everything in the factory is being done by machines.

One of the stakeholders at the upper management level admitted that IT service providers organisations are serving automotive factories in different pieces. They are not running the whole factory but they are solving some problems remotely. This was done by human beings earlier like, engineers who might have been using calculators and then the computers came.

But they were working from the factory and now their presence is shadowed by the cyber-physical systems.

For AI an organisation requires huge backup data. For that data set, to be updated continuously, one requires large manpower. Hence for automation, the technology is used and adopted in an intelligent way. As the economy develops, the industry develops, the skill develops. And employment is created.

3. Industrial relations and collective bargaining

Industrial unrest in many of the automobile companies in India, e.g. Maruti Suzuki, HMSI, SKODA, are an example of the effect of automation. It may not be imprudent to say that such trends, in the absence of universal and effective minimum standards, are leading to human rights violations as well.

The plants' assembly functions have been automated thereby displacing workers and in return making workers' organisations, if existing, powerless.

The manufacturing sector, following the liberalisation of the Indian market, has transformed itself into assembly units. The automobile components are made elsewhere by the MSMEs, most of which are operational in the informal economy under most precarious conditions. The plants' assembly functions have been automated thereby displacing workers and in return making workers' organisations, if existing, powerless. The employers exercise monopoly power and operate plant devoid of any dialogue with the worker or their representative bodies.

There is also a preference for internal union and for not engaging politically affiliated unions. In such a situation, the instruments of collective bargaining, have further been marginalised. A precondition for effective collective bargaining as also co-determinations is power equilibrium between management and workmen.

4. Education, skilling, reskilling and upskilling

One of the stakeholders, having experience as a bureaucrat and working with Skill Councils, stated that, India has not been able to have any successful scheme where it has given proper training. Today everybody depends upon government for imparting skill-set to billions. They are also heavily dependent on government funds. The manufacturing industries had stopped doing the apprentice courses which was the trend, in the 60s and 70s, as stated by the bureaucrat. The apprenticeship scheme was mainly used to skill people.

Everyone talks about skilling people in Industry 4.0, teach a person how to use a computer, etc. But unless one builds the foundation (of a learning system), it cannot absorb the technology. Similar to the foundational skill which Toyota employs. For example, with electric cars coming in, the nature of engines and transmission has changed completely. So the predictions being made about what skillset people are needed, now have become obsolete with the emergence of new technology.

The field research showed that industries have in-built learning factories, (in some cases, known as Dojo centres) which facilitate development of abilities to learn and experiment. The practical experience can only be learned in the factory, and cannot be taught in a classroom. The Toyota system took same number of people with similar educational background as in the USA. In the 60's, Americans were as good as the Japanese in terms of math and language. But how did Toyota get so many steps ahead of the American automotive industry? A learning system is required where people can do pieces of work and evolve with the system as a part of it.

With public sector in the background and private sector as the key player, who has just started taking initiatives, there is still a lack in the desire to invest in skilling and HR training. It was found out that most of the companies outsource skilling. For example, a big company hiring 10 new employees, will outsource skill trainings to a third party. The entire selection process is outsourced. The initiative from the private sector is almost zero.

One of the stakeholders gave a comparative perspective on this point. He stated that in the USA, the main research around skilling and education is

done by the institutes and by private organisations, and universities. They have labs for the training of not only the working class but also teachers, designing curriculum, and a qualification framework. The industry bodies, government, civil society organisations and academia work in tandem. Therefore, it is in the best interest that the industry offers apprenticeship.

It is in the best interest of the industry to offer apprenticeship courses and train people according to their needs and recruit them.

5. Gender

Any form of automation does have a gendered impact on society as was captured aptly by Ester Boserup:

"It is men who do modern things. They handle industrial inputs while women perform the degrading manual jobs; men often have the task of spreading fertilizer in the fields, while women spread manure; men ride the bicycle and drive the lorry, while women carry headloads, as did their grandmothers. In short, men represent modem farming in the village, women represent the old drudgery."[7]

There is much optimism about the 4th Industrial Revolution holding liberatory potential for women. However, there are critical gendered issues that currently facing this industry, that are inherently tied to questions around the Future of Work.

Women may be more protected than men owing to their non-automatable social, personal and soft skills in other sectors like education and health, where women are concentrated.

With 47 per cent of jobs estimated to be at risk in USA,[8] it is clear that the advent of technology will impact the Future of Work, but whether gender justice ensues is still unclear. While the World Economic Forum purports the effect to be almost even (48 per cent job loss to women and 52 per cent to men)[9] whereas PricewaterhouseCoopers (PwC) has predicted that women are comparatively more protected than men owing to their non- automatable social, personal and soft skills in other sectors like education and health, where women are concentrated.[10]

One of the interviewees of a leading think-tank around tech policy in India explained as to how biasness is inherent in the AI models. She stated that *"while we may technologically move towards emerging technologies such as Artificial Intelligence (AI), fairness issues in AI can arise at multiple stages in the pipeline of AI design, most commonly at the level of the data or the algorithm"*. This implies that newer technology doesn't necessarily mean fairer or better technology, especially for underrepresented and underserved communities. On the other hand, opaque, large-scale algorithms used to power AI and Big Data not only perpetuate existing social stratification but also amplify it. Math is able to combine with technology to multiply disorder, adding efficiency and scale to already biased systems. For example, there is an AI-enabled app called "FaceTagr" which is being used by policemen in Tamil Nadu to capture photographs of people who "look suspicious" - but if physical appearance is an algorithmic input, then it is more likely for individuals belonging to certain socio-economic communities of class, caste, gender, and sexuality to be labelled as suspicious because of existing historic biases and stereotypes. Hence, the app is likely to target homeless people, transgender persons, etc.

Opaque, large-scale algorithms used to power AI and Big Data not only perpetuate existing social stratification but also amplify it.

AI models are increasingly being deployed in India for public-facing decision-making - from healthcare to education to finance. These automated models assist in deciding what kind of job advertisements one see online, whether a customer is eligible for a loan, or health insurance etc. Hence, these technologies have a very real-life and disproportionate impact on people's lives depending on an individual's social location.

6. Policy recommendations

The following policy recommendations are suggested: -

i. The number of assembly lines in a given plant can be increased. The losses which are seen in weld, paint and body shops can be adjusted into assembly lines where there is a need for more manual labour. Even if some companies like Tata Motors which is consolidating the number of vehicle platforms, the government herein

should bring policies which favour a given company producing more variants. Higher the process upgradation, higher number of assembly lines and more need of manual labour.[11]

ii. The Original Equipment Manufacturers should build in-house training and skilling centres also called as Dojo Centres. Although some of the OEMs have this facility[12] with their Tier-I suppliers, but the study found that many also lack these facilities. The automation which is brought in any shop, should be taught to all kinds of workers in these facilities for their up-skilling.[13]

iii. The companies should focus on adapting their workforce to technical competencies, social competencies, training and qualification and technology-based learning. The jobs requiring IT or mechatronic skills would increase in future and thus require a need of adaptation. Furthermore, soft skills in the nature of learning capacity, teamwork and problem solving should be inculcated.[14]

iv. In order to bring gender equality, the government should come up with all female (later on third gender too), Industrial Training Institutes in order to bring diversity and inclusion in the automotive industry. With the emergence of IT skills related job, the females can be included both at the shop floor as well as at the upper management level and for this, the government skilling bodies should organise all female campus placement fair and invite the leading OEMs from the country.

v. The OEMs already arrange for pick up and drop facilities for all their labours. The OEMs can focus on hiring female bus drivers and conductors to enhance safety of the women during their travel. This method would incur a similar or lesser cost as any other solution. Furthermore, to overcome societal norms, females of those households whose men are already working in the factory, should be promoted. Untrained females should be kept as an apprentice in the factory and given training. It would also be easier for these females to get training as they would be working alongside their male counterparts.

vi. Since now there is increasing inequality and risk of shorter job length, the government should come up with a security coverage in the form of pension benefits. The appropriation of these pension benefits should come from wealthy taxpayers money and redistributed among the worker class only. The worker herein includes, the contractual workers, apprentices and temporary workers. Further, these workers should not be taxed by the government in any form – direct or indirect.[15]

Electric vehicles manufacturing and its impact on jobs

Electric vehicles (EVs) are not a new concept and have been a strong competitor to the gasoline automobiles in the early 20th century. However, due to the availability of cheap fuel and technological advancement of gasoline engines, EVs fell out of the race. EVs differ from traditional gasoline vehicles with respect to two specific components: 1) lithium-ion battery and, 2) electric motor. Traditional vehicles use lead-acid batteries, whereas EVs use lithium-ion batteries which are heavier, costlier and takes more time to be re-charged and thereafter replaced. However, the scientific community is engaged in the research to bring about lighter and less expensive batteries in order to boost consumer choice, confidence and convenience.

For better understanding the shift in jobs due to EV technology, it's necessary to understand the present day occupations involved in this industry and thereby how it would be impacted. Occupations around this industry can be in the form of scientists who conduct research in electric drive technology, manufacturing workers who build the vehicles and the automotive maintenance technicians who repair the vehicles.[16]

Occupation in scientific research, design, and development

A major concern with electric vehicles is how efficient batteries are for the long-range drive. This situation is magnified due to gaps in charging infrastructure available. Thus, in order to make electric vehicles a viable alternative to present day vehicles, there is a need for scientists to work on the fuel economy. Improved batteries would result in reliance more on electric propulsion and less on fossil fuels. An increased need for research and development in this area means that there would not be a shift in the jobs of this demography.

Further workers who design and develop EVs technology based on the research provided by scientists include engineers, technicians, software developers, and industrial designers. This demography is a link between the scientific community and the commercial application of the technology. This community includes chemical engineers, electrical engineers, industrial engineers, material engineers, and mechanical engineers. There is a need for engineers for developing new battery designs, electrical circuits, control systems, and the aftermarket. Although there is a need for engineers qualified in this particular technology, specialised courses for engineering students are not available in India. Henceforth there is a talent crunch with respect to skills and the automobile industry is currently facing the wrath.[17] This places the country's dependence on other countries for the import of not only materials but also for the after-services. Auto firms have already started ringfencing of talent locally and focusing on training the talent coming out of premier institutes like Indian Institute of Technology (IITs) and National Institute of Technology (NITs)[18] as they are the ones where specialised courses on Automotive and EVs are starting.[19] The Indian government is in the process of creating a program under the National Electric Mobility Mission Plan (NEMMP) to carve out and train people for design and testing, battery manufacturing and management, sales, services, and infrastructure.[20]

Auto firms have already started ringfencing of talent locally and focusing on training the talent coming out of premier institutes like IITs and NITs.

Occupation in manufacturing and maintenance

In order to understand the jobs created and lost in the manufacturing plants and aftermarket, the value chain in electromobility needs to be understood. Jobs in this particular sector can be classified into: battery manufacturing, charger manufacturing, wholesales, installation of the charging points (home chargers, work chargers, public chargers in parking, public fast charging and ultra-fast charging), charge point operation and maintenance and electricity generation.[21] The maintenance of the chargers is the most job-intensive segment on the electromobility value chain. However, the battery, motor, and electronics associated with the drive train do not require regular maintenance. Oil changes also become obsolete as apart from brake fluids no other fluid is used. EVs also use regenerative braking system which almost zeroes down the maintenance cost of EVs. This results in lower deployment of people in maintenance in

comparison to the ones deployed for internal combustion engines driven vehicles.

In the manufacturing processes also, there would be a shift of the way in which plant functions. The whole supply chain would likely see a shift.[22] For traditional suppliers to shift, they would have to move from supplying parts such as a gearbox, exhaust pipes to delivering battery materials, regenerative braking systems. New suppliers would also emerge in the form of battery manufacturers, mining and lightweight companies, which are net job creators. There are some allied areas which would see an increase in jobs.[23] EVs would create an additional electricity demand triggered by the consumption of an increased amount of electric cars, and thus, electricity generation would see the creation of jobs. Grid connection would also see job creation as it's the process of linking an EV charger to the existing grid so that it can efficiently power electric vehicles. The above suggests that there would not be a net loss in terms of jobs, provided that workers are upskilled to meet the evolving needs of the future.

New suppliers would also emerge in the form of battery manufacturers, mining and lightweight companies, which are net job creators.

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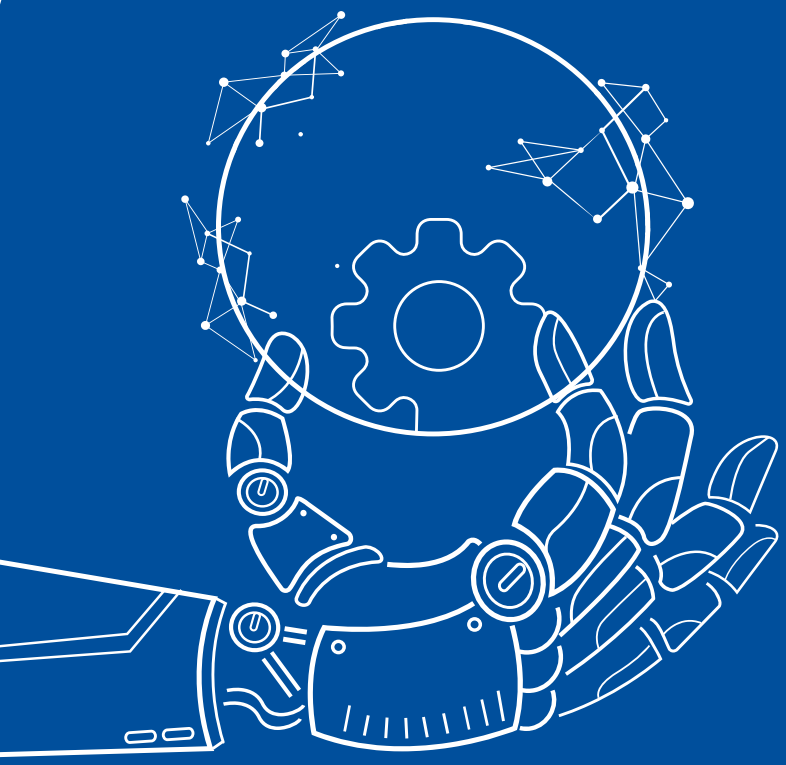

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