

**RAKHI SEHGAL**

**INDUSTRY 4.0 & JUST TRANSITION  
FOR WORKERS IN THE AUTOMOTIVE  
INDUSTRY IN INDIA**

**EDITED BY AUREL ESCHMANN  
AND PRAGYA KHANNA**

RAKHI SEHGAL

**INDUSTRY 4.0 & JUST  
TRANSITION FOR WORKERS  
IN THE AUTOMOTIVE  
INDUSTRY IN INDIA**

EDITED BY AUREL ESCHMANN  
AND PRAGYA KHANNA

**IMPRINT**

STUDIEN 9/2020

is published by the Rosa-Luxemburg-Stiftung

Responsible: Aurel Eschmann

Straße der Pariser Kommune 8A · 10243 Berlin, Germany · [www.rosalux.de](http://www.rosalux.de)

ISSN 2194-2242 · Editorial deadline: September 2020

Illustration front page: Frank Ramspott/iStockphoto

Proofreading: Gegensatz Translation Collective

Setting/Production: MediaService GmbH Druck und Kommunikation

Printed on Circleoffset Premium White, 100% recycled paper

---

## CONTENTS

Abbreviations . . . . .	4
Acknowledgements . . . . .	5
Preface . . . . .	6
Highlights . . . . .	7
1 Introduction . . . . .	8
2 Impact of the Fourth Industrial Revolution on the Indian Automotive Industry . . . . .	9
2.1 A Brief Overview of the Indian Automotive Sector . . . . .	10
2.2 Digitalization of Production of Passenger Vehicles . . . . .	11
2.3 Challenges in Adopting I4.0 Technologies . . . . .	12
3 Smart Cars and Automotive Electronic Components . . . . .	14
4 Labour Relations in the Automotive Industry . . . . .	18
4.1 The Challenge of Skilling and Re-Skilling . . . . .	19
5 Trade Union 4.0: Towards a Just Transition for Workers . . . . .	21
6 Industrial Relations in the Age of Industry 4.0 . . . . .	22
7 Trade Union Action Plan . . . . .	25
8 Conclusion . . . . .	26
Bibliography . . . . .	27

## ABBREVIATIONS

4IR	Fourth Industrial Revolution
ABS	Anti-Lock Braking System
ACMA	Automotive Component Manufacturers Association of India
ADB	Asian Development Bank
AIMA	All India Management Association
APAC	Asia Pacific
BCM	Body Control Module
BS-VI	Bharat stage (BS) emission standards are laid down by the Government of India to regulate the output of air pollutants from internal combustion engines and spark-ignition engine equipment, including motor vehicles.
Capex	Capital Expenditure
CEO	Chief Executive Officer
CII	Confederation of Indian Industry
EMS	Electronic Manufacturing Services
EPS	Electric Power Steering
ESDM	Electronic System Design and Management
GDP	Gross Domestic Product
GoI	Government of India
GUFs	Global Union Federations
GVW	Gross Vehicle Weight
HRM	Human Resource Management
I4.0	Industry 4.0
ICE	In-Car Entertainment
ICTs	Information and Communication Technologies
IDA	Industrial Disputes Act, 1947
ILO	International Labour Organization
IIoT	Industrial Internet of Things
IoT	Internet of Things
IR	Industrial Relations
IT	Information Technologies
ITUC	International Trade Union Confederation
LCA	Low Cost Automation
Make in India	Government policy to encourage companies to manufacture their products in India
MNCs	Multinational Companies
MSMEs	Micro, Small, and Medium Enterprises
NOS	National Occupational Standards
NSDC	National Skill Development Corporation
NSQF	National Skills Qualifications Framework
OEMs	Original Equipment Manufacturers
PRC	People's Republic of China
R&D	Research & Development
RIED	Rane Institute for Employee Development
RPG	Reverse Parking Guide
Skill India	Campaign to encourage skills training of youth
SMEs	Small and Medium Enterprises
SRS	Skill Requirement System
TKAP	Toyota Kirloskar Auto Parts
TINA	There Is No Alternative
TPMS	Tyre Pressure Monitoring System
ULP	Unfair Labour Practice
UN	United Nations

## ACKNOWLEDGEMENTS

I would like to thank Stefan Mentschel, Rajiv Kumar, Pragya Khanna, and Aurel Eschmann at the Rosa Luxemburg Foundation's South Asia Office for commissioning this paper and for their valuable input. I owe a special thanks to Stefan and Aurel for the engaging conversations we had on the north-south development paths and implications of the Fourth Industrial Revolution on the countries of the Global South in particular.

My engagement with Industry 4.0 and the automotive sector in India started with colleagues at the Centre

for Internet and Society (CIS), New Delhi when they invited me to collaborate. The collaboration over the last three years has been a fun and enriching experience, as we learn together and from each other.

None of the insights and learnings would be possible without the generous sharing by automotive workers of the Gurgaon industrial belt over the last decade and a half. Their generosity, courage, struggles, persistence, and resistance continue to inspire me. The motivation for this paper stems from my engagement with them for more than a decade and a half.

## PREFACE

Conversations and debates on the Fourth Industrial Revolution (4IR) and Industry 4.0 (I4.0) technologies have been dominated by the experiences of a handful of advanced industrialized countries. The United Nations (UN) and the International Labour Organization (ILO) have been cautioning that adoption of newer technologies is not dependent solely on technological feasibility but a host of other factors. These range from social, cultural, and economic factors, attitudes towards technology and innovation, socio-economic conditions of the society, education and health infrastructure, the state of inequality, and possibility of social upheaval in the face of job losses. The current discussions have often done little more than repeating the old neoliberal dogma TINA (there is no alternative), while ignoring the reality that technology adoption is not merely a technical question. From this reductive perspective it would appear that the dynamic swings back to industrialized countries controlling the design, development, and innovation of newer technologies. Developing countries on the other hand, are fated to serve as a kind of unskilled digital labourers doing low-end work for a pittance, even as they provide the markets for the digitalized products.

In light of these grim future prospects it is crucial to shift our gaze and examine the adoption of newer technologies from the perspective of developing countries. Regional variations are likely to yield different results in different parts of the world. Therefore, global narratives of the adoption and impact of 4IR and I4.0 need to be localized. The wide range of social and cultural factors that play into the 4IR mean that the above scenario is by no means an unavoidable reality, as they offer significant spaces for political and social direction. However,

this only holds true if these global phenomena are thoroughly analyzed in their actual local configurations.

The ILO, as well as global union federations (GUFs) such as IndustriALL and the International Trade Union Confederation (ITUC) among others, have emphasized that deployment of technology is not a given and will be mediated through local political, legal, and socio-economic structures. It may further be influenced by a range of policy decisions at firm or government level and in the public interest. The ILO also points out that while the question of job displacement is critical, employment conditions, labour rights, social protection, gender relations, and the distribution of technology gains are equally-important considerations in order to enable leveraging of technological change for inclusive, equitable, and sustainable outcomes.

This paper examines the complex terrain of adoption of digital technologies of production in the automotive industry in India to understand two key aspects: first, the conditions of adoption and second, the impact of digitization on work relations. What are the preconditions for adoption, who stands to benefit, who loses, who will be left out, how are social relations likely to change, how will technology be localized adding dynamism to innovation etc.? Answers to such questions require a granular assessment of the changes underway by way of sketching the background. The aim of this paper is to make accessible debates on 4IR and I4.0 for workers and trade unions of the automotive industry. This in turn would help in developing the tools, framework, and action plan towards meaningful participation in and contribution to decisions which will have a significant impact on their lives and the labour movement.

## INDUSTRY 4.0 & JUST TRANSITION FOR WORKERS IN THE AUTOMOTIVE INDUSTRY IN INDIA

### HIGHLIGHTS

1. The adoption of I4.0 technologies and transition to smart factories is still in its infancy in India and limited to Original Equipment Manufacturers (OEMs), Tier 0.5, and Tier 1 component manufacturing companies. The transition is based significantly on acquiring technology via joint ventures and technical alliances rather than via in-house R&D and innovation.
2. There are significant challenges facing the micro, small, and medium enterprises (MSMEs) that comprise the bulk of the component manufacturing sector, in adopting expensive and capital-intensive technologies.
3. Technological adoption is likely to be incremental. It will be more comprehensive in greenfield projects, while brownfield projects are likely to invest in hybrid technologies to enhance the life of existing manufacturing infrastructure while integrating new technologies to meet emerging manufacturing challenges.
4. Perhaps the German model of incremental evolutionary changes that allow for all partners to adapt, rather than the US model of disruptive revolutionary change, would be a more suitable model to follow for India and other countries of the Global South.
5. As with previous transitions, it is likely that automotive manufacturing companies will have a large role in moving their supplier companies down the path of technological adoption. Investments by foreign companies establishing technology development centres in India, taking advantage of India's low-cost pool of engineers, play a significant role in enabling Indian companies to upgrade. The country's industrial policy will play a significant role in enabling such transitions and therefore merits a revision.
6. Imported technology needs to be adapted for Indian conditions and customer preferences, thus allowing Indian component manufacturers to learn design and development in partnership with OEMs.
7. Passenger vehicles, i.e. cars, are becoming smarter and more connected with the embedding of electronics and information and communications technologies in key components in order to lower emissions, provide infotainment, or to improve fuel efficiency and safety.
8. The Electronic System Design and Management (ESDM) sector in India is in a nascent stage. 75 percent of electronic components and critical raw materials are imported. The Government of India is actively promoting the development of the ESDM sector through campaigns such as *Make in India* which aims to develop India into an export hub.
9. However, engagement of India's automotive sector with the Fourth Industrial Revolution is likely to be shaped by significant legacy challenges such as quality issues, low productivity, and low investments in R&D, in-house innovations, and skill enhancement.
10. Since the adoption of I4.0 technologies is still in its infancy in India, it is hard to assess the emerging impact on the workforce. However, even at this stage the changing job and task content, skilling requirements, job losses, and shifting power relations reveal the limits of existing frameworks for labour relations and industrial relations. Consequently, the automotive sector has been rocked by upheaval and (increasingly violent) protests at regular intervals.
11. The iniquitous nature of the contract labour system—as shown in issues such as the falling share of workers in productivity gains, declining real wages, and repression of the freedom of association and collective bargaining—resulted in protests such as the strike of Maruti Suzuki workers in 2011–12. Yet, nothing has changed in the existing labour legislation and industrial relations.
12. On the contrary, labour law changes currently sought to be implemented by both national and state governments are intended not only to remove the fig leaf of existing labour welfare and protection but also to make the very notion of labour protection redundant.
13. Signalling to investors and capitalists that they are free to exploit labour without restrictions and regulations—in the name of generating employment and furthering industrial growth—is short-sighted as pointed out even by some industry leaders. It is also counter-productive with regard to establishing cooperative industrial relations that are required for a successful transition to a high technology manufacturing model premised on high skills and cognitive capacities.
14. The trade union movement needs to shift the terrain and terms of the fight to ensure that digitalization is approached simultaneously as a workforce and a technological issue. Cooperative industrial relations can only be reached with collaboration in R&D and innovation, formal employment relations, high wages, and social protections.
15. Trade unions need to develop an action plan to thwart employer attempts to use digitalization to further fragment labour, subject workers to greater surveillance and control, or blur boundaries of work hours through always-on connected systems.



16. Trade unions need to negotiate a Social Compact for 4IR addressing local socio-economic conditions and societal inequality. Such a compact needs to ensure that digital technologies create good work and a fairer economy, improve lives and livelihoods, protect the safety and health of workers, and engender a revolution in skills, rights, and social protection through negotiation.
17. To prepare for such negotiations, trade unions need to have a deeper understanding of all facets of social transformation and change that shall be brought about by digital technologies within specific local contexts. They need to be sensitive to historic social oppressions of caste, gender, and all forms of discrimination (religious, geographic, sexual orientation) as I4.0 threatens to increase rather than lessen existing inequalities.

## 1 INTRODUCTION

The automobile sector of India is one of the largest in the world and accounts for over 7.1 percent of India's gross domestic product (GDP), contributing nearly 22 percent to the country's manufacturing GDP.<sup>1</sup> The auto components industry makes up about 2.3 percent of India's GDP. In addition, India is expected to be the world's third-largest automotive market in terms of volume by 2026.<sup>2</sup> In 2015, the number of people directly employed by the automotive sector in India came to around one million people, while the industry employed about 19 million people overall.<sup>3</sup> According to a report by the National Skill Development Corporation (NSDC), direct employment in the sector was expected to rise to 15 million by 2020,<sup>4</sup> while total employment in the sector is expected to be 38 million by 2022. According to the NSDC, the automotive sector employs 56 percent of India's workforce.

Global structural transformations in the automotive sector and mobility options have impacted the auto manufacturing sector in India, considered to be the most developed in South Asia. A slowing Indian economy, falling incomes, changes in tax structures, transition to BS-VI pollution norms, changes in the axle load norms, the liquidity crunch, low capacity utilization, and a lack of policy clarity on electric vehicles have all led to a decline in consumer demand, severely affecting the car manufacturing industry. The ongoing Covid-19 pandemic has further aggravated the situation, forcing countries to a standstill and dealing another blow to consumer demand.

The changes that Industry 4.0 technologies are expected to generate will impact and reorganize production, logistics, business models, and global trends in trade, investment, and employment. The transformations are expected to address the crisis in manufacturing and productivity and will likely change the geographies of production. Some predict they could even render inconsequential the advantages of low labour cost. This is bad news for India as its development model is premised on this low labour cost advantage.

To give an example, the relationship between IT suppliers and the automotive industry manufacturers will likely undergo a significant transformation. It is possible that new kinds of car companies will emerge that create profits from mobility services (car or ride sharing) or generate revenues from connected services (software and apps for information or entertainment) and data. Thereby new business opportunities focus more on add-ons generating downstream revenues than the car in itself. Furthermore, with technology and design at a premium, the auto supply chain is likely to witness some restructuring. The biggest drivers of change and innovation come from the use of electronics and information and communication technologies (ICTs) in automobiles. Tier 1 companies play substantial roles in the design of systems and coordination of supply chains for manufacturing and assembly.

Lack of innovation in the crucial Tier 1 companies and imports which account for nearly 75 percent of all electronic components, could turn out to be severe constraints in the ability of the Indian auto industry to move up the global supply chain.

Debates on the Fourth Industrial Revolution and Industry 4.0 focus primarily on three issues: job losses and employment conditions; technology adoption; and the role of government in harnessing technology for workers. Even where there might not be job losses, task and skill requirements may undergo significant transformation putting less technically skilled workers—especially elderly workers, women, and those from marginalized social groups—most at risk. It is also anticipated that there will be an increase in labour market precariousness, a rise in new and more flexible forms of working, and unstable employment relationships devoid of social insurance benefits. In addition, technology will allow for new ways to monitor and measure performance which will be disadvantageous for workers unless policies for technology, labour, and the public address the issue. These changes underline the need to evolve appropriate social protection and social insurance systems as well as revisit industrial relations (IR) architecture.

In India, instead of democratizing industrial relations, Indian industrial relations and labour reforms appear to be heading in the opposite direction, with the shift in the balance of power in favour of employers, and progressive disengagement of the state from industrial relations. Current labour reforms in India are taking more workers out of the ambit of labour law protections, not only failing to address the fragmentation and dispersal of employment relationships but also making it harder for workers to access their rights. The

<sup>1</sup> Make In India (2016), "Sector Survey – Automobiles", <http://www.makeinindia.com/article/-/v/make-in-india-sector-survey-automobile>. <sup>2</sup> Invest India (n.d.), "Sector: Automobile", <https://www.investindia.gov.in/sector/automobile>. <sup>3</sup> "19.1 million people employed in automobile sector directly or indirectly. This includes manufacturing in OEM, Auto components, raw material factories, automobile dealers, service centres, and other enabler sectors." (NSDC 2013, p. iv.). <sup>4</sup> NSDC (2013).

Covid-19 crisis made several states in India attempt a wholesale suspension of labour laws for several years, by issuing ordinances.<sup>5</sup> These attempts have been criticized by trade unions and the ILO.<sup>6</sup> Since 2014, the Central Government has taken contradictory stands on this issue: opposing such moves during the pandemic, but on the other hand supporting the same kinds of labour reforms.

While this paper does not address the likely fallout of the Covid-19 pandemic on the industry, it is important to flag the large-scale lay-offs that have started already. An industry expert estimates that two to three million (out of six million) jobs will be lost in the North Indian manufacturing hub alone. He expects that nationally, the industry will shed nearly 30–50 percent of jobs.<sup>7</sup> According to news reports, the Covid-19 pandemic has also forced most automotive manufacturers to significantly reduce and delay plans for capital expenditure (capex) by at least a year or two. Simultaneously, most experts are expecting increasing digitalization of manufacturing, supply chains, logistics, and warehousing in order to prepare for similar disruptions in the future. These are significant developments and without a doubt, the Covid-19 crisis will lead to revised strategies.

Globally, many unions have raised the issues of technological skill bias and the need for improvements in national education systems, training, re-training, and skilling. Some unions are also demanding newer rights, such as: the right to information and consultation; the right to education, training, and life-long learning; and the right to defined levels of privacy both at home and at work. Unions will have to find new ways of organizing workers, including new pools of the workforce especially in the platform and gig economy.

These demands for new rights add to an already long list of issues that an evolving industrial relations framework will need to address, including, but not limited to: types of contracts, protections, incentives and rewards, involvement of workers in the production process, training and life-long learning, data and privacy, working hours and places, collective bargaining, sensitivity to the weakest groups of workers, effective social security systems, and evolving occupational health and safety strategies including protections from gender-based violence and violence in the workplace.

This paper aims at giving an overview of the specific transformations and challenges that are to be expected through Industry 4.0 in the Indian automotive industry. Special focus will be on the restructuring of labour relations that is to be expected. Section two will examine the contemporary trends in reorganization of the automotive industry globally, while also sketching the contours of India's automotive industry and the challenges in adopting I4.0 technologies. Section three focuses on smart cars and the automotive electronic components that make the newer cars smart, along with a discussion of the Indian auto component industry and the likely impact of I4.0 on this segment

of the industry. Departing from the technology-dominated mainstream discussion, in section four the paper turns its attention to possible impacts on workers, and the kind of just transition required for labour. Section five discusses industrial relations and the future of work in the context of India's industrial relations system to anchor the discussion in the specificities of the historical legacy of social institutions.

## 2 IMPACT OF THE FOURTH INDUSTRIAL REVOLUTION ON THE INDIAN AUTOMOTIVE INDUSTRY

Experts believe that the entire business model of the automobile industry is on the threshold of revolutionary global change, where automobile manufacturers will increasingly become reliant on big data.<sup>8</sup> Currently, India's automotive industry is at an inflexion point and is witnessing five megatrends that are expected to transform the industry in a big way.<sup>9</sup> Rapidly-evolving customer needs, the disruptive impact of technology, the dynamic regulatory environment, changing mobility patterns, and global interconnectedness are all impacting the way auto companies are doing business today globally and in India. The industry had never witnessed this magnitude of multi-dimensional change until now. Today, vehicles are no longer viewed as only being a means for commuting or transporting people and goods. The experience and utility of driving a car is very different from what it was a decade ago. Thanks to emerging technologies, customers' expectations have risen high on three counts: a vehicle's performance, its smart and safety features, and their experience.<sup>10</sup> In addition, all stakeholders such as the customer, government bodies and regulators, and social institutions are talking about the environmental impact made by the sector. Furthermore, to bring emissions down and encourage sustainable driving, there is a huge emphasis by the Indian Government on the adoption of electric vehicles.<sup>11</sup> All these factors put together

<sup>5</sup> Ashima Obhan and Bambi Bhalla (2020), "India: Suspension Of Labour Laws Amidst Covid-19", Mondaq, 18 May 2020, <https://www.mondaq.com/india/employment-and-workforce-wellbeing/935398/suspension-of-labour-laws-amidst-covid-19>. <sup>6</sup> Indian Express (2020), "ILO 'expresses concern' at labour law changes in India, asks PM to intervene", <https://indianexpress.com/article/india/i-lo-expresses-concern-at-labour-law-changes-in-india-6426909/>. <sup>7</sup> Ashok Kumar (2020), "Mass lay-offs likely in automobile sector in the Millennium City", The Hindu, 22 May 2020, <https://www.thehindu.com/news/cities/Delhi/mass-lay-offs-likely-in-automobile-sector-in-the-millennium-city/article31666328.ece>. <sup>8</sup> IndustriAll (2017), The Challenge of Industry 4.0 and the Demand for New Answers, p. 21. <sup>9</sup> Amrit Raj (2017), "What are CAFE norms and why do they matter in the proposed Toyota-Suzuki deal?", Mint, 6 February 2017. <sup>10</sup> PricewaterhouseCoopers (2019), Indian automotive sector: Creating future-ready organisations, p. 13. "In today's world, customers are viewing almost everything as an experience. Unlike in the past where every customer would visit a dealership to experience a vehicle or on occasions make a purchase decision without this experience, today almost every customer is 'experiencing' vehicles online. Many of them would have already decided or narrowed down on the vehicles of their choice, based on online research and crowd-sourced views gathered through their peer networks. Digitisation of the entire value chain is required to serve this new customer, anywhere and anytime." <sup>11</sup> According to research commissioned by German auto unions and industry, an electric vehicle takes 30 percent less time to assemble, the powertrain has only 16–17 percent of the components that an internal combustion engine (ICE) has, and a battery factory requires only 20 percent of the workforce compared to an ICE engine plant. See: <https://www.reuters.com/article/us-germany-electromobility-jobs/switch-to-electric-cars-threatens-75000-german-auto-industry-jobs-idUSKCN1J115L?feedType=RSS&feedName=technologyNews>.

are gradually making traditional manufacturing and existing vehicles outdated.

As more emerging technologies get embedded in automobiles, the relationship between tech companies and automotive industry manufacturers is also going to undergo significant transformation. It is expected that the major tech companies will disrupt the automotive value chain and start grabbing revenues at different nodes of the chain, perhaps eating into the margin of the automobile industry manufacturers.

UNIDO and the World Bank studies<sup>12</sup> among others, anticipate deep structural changes in the industry and in the geographical spread of automotive manufacturing centres. The fact that technology and innovation are both emanating from and controlled by the countries of the Global North and that the new technologies neutralize the low labour cost advantage of global south countries where manufacturing is currently located, mean that it is possible that some manufacturing will relocate to the global north. The likelihood of exacerbating global inequality, as well as inequality within countries, as a result of such structural transformation cannot be overlooked.

The talk about a shift from globalization to regionalization has gained further traction as a result of supply chain disruptions caused by the Covid-19 pandemic. It is anticipated that OEMs will be forced to evaluate the entire supply chain to minimize geographical disruptions as witnessed this year, and perhaps also diversify and localize supplies. In addition, companies are likely to plan new investments for digitizing supply chains, build sanitized and perhaps automated warehousing and logistics solutions, and stockpile emergency cash reserves for future disruptions.<sup>13</sup> For example, the Covid-19 pandemic disrupted supply of raw materials and other critical components from China, which accounts for 25 percent of India's automotive parts imports.<sup>14</sup>

There is a tremendous buzz around the adoption of I4.0 technologies. Changes, particularly in supply chains, warehousing, and logistics, open up scope for further or faster-than-anticipated adoption of I4.0 technologies. It may also provide the requisite fillip to the *Make in India*<sup>15</sup> initiative for securing India a place on the manufacturing map of the world, boosting productivity and efficiency. However, there is little clarity in the public domain on the state of adoption of the new technologies in manufacturing sectors, including the automotive sector, which is widely perceived to be the foremost sector adopting these technologies.

India holds an advantage in low-value-added, labour-intensive manufacturing due to its low labour cost model and economies of scale. It is the most competitive in terms of average monthly and minimum monthly wages in comparison to its Asian counterparts.<sup>16</sup> This competitive advantage, however, might be neutralized by the Fourth Industrial Revolution, unequally rewarding the high technology lead of industrialized countries. The Indian government initiated

a campaign called *Skill India*<sup>17</sup> to reinforce this labour cost advantage for a skilled workforce. Yet, India will have to overhaul not just its development model and industrial policy but also more fundamentally health and education (including vocational training), infrastructure, and policies in order to reap the benefits of the Fourth Industrial Revolution. According to some experts, India is already too late to the party given the state of disrepair of both human development (human capital) and physical infrastructure that is needed to be built over years with significant investment. A far bigger challenge is to change mindsets to begin valuing vocational training that would be key to preparing an army of skilled workers; to view labour not as a cost, but as an asset; and to treat workers, including blue-collar workers, with respect and dignity and see them as equal partners in the quest for manufacturing excellence. Especially in the case of India, a deep structural shift in power relations in society is needed to overcome feudal mindsets that see employees through the prism of master-servant relations. This is often fuelled by deeply embedded caste and gender hierarchies that undergird seemingly modern and professional employment relationships.

## 2.1 A Brief Overview of the Indian Automotive Sector

Production in the sector is mainly concentrated in four large auto manufacturing hubs across the country:

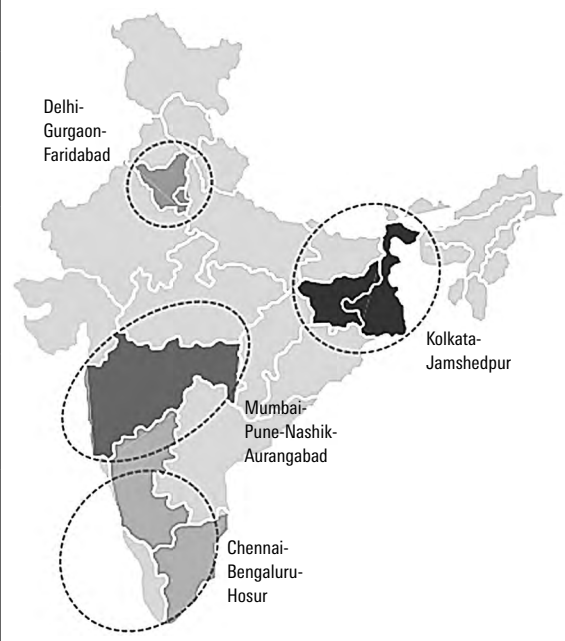
- Delhi-Gurgaon-Faridabad-Ghaziabad-Gautam Buddha Nagar in the North; 32 percent of revenue share;
- Mumbai-Pune-Nashik-Aurangabad-Thane in the West; 33 percent of revenue share;
- Chennai-Bangalore-Dharampuri-Vellore-Kanchipuram-Tiruvallur in the South; 35 percent of revenue share and 60 percent of the sector;
- Kolkata-Jamshedpur in the East.

The automotive industry comprises of two-wheelers, passenger vehicles, commercial vehicles, and three-wheelers. Two-wheelers lead with 81 percent of the market share, passenger vehicles follow with 13 percent of the market share, while both commercial and three-wheeler vehicles have three percent market share each.

<sup>12</sup> For example see: Springer and Schnelzer (2019), Hallward-Driemeier and Nayyar (2018), World Bank (2016). <sup>13</sup> Kavan Mukhtyar and Yogesh Thakar (2020), "Life after Covid-19: How the Indian automotive sector can be future-ready", Business Standard, 29 April 2020, [https://www.business-standard.com/article/economy-policy/life-after-covid-19-how-the-indian-auto-sector-can-be-future-ready-120042900315\\_1.html](https://www.business-standard.com/article/economy-policy/life-after-covid-19-how-the-indian-auto-sector-can-be-future-ready-120042900315_1.html). <sup>14</sup> KPMG (2020), Potential Impact of Covid-19 on the Indian Economy, <https://home.kpmg/content/dam/kpmg/in/pdf/2020/04/potential-impact-of-covid-19-on-the-indian-economy.pdf>. <sup>15</sup> Make in India is a government policy aimed at boosting investment in the manufacturing sector and incentivizing businesses to manufacture their goods in India. See: <http://www.makeinindia.com/about>. <sup>16</sup> See for example: <https://www.financialexpress.com/industry/indian-workers-earn-81-per-cent-less-than-chinese-says-study/276871/>. <sup>17</sup> Skill India is a government policy and mission to encourage the skill training of Indian youth. See: <https://skillindia.nsdindia.org/>.

Image 1

List of companies				
North	Ashok Leyland	Mazda	Tata Motors	JCB
	Force Motors	Amtek Auto	Bajaj Auto	Yamaha
	Piaggio	Eicher	Hero Group	Mahindra
	Swaraj	Honda SIEL	Escorts	Suzuki Motorcycles
	Maruti Suzuki	ICML		
West	Ashok Leyland	M&M	Tata Motors	Mercedes Benz
	Bajaj Auto	Eicher	Volkswagen	Tata Hitachi
	FIAT	Skoda	Renault-Nissan	Volvo Eicher
	GM	Bharat Forge	John Deere	
East	Tata Motors	International Auto Forgings		
	Hindustan Motors	JMT		
	Simpson & Co	Exide		
South	Ashok Leyland	Volvo	Bosch	Daimler
	Ford	Sundaram Fasteners	TVS Motor Company	Caterpillar
	M&M	Enfield	Renault-Nissan	Hindustan Motors
	Toyota Kirloskar	Hyundai	TAFE	
		BMW		



Source: SESEI 2018, p. 14

Image 2

Automobiles			
Two-wheelers	Passenger vehicles	Commercial vehicles	Three-wheelers
Mopeds	Passenger cars	Light commercial vehicles	Passenger carriers
Scooters	Utility vehicles	Medium and heavy commercial vehicles	Goods carriers
Motorcycles	Multi-purpose vehicles		
Electric two-wheelers			

Source: SESEI 2018, p. 5.

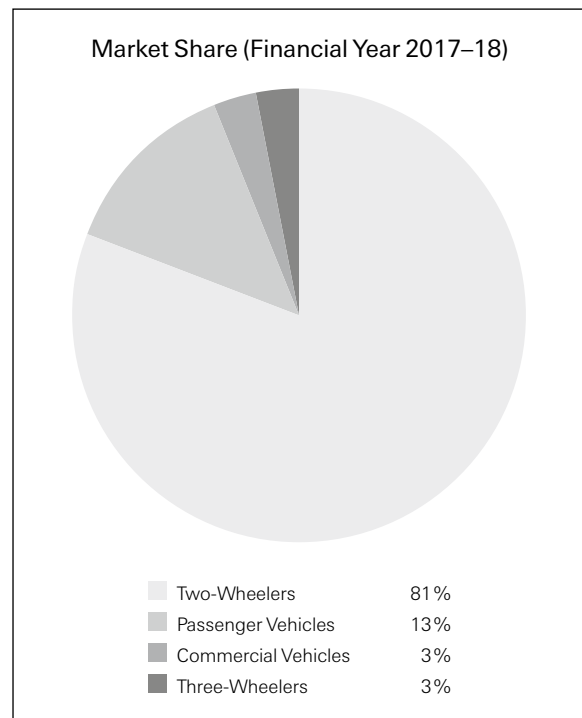
### 2.2 Digitalization of Production of Passenger Vehicles

There are some news reports that suggest that Honda’s fourth two-wheeler plant in India, at Vithalapur, is one of the most automated in the world and that the “company’s first plant in Manesar has 65 automation processes; the fourth has 241. While Manesar requires one person to produce one vehicle, Vithalapur does it with 0.64 – that’s a 36 per cent jump in productivity.”<sup>18</sup> Similarly “at GE’s multi-modal factory at Chakan, near Pune, 550 people produce output of nearly half a billion dollars currently.”<sup>19</sup>

According to Saon Ray and Smita Miglani:

[I]n 2017, Maruti Suzuki India managed seven process shops and five assembly lines by employing around 1,700 robots, Ford India had 437 robots operating the assembly lines and body shop at its Sanand (Gujarat) plant. Hyundai Motor India has reduced labour costs by utilising over 400

Image 3



Source: SESEI 2018, p. 8.

<sup>18</sup> Goutam Das (2017), “Going, Going, Gone: Automation can lead to unprecedented job cuts in India”, Business Today, 18 June 2017. <https://www.business-today.in/magazine/cover-story/going-going-gone/story/253260.html>. <sup>19</sup> Ibid.

robots in its Sriperumbudur (Tamil Nadu) manufacturing operations. The company has been systematically training people and skilling them to handle multiple operations. The production lines of Tata Nano consist of over 100 robots in the Sanand Plant of Tata Motors. Other enterprises such as Renault India are working in the field of automation of business processes to prevent accidents.<sup>20</sup>

They add that “through the use of advanced modular platforms, platform sharing among different car manufacturers, automation and use of newer materials ... upgrading has been occurring in every category.”<sup>21</sup> It is unclear if these are exceptions or the rule in the industry and if we are seeing the emergence of ‘smart factories’ in India across the automotive supply chain.

### 2.3 Challenges in Adopting I4.0 Technologies

As mentioned before, the bulk of production and employment in India lies in the small and medium enterprises sector (SMEs). Being a labour surplus country, the adoption of I4.0 technologies that may potentially displace labour is being cautioned by many from the industry and the government. Subhash Chandran of Tech Mahindra recommends a phased approach or what he calls “Industry 3.5”.<sup>22</sup> This would be an intermediate step using a combination of hardware retrofit and IT-driven manufacturing. In his view,

While Industry 4.0 is a good concept, what India requires is a phased approach which will ensure that the existing manufacturing infrastructure’s life is extended using hardware enhancements and IT, but simultaneously make it smarter to address the new generation manufacturing challenges. The Indian government should emulate the example of the German government, and come out with our own version of Industry 4.0 or 3.5 and provide the required support for its adoption.

Wolfgang Schroeder points out that “Industry 4.0 debate is currently not just about the question of competitiveness, but also about the question of controlling the consequences of digitalization for the economy and society”,<sup>23</sup> thereby echoing the ILO and global union federations that one size does not fit all and each country will have to evolve a suitable transition strategy accounting for its local conditions. The German production model, he says, relies on incremental evolutionary changes in contrast to the disruptive US model which emphasizes the prospect of I4.0 to crowd out existing production and business models, terming the different approaches as evolution and revolution.<sup>24</sup>

An ILO study points out that Third Industrial Revolution technologies are still in the process of unfolding in India. With nearly 300 million Indians living without electricity and only 35 percent of the population having access to the Internet, the country lacks the physical infrastructure needed for a digital economy.<sup>25</sup>

Furthermore, against the background that over 80 percent of the workforce are engaged in the unorganized sector<sup>26</sup>, a study by Columbia University points out that in the next few decades:

India is unlikely to experience significant job loss from automation. Labour costs are low enough that implementing the expensive infrastructure and systems required to facilitate automation does not make economic sense, especially in the informal sector where the vast majority of individuals work. These technologies may, however, eliminate jobs that have served as traditional ladders for social mobility in a time of inequality. They will also elevate the digital platform economy into a position of dominance, requiring labour reforms to address the unforeseen challenges that result.<sup>27</sup>

Recognition of this challenge is evident in the inclusion of gig economy workers in the draft Labour Code on Social Security,<sup>28</sup> even if the inclusion seems ad hoc and not well thought out.<sup>29</sup> ILO research<sup>30</sup> points out that celebrating the gig economy and gig platforms as avenues of employment might be short-sighted. It is likely that the gig economy will rearrange informality by way of enabling registration and access to formal banking systems and skilling, but not access to greater social protection, job and income security, and employment benefits. Furthermore, Uta Dirksen argues that “[c]alling gig economy workers self-employed is inaccurate and disadvantageous to their rights. Their commitments to their respective platforms include many of the obligations of conventional employment. So it is unfair that their rights do not match this de facto status.”<sup>31</sup>

Adding to the list of challenges a developing country like India is facing in the adoption of I4.0 technologies, Deepanshu Mohan highlights that “in spite of the boom and the shining success story of the industry in India since the 1990s, we now observe a major productivity gap circumscribing the prospects of growth within the automotive industry and in its ability to sustainably create more well-paying jobs across the country.”<sup>32</sup> According to a 2016 World Bank study, large-scale productivity gaps persist with most OEMs together with suppliers in tiers 1, 2, and 3 all having “subscale/fragmented operations with low capacity utilization, quality levels and investment in skills below

<sup>20</sup> Saon Ray and Smita Miglani (2018), Upgrading in the Indian automobile sector: the role of lead firms, p. 22, [http://icrier.org/pdf/Working\\_Paper\\_360.pdf](http://icrier.org/pdf/Working_Paper_360.pdf). <sup>21</sup> Ibid., p. 31. <sup>22</sup> Subhash Chandran (2016), “Phased Approach for Industry 4.0 to Succeed”, Tech Mahindra, 30 August 2016 (as of 15 September 2020, no longer online). <sup>23</sup> Wolfgang Schroeder (2016), Germany’s Industry 4.0 Strategy: Rhine Capitalism in the Age of Digitalisation, London: Friedrich-Ebert-Stiftung, p. 3, [https://www.fes-london.org/fileadmin/user\\_upload/publications/files/FES-London\\_Schroeder\\_Germanys-Industrie-40-Strategy.pdf](https://www.fes-london.org/fileadmin/user_upload/publications/files/FES-London_Schroeder_Germanys-Industrie-40-Strategy.pdf). <sup>24</sup> Ibid. <sup>25</sup> International Labour Organization (ILO) (2018a), Emerging technologies and the future of work in India, p. xi, [https://www.ilo.org/wcmsp5/groups/public/---asia/---ro-bangkok/---sro-new\\_delhi/documents/publication/wcms\\_631296.pdf](https://www.ilo.org/wcmsp5/groups/public/---asia/---ro-bangkok/---sro-new_delhi/documents/publication/wcms_631296.pdf). <sup>26</sup> Ibid. <sup>27</sup> Nirupam Bajpai and John Biberian (2019), The Future of Work in India Adapting to the Fourth Industrial Revolution, ICT India Working Paper #11, Center for Sustainable Development, Earth Institute, Columbia University, p. 1, <https://academiccommons.columbia.edu/doi/10.7916/d8-0hg8-b438/download>. <sup>28</sup> A copy of the draft bill can be found here: [https://labour.gov.in/sites/default/files/375\\_2019\\_LS\\_Eng.pdf](https://labour.gov.in/sites/default/files/375_2019_LS_Eng.pdf). <sup>29</sup> For a critique see: CIS (2019b), <https://cis-india.org/internet-governance/files/comments-to-the-code-on-social-security-2019>. <sup>30</sup> ILO (2018a), Emerging technologies and the future of work in India. <sup>31</sup> Uta Dirksen (2018), “In Latin America the future of work is already here, and it is only good for some”, FES Connect, 26 October 2018, <https://www.fes-connect.org/news-detail/in-latin-america-the-future-of-work-is-already-here-and-it-is-only-good-for-some/>. <sup>32</sup> Deepanshu Mohan (2017), “India Is Very Much Part of the Global Productivity Slowdown”, The Wire, India, 19 January 2017, <https://thewire.in/economy/india-global-productivity-slowdown>.

international benchmarks.”<sup>33</sup> Another major challenge for the industry in India remains in moving up the global supply chain while competing with other big industrial bases with respect to investment in R&D, more innovation, and commercialization of new products that can create a niche for the industry in the global automotive market space.<sup>34</sup> Only a tiny number of cars are entirely designed and developed in India.<sup>35</sup>

Priyam Saraf adds that global OEMs “now expect design capabilities from firms at all levels of the value chain, because subcontracting makes sense only when the supplier can be held responsible for entire modules of tasks.”<sup>36</sup> For global Tier 1 companies, design capabilities are becoming critical factors in selecting Tier 2 supplier companies, signalling a restructuring of the global auto supply chain. Tier 1 companies are increasingly becoming large global firms themselves, either specializing in complex systems or integrating several simpler subsystems. Saraf characterizes this as constituting a ‘Tier 0.5’ since these companies bear substantial responsibility in the design of systems and coordination of the supply chain for manufacturing and assembly. In turn, firms supplying to such Tier 0.5 companies also take on design responsibilities for their sub-modules and components. Saraf concludes that with “a few exceptions, firms in India and Pakistan are not demonstrating sufficient and quick uptake of design capabilities, which is likely to impair their competitiveness and ability to link to Global Value Chains (GVCs).”<sup>37</sup>

John Sutton reports higher defect rates (in parts-per-thousand) for Indian versus Chinese suppliers. In his view, foreign automakers invested more aggressively to build up a local supply chain in China than in India, thus Indian suppliers were lagging behind Chinese suppliers in both productivity and quality.<sup>38</sup> However, in recent years, several foreign companies have begun establishing their technology development centres in India in order to meet global requirements and relocated production of complex components at Tier 1 level to India. The stringent quality, cost, and delivery requirements helped Indian firms to upgrade. In all of this, it was the Indian government’s industrial policy that secured development of basic capabilities. “The current automobile industry in India is in many ways a product of a micro economic environment controlled by the state through various regulations and interventions. The different industrial policy regimes influenced firm level learning processes and shaped technological capability accumulation.”<sup>39</sup>

The Confederation of Indian Industry (CII) estimates that while R&D spending as a percentage of revenue in four-wheeler OEMs is on a par with the global OEMs, Maruti is an exception, spending only 1.29 percent of its revenues on R&D. In the commercial vehicles segment, R&D spending ranges from 1–1.5 percent while the R&D spending of two-wheelers is very low compared to the global counterparts. “India is still known to operate legacy machines and there is still

resistance to investment in technology and lesser focus on product innovation.”<sup>40</sup> A recent report quotes Uno Minda Group chairman NK Minda as saying that “the contribution of overseas design and development is the highest in passenger vehicles, while local development is higher in case of two-wheelers and commercial vehicles.”<sup>41</sup>

In fact one challenge of the auto component industry is that a significant number of them are dependent on foreign technology either through joint ventures or technical alliances and there is very little in-house investment in R&D.<sup>42</sup> Significantly, Nabeel Khan reports that:

In the current scenario, the dependence on foreign Joint Venture (JV) partners is higher in case of electrical and electronics, a segment where 9 percent of the component makers in India work. Engine and transmission, which constitutes 37 percent of the total auto-parts makers in India, is another area where JVs and technical alliances are pivotal. In metal working, forging and casting and precision components, Indian-owned components tend to operate independently.

This model is explained by Venkatram Mamillapalle, Managing Director of Renault India, as a fallout of “the convenience of adapting to the changing technology faster”, and the fact that “low volume in some high-cost technology had also made the industry opt for joint ventures or technical alliances.”<sup>43</sup> However, the continuing lack of in-house capacity for R&D and innovation should be cause for worry for the *Make in India* aspirations that the policymakers harbour.

The All India Management Association (AIMA) confirms this grim outlook, assessing that “at present, India lags its global peers in I4.0 adoption.”<sup>44</sup>

But after stating all of the challenges described above, AIMA adds a silver lining:

That said, going by the progress that India is seeing in the two very critical enabling I4.0 technologies, IoT and big data, the country seems to be developing the right platform to base its ‘smart factories’. India is expected to command nearly 20 per cent of the global IoT market, which is estimated to reach INR19,49,505 crore by 2023. Furthermore, Industrial IoT, or the segment of the IoT market that particu-

<sup>33</sup> Priyam Saraf (2016), *Automotive in South Asia: From Fringe to Global*, The World Bank, p. i, <https://openknowledge.worldbank.org/bitstream/handle/10986/25119/108826revdOctober2016.pdf?sequence=5&isAllowed=y>. <sup>34</sup> Ibid. <sup>35</sup> Nabeel Khan (2020), “Who owns the Indian Component Industry”, 15 May, ETAuto, <https://auto.economicstimes.indiatimes.com/news/auto-components/etauto-originals-who-owns-the-indian-component-industry/74880674>. <sup>36</sup> Saraf (2016), p. 9. <sup>37</sup> Ibid. <sup>38</sup> John Sutton (2004), “The Auto-component Supply Chain in China and India - A Benchmarking Study”, London School of Economics, STICERD Research paper no. 34, p. 13, <https://pdfs.semanticscholar.org/21115/dafbc110a279f153aff72803e0ef2f6229e.pdf>. <sup>39</sup> D. Kale (2012), “Sources of innovation and technology capability development in the Indian automobile industry”, *International Journal of Institution and Economics*, vol. 4, no. 2, p. 121, <https://pdfs.semanticscholar.org/c03e/26216ebc44d65ba473c4f6834005da6a5bf5.pdf>. <sup>40</sup> Confederation of Indian Industry (CII) (2016), *Automotive Advanced Manufacturing: Taking quality and productivity to the next level amid severe industry disruptions*, p. 34, <https://www.mycii.in/KmResourceApplication/51762.20160729AutomotiveAdvancedManufacturing-CIIvF.pdf>. <sup>41</sup> Nabeel Khan (2020). <sup>42</sup> Ibid. <sup>43</sup> Ibid. <sup>44</sup> All India Management Association (AIMA) (2018), *Industry 4.0: India Inc. Gearing Up for Change*, p. 8, <http://resources.aima.in/presentations/AIMA-KPMG-industry-4-0-report.pdf>.

larly caters to the manufacturing sector, currently accounts for 60 per cent of the Indian IoT market.<sup>45</sup>

While the refrain of the industry and experts is to improve India’s competitiveness, value addition, innovation, and investment in R&D in automotive manufacturing, another hard reality is the unfolding impact of the Covid-19 pandemic. By one account the MSMEs will defer investment in capital expenditure (capex) by two years.<sup>46</sup> Given that 70 percent of auto component manufacturers are MSMEs, deferral of capex investment directly impacts the plans and pace of adoption of I4.0 technologies.

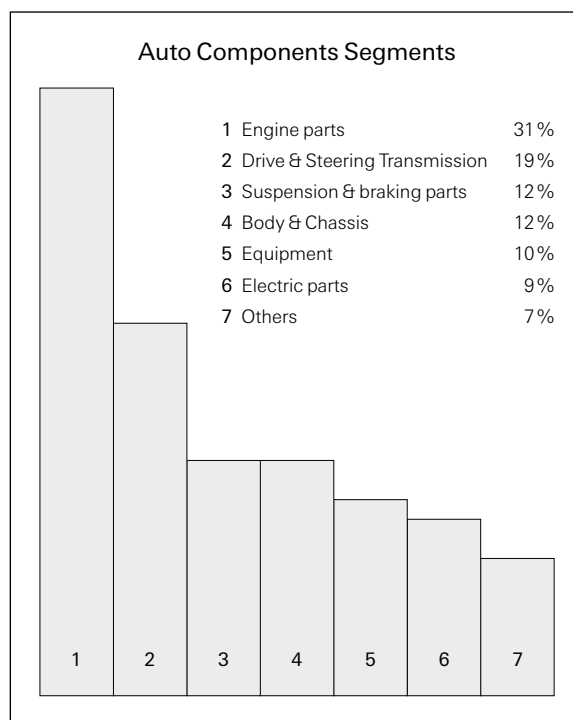
### 3 SMART CARS AND AUTOMOTIVE ELECTRONIC COMPONENTS

The use of electronics and information and communication technologies (ICTs) in automobiles is the biggest driver of change in the industry with nearly all innovations coming from electronics. A car has many components—in some cases as many as 30,000 parts go into an engine.<sup>47</sup> “Most of the solutions designed to lower emissions, improve fuel-efficiency, increase safety and provide convenience services like infotainment for customers are dependent on electronics and associated embedded applications.”<sup>48</sup> However, the auto electronics industry in India is currently at a nascent stage and more than 75 percent of all electronic components are currently imported.<sup>49</sup> Furthermore, as alluded to earlier, the “Indian auto parts sector is characterized by a few large players that can produce at export quality, while functioning in a sea of highly fragmented, organized and unorganized firms.”<sup>50</sup> More than 70 percent of the Indian auto component companies are SMEs with limited access to capital and technology.<sup>51</sup>

Manufacturers and the Government of India (GoI) hope that companies in the Electronic System Design and Manufacturing (ESDM) sector will invest in India and develop it into an export hub to the world. It is anticipated that with emerging regulations on safety and emissions, an average Indian car will have more electronics components than ever before, thus the Electronic Manufacturing Services (EMS) industry is expected to be a significant contributor to the entire electronic industry’s development. The *Make in India* initiative is also promoting the development of electronics manufacturing clusters throughout the country.

The Automotive Component Manufacturers Association of India (ACMA), suggests that in the short term, key technologies to focus on would be the Anti-Lock Braking System (ABS), the Body Control Module (BCM), and the Immobilizer. The technical know-how for these technologies is readily available in the Indian market and some of the Indian suppliers are already developing these systems either in collaboration with a global player or on their own. ABS is expected to dominate the short-term technology market because it is mandatory in trucks above 12 tonnes gross vehicle weight (GVW) and buses above five tonnes GVW,

Image 4



Source: ACMA

and is anticipated to see mandatory adoption in the passenger vehicle and two-wheeler segments. In the medium term ACMA suggests that the technology focus would be on Telematics, the Tyre Pressure Monitoring System (TPMS), and the Electric Power Steering (EPS), with a dominant focus on airbag and EPS. However, it assesses that “medium term technologies have low penetrations in the current market and are suggested to be targeted by suppliers who have [a] strong financial background and can make huge investment[s] in developing these technologies.”<sup>52</sup> In the long term, the focus can be on developing technologies for parking, cam, crank, and oxygen sensors.

These technologies have accompanying ecosystems at varied levels of development. To analyze which smart car technologies could be produced in India and which rely heavily on foreign intellectual property or know-how, ACMA categorizes all subcomponents along the lines of design and manufacturing capabilities of Indian suppliers. The categories are based on five key actions—develop indigenously, import and integrate, import and value addition, technical tie-ups, and value-added service. “Sub Components which are relatively easy to design and manufacture

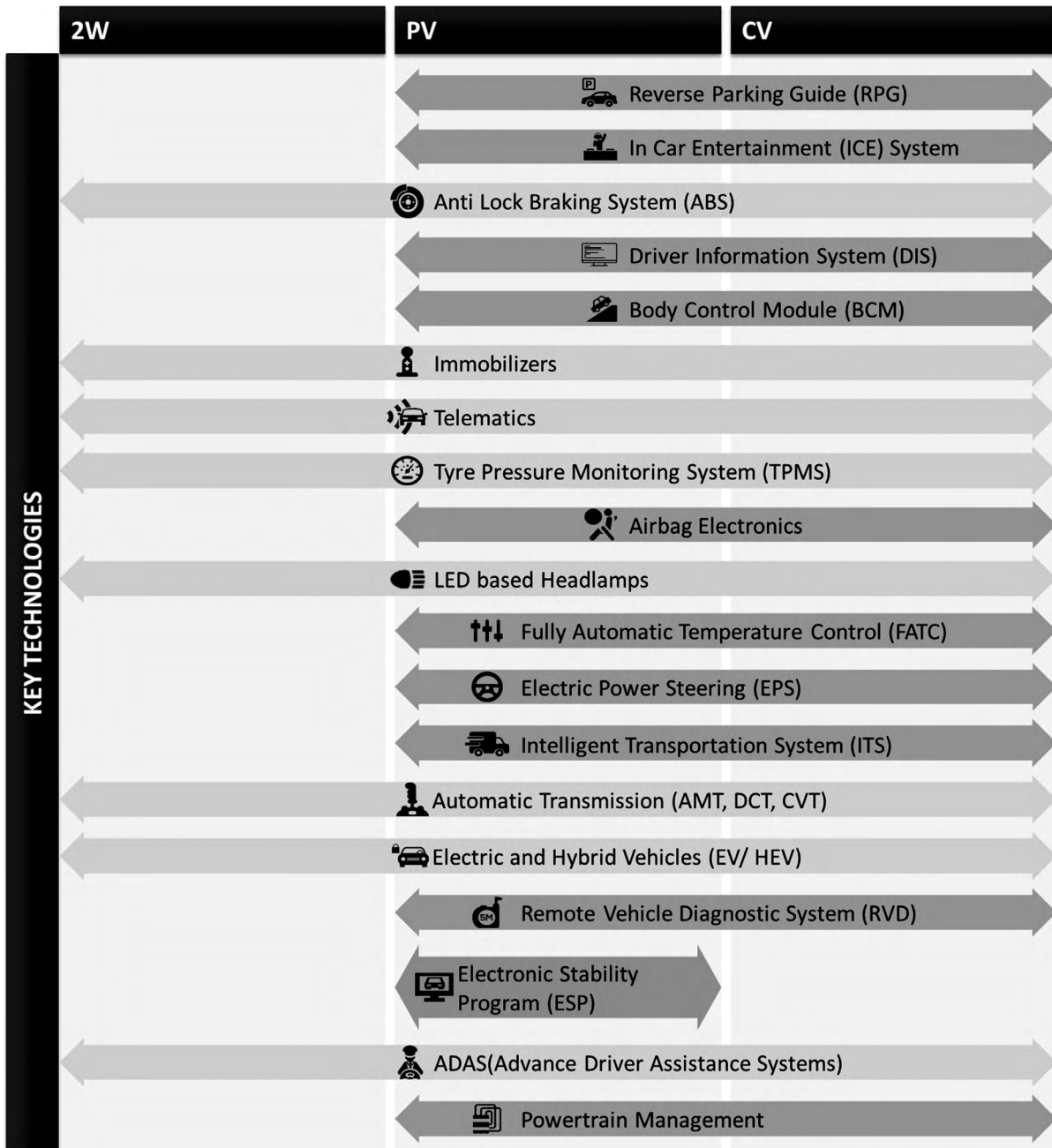
45 Ibid. 46 Shrutu Mishra (2020), “COVID-19 impact: Auto component makers may cut \$4 billion capex by 2022”, <https://auto.economictimes.indiatimes.com/news/auto-components/covid-19-impact-auto-component-makers-may-cut-4-billion-capex-by-2022/75770026>. 47 Ray and Miglani (2016b), Innovation (and upgrading) in the automobile industry: the case of India, ICRIER Working Paper 320, [http://icrier.org/pdf/Working\\_Paper\\_320.pdf](http://icrier.org/pdf/Working_Paper_320.pdf). 48 Automotive Component Manufacturers Association of India (ACMA) (2016), Automotive Electronics: Master Plan Development for Auto Components Industry in India, p. 3, [https://www.acma.in/uploads/research-studies/Automotive\\_Electronics\\_Study.pdf](https://www.acma.in/uploads/research-studies/Automotive_Electronics_Study.pdf). 49 Ibid. 50 Saraf (2016), p. 2. 51 NSDC (2013), p. iv. 52 ACMA (2016), p. 16.

are supposed to be ‘developed indigenously’ by Indian suppliers. Sub components for which technical knowhow is very restricted and [where] there are constraints in domestic manufacturing are supposed to be ‘Import and Integrate’ by Indian suppliers.”<sup>53</sup> The former could be manufactured by small suppliers and the latter by medium-sized suppliers. For example, for the reverse parking guide (RPG) system, ultrasonic

sensors, controllers, and displays can be developed indigenously by Indian suppliers while cameras would have to be imported and enhanced with value addition. In the in-car entertainment (ICE) system, speakers can be developed indigenously while head units and rear seat displays require technical tie-ups.

The ACMA report outlines the world of electronic components<sup>54</sup>:

Image 5



Source: ACMA, Automotive Electronics study, p. 8.

53 Ibid., p. 17. 54 Ibid., p. 8.



The timeline for development of some of these technologies suggested by the ACMA study is as follows<sup>55</sup>:

Image 6

Short Term Technologies (Technologies readily available and could be implemented in 1–3 yrs)	Medium Term Technologies (Technologies available and could be implemented in 3–5 yrs)	Long Term Technologies (Technologies under development)
Reverse Parking Guide (RPG)	Telematics	Intelligent Transportation System (ITS)
In Car Entertainment (ICE) System	Tyre Pressure Monitoring System (TPMS)	Automatic Transmission (AMT, DCT, CVT)
Anti Lock Braking System (ABS)	Airbag Electronics	Electric and Hybrid Vehicles (EV/HEV)
Driver Information System (DIS)	LED based Headlamps	Remote Vehicle Diagnostic System (RVD)
Body Control Module (BCM)	Fully Automatic Temperature Control (FATC)	Electronic Stability Program (ESP)
Immobilizers	Electric Power Steering (EPS)	Advance Driver Assistance Systems (ADAS)
		Powertrain Management

Source: ACMA, Automotive Electronics study, p. 7.

Another assessment of the automotive component industry is presented by Ray and Miglani.<sup>56</sup> Their interviews with industry sources revealed that in the passenger car segment,

predominant imports included electronic parts, critical engine parts, and motors ... the crankshaft is a very important part but difficult to make in India; it is made in Japan and Thailand. Another example is the electronic brakes and electronic control systems (which have stringent specifications as well). Components such as the cylinder block can be made in India or Thailand. The indigenous market for components such as engines is limited however, and companies have even started exporting these from India ... Component imports are in two categories, one, high tech parts, which come mainly from Germany, Japan, Korea and Thailand; and aftermarket parts which usually originate in China ... transmission parts and Electronic Control Modules are sourced from abroad ... Lightweight materials such as magnesium composites which are not locally available are imported. Some industry players feel that India lacked the technology for making newer cars with lightweight products (using modern plastics, aluminium and magnesium) and substantial investment in capital goods is needed. India is also good at manufacturing engines, though they are designed elsewhere.<sup>57</sup>

Echoing the CII view, they add that research for new product development is lagging in India, restricting the industry’s participation in GVCs when compared to countries such as China, Japan, or Germany. As many others have pointed out, SMEs are cautious about making investments in technology, affecting the ability of Tier 2 and 3 suppliers to support the industry in its efforts to upgrade and operate at globally competitive levels.<sup>58</sup>

ACMA assesses that “Indian OEMs (Bajaj Auto, Mahindra and Mahindra, Tata Motors, and [o]thers) have high willingness to work with Indian suppliers over foreign OEMs (Maruti Suzuki, Honda Cars, Hyundai, and [o]thers). Foreign OEMs have set suppliers routed from their parent company; they prefer [to] opt for

the same suppliers, leaving very [little] chance for any new Indian supplier’s entry into their value chain.” Moreover, the willingness of Indian OEMs “to work with Indian suppliers is comparatively high on less critical program areas such as Infotainment, Comfort & Convenience, and Body Electronics; in comparison to critical program areas such as Powertrain and Safety due to high level of complexity in manufacturing and design of these domain components.”<sup>59</sup>

Sunil Kaul, who is Group President for Technology, Innovation & Automation at the Anand Automotive Group<sup>60</sup> feels that the “conditions in India are different from those in Europe or the US. Hence the technology developed elsewhere in the world has to be adapted to the vehicle and its application.”<sup>61</sup> For this reason early engagements with engineering teams of OEMs are important in order to “design products specifically for the Indian market” as it takes “two or three years of interaction and learning from partners to have a design project for India along with the OEMs.”<sup>62</sup>

In addition, L. Ganesh, the chairman of the Rane Group has stated that since OEMs are increasing their model-mix and product variety in response to customer demands, component suppliers have to respond with simpler, more versatile components that can be used across multiple platforms. This challenges the ability of component manufacturers to optimally utilize capacity across multiple models.<sup>63</sup> His view is that all component domains will change, and that this calls for investments in: R&D; teams with appropriate skills for innovation; and training of the workforce. The role of Human Resources (HR) will also evolve, since the “accelerated rate of change on technologies and business model innovation require companies to rewire the talent strategy to enable employees [to]

<sup>55</sup> Ibid., p. 7. <sup>56</sup> Ray and Miglani (2016b), p. 16. <sup>57</sup> Ibid., pp. 17–18. <sup>58</sup> Ibid., pp. 19–20. <sup>59</sup> Ibid., p. 23. <sup>60</sup> It is one of the largest Tier-1 auto component manufacturers, having 15 joint ventures and eight technical collaborations with many reputed global Tier-1 companies. <sup>61</sup> AutoParts Asia, “Innovation has to be in stages”. <sup>62</sup> Ibid. <sup>63</sup> AutoParts Asia, “Investment challenges in disruptive market”.

acquire new skills” and “[g]etting the right people, re-skilling employees, educating the workforce, keeping track of changes, are key HR roles that will have to be re-oriented to the future.”<sup>64</sup>

Adding to this view, Sunil Kaul, the Anand Automotive Group President says that “[s]kill is [an] intangible asset that needs investment. The transition from automobile, mechanical or electrical domain to electronics and information technology across the entire manufacturing process of concept development, safety, IoT, servicing delivered parts and sustainability is a challenge in itself. Bridging the gap between courses offered at educational institutions and the skills of observation, thinking out-of-the box and implementing, upon entry into the industry, require new industry-academia collaboration.”<sup>65</sup>

As per data from the National Skill Development Council (NSDC), of the 7.6 million employed in manufacturing, 72 percent are working in the component sub-sector and even there the majority is employed in Tier 3 and raw material manufacturing companies. By 2022, this share is expected to increase to 80 percent. With manufacturers opting for increasing contractualization of employment as discussed earlier, the share of contract workers has jumped from 40 percent in 2008 to 56 percent in 2014 and is expected to stabilize at around 65 percent in 2022.<sup>66</sup>

Image 7

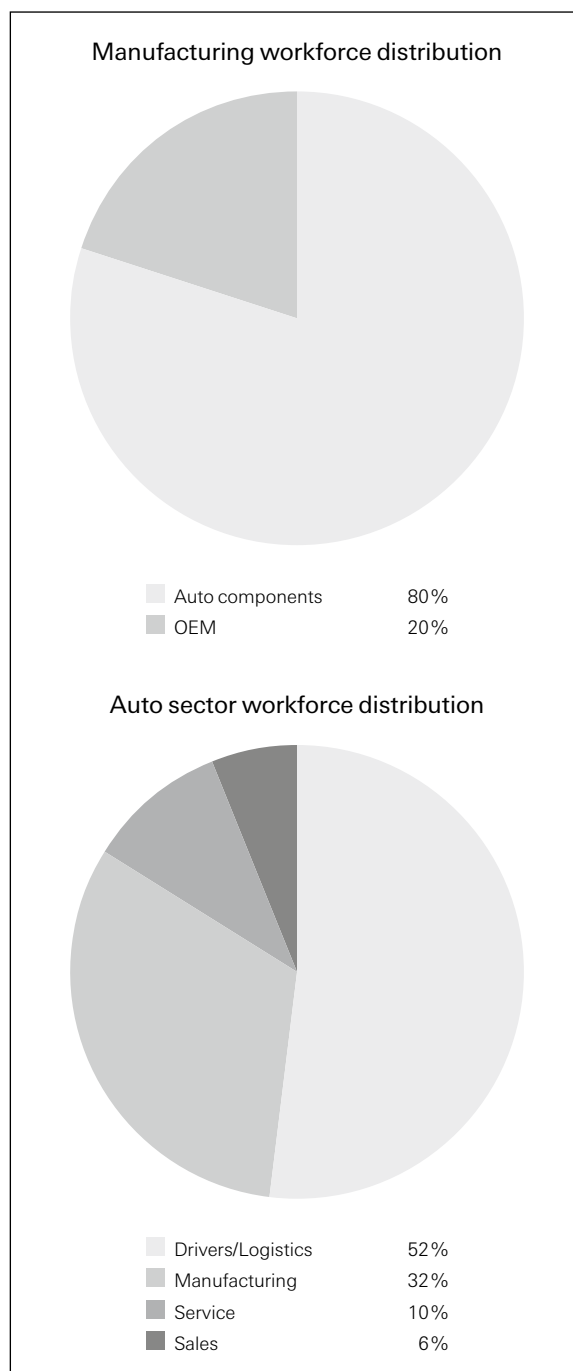
Sub-sector	Employment (in million)		
	2013	2017	2022
OEM	1.87	2.04	2.23
Auto component manufacturers	4.81	5.99	7.26
Service centers	2.80	3.10	3.44
Dealerships	1.50	1.68	1.95
<b>Overall sector</b>	<b>10.98</b>	<b>12.81</b>	<b>14.88</b>

Source: NSDC, Human Resource and Skill Requirements in the Auto and Auto Components Sector, p. iii.

Indirect employment is expected to go up to 68 percent of the total employment,<sup>67</sup> and with automation and operational efficiency, an addition of one manpower at the OEM would lead to generating eight jobs at the vendor’s end.<sup>68</sup>

Several CEOs and industry consultants have cautioned that the success of digital transformation depends on human capital. Despite this recognition, the continuing reliance of the industry—both the OEMs and the auto component manufacturers—on contract labour appears to be an unresolved contradiction. The slowdown in the industry had already resulted in the firing of contract workers both by OEMs and auto component manufacturers even prior to the lockdown enforced on 22 March 2020 to contain the Covid-19

Image 8



Source: NSDC, Human Resource and Skill Requirements in the Auto and Auto Components Sector, p. iv.

pandemic. The pace of firings has only increased after the Government of India rescinded its lockdown order of 29 March 2020 instructing all companies to retain workforce and pay salaries during the lockdown. However, once the order was rescinded not only did the pace of lay-offs increase but the retrenchments even reached workers regularly employed by some

<sup>64</sup> Ibid. <sup>65</sup> AutoParts Asia, “Innovation has to be in stages”. <sup>66</sup> NSDC (2013), p. iv. <sup>67</sup> Ibid. <sup>68</sup> Ibid., p. 2.

auto component manufacturers.<sup>69</sup> Some industry leaders have voiced their disquiet, pointing out that workers' trust in the company, their investment, attachment, and loyalty to the company are harmed by such short-sighted decisions.

In a recent interview,<sup>70</sup> R. C. Bhargava, Chairman of Maruti Suzuki India Limited (MSIL) made several important observations on this issue:

Labour costs are secondary issues. First, you have to get the right kind of worker with the right kind of skills. Many companies in India today still feel that this use of migrant labour in the form of contract labour, provided by contractors, is the cheapest way to do business.

This is cheap only in the short term. It does not help companies improve productivity, does not help them become competitive, quality does not improve because workers keep changing every few months or maybe in a year or so and no skills are built up.

This is a question that must be central to the automotive industry going forward as several studies on digitalization of production have begun to emphasize that one of the topmost concerns is going to be the workforce. Bhargava added that "India attracts very few people and the reason is that we cannot get productive management; and labour is one of the most important resources for getting productive management."

In light of this key role of labour in assessing the ability of the Indian economy to embark on the I4.0 trajectory, it is worth taking a closer look at the changes in the workforce that are required in the I4.0 transition. This is a crucial step for understanding its implications for workers and unions, and will be the focus in the last part of this study.

#### 4 LABOUR RELATIONS IN THE AUTOMOTIVE INDUSTRY

Tommaso Pardi argues that major structural changes in the automotive industry are taking place in emerging economies<sup>71</sup>; in India the introduction of liberal policies in the 2000s and the takeover of Maruti Suzuki, the joint-venture enterprise between the GoI and Japanese-owned Suzuki, marked an anti-Fordist turning point. A policy of high wages was rejected in favour of informalization of employment, increasing intensification of work, and constant wages. Both China and India have been witnessing a series of strikes, highlighting the "socially unsustainable nature of this type of development."

Tom Barnes terms this as "low road" labour relations,<sup>72</sup> seen in high wage inequality and informalized employment relations "via a multi-layered network of labour contractors who undermine the representational and organizational rights of workers, and have generated a significant number of industrial disputes, including periodic bouts of serious and even violent conflict" as also argued by Shyam Sundar and Sapkal.<sup>73</sup> Such a type of development is socially unsustainable in nature as seen in India witnessing a series of strikes in the industry. According to Barnes, "low road"

labour relations are a result of a "combination of India's distinctive national and regional norms, social relations and institutions with the global carmakers' governance practices" as the Indian state gradually liberalized global investment rules.

Trade union leaders from the Gurgaon and Gujarat automotive belts have criticized the deployment of campaigns such as *Skill India* as they create a large floating population of skilled workers instead of contributing to more secure labour conditions. The skilled workers work for a few months in one company before being deployed to another. The chances of their regularization are extremely remote, even as this reserve army of skilled workers is used to drive down wages of permanent workers in the automotive manufacturing clusters, effectively reducing labour costs for the manufacturers.<sup>74</sup>

Anumeha Yadav reported on this trend at the time that it was being introduced:

Temps, hired [on seven-month contracts], constitute a new category of workers. They now make up two-thirds of Maruti's Manesar workforce. They were ostensibly hired to phase out the contract system with all its attendant problems. But in practice, the new system has made the tenure of workers even more precarious.

... The "company temps" would be paid Rs 14,000 [approximately EUR 160] monthly – about half the salary of permanent workers, who earn Rs 35,000 [approximately EUR 400] and more.<sup>75</sup>

As mentioned earlier, I4.0 technologies are expected to erode the low labour cost advantage, and the infrastructure and assets deployed in the era of Industry 2.0 and Industry 3.0 will no longer suffice. Accordingly, skills and capabilities utilized to operate these assets, that developing countries have relied on thus far for industrialization and manufacturing competitiveness, will be ineffective in the new technological environment. Automotive players across the value chain will need to gear up to meet these changing requirements. Experts and industry leaders emphasize that adoption of new technologies is as good or bad as the human capital deployed with it. This would not only mean altering infrastructure and skill sets of people in the new environment, but also altering labour and indus-

<sup>69</sup> Outlook India (2020), "Rico Auto lays off 119 permanent workers from Dharuhera plant", 25 May 2020, <https://www.outlookindia.com/newscroll/rico-auto-lays-off-119-permanent-workers-from-dharuhera-plant/1845733>. <sup>70</sup> Tamanna Inamdar (2020), "Need to deal with labour issue with a long-term perspective: RC Bhargava", 9 May 2020, <https://auto.economicstimes.indiatimes.com/news/industry/need-to-deal-with-labour-issue-with-a-long-term-perspective-rc-bhargava/75646968>. <sup>71</sup> Pardi argues that Chinese auto sector growth was fuelled by the 'premium' demand of urban elites and the industry came under the control of multinational foreign manufacturers resulting in "high capital intensity in the final stages of manufacturing and assembly, of which the costs are amortized by a flexible use of the labour force and a considerable amount of subcontracting". Pardi (2017), pp. 2–3. <sup>72</sup> Tom Barnes (2017), "Why Has the Indian Automotive Industry Reproduced 'Low Road' Labour Relations?", in Ernesto Noronha and Premilla D'Cruz (eds.), *Critical Perspectives on Work and Employment in Globalizing India*, London: Springer, pp. 37–56. <sup>73</sup> Shyam Sundar and Sapkal (2019), "Wage Disadvantage of Contract Workers", *The Indian Journal of Industrial Relations*, vol. 54, no. 3, [https://www.researchgate.net/publication/330010184\\_Wage\\_Disadvantage\\_of\\_Contract\\_Workers](https://www.researchgate.net/publication/330010184_Wage_Disadvantage_of_Contract_Workers). <sup>74</sup> Personal communication with author. <sup>75</sup> See: Yadav (2015). She also writes that the company employs 3500 temps vs 1600 permanent workers.

trial relations frameworks. The challenges posed will be accentuated as new and traditional ways of working continue to coexist and evolve.

#### 4.1 The Challenge of Skilling and Re-Skilling<sup>76</sup>

India's National Policy for Skill Development and Entrepreneurship 2015<sup>77</sup> aims to ensure that 500 million Indians have skills appropriate to the labour market by 2022.<sup>78</sup> Some recent changes to the 1961 Apprenticeship Act are aimed at increasing flexibility and removing apprentice numbers prescribed per trade or unit. Among the initiatives taken by the Govt to establish competency levels and enable vertical mobility of the skilled workforce are the National Skills Qualifications Framework (NSQF) and the creation of National Occupational Standards (NOS).<sup>79</sup>

According to news reports only 36 percent of Indian companies conduct in-house enterprise-based training compared to 88 percent in Germany, 85 percent in China, 52 percent in Russia, and 51 percent in Brazil and Mexico. Only one sixth out of over three million job hunters are considered 'employable'. The skill gap is projected to affect over 250 million workers by 2022. Skill development of a large talent pool is considered to be most critical in delivering manufacturing excellence.

The IndustriAll Global Union underscores the challenges this poses:

The transition to smart manufacturing has a variety of impacts on how work can and will be done in the future and on its inclusiveness, or rather exclusiveness, for some workers. Manual work is decreasing, while computerized work is in fact increasing. Computer literacy and being able to understand and work in common programming languages will be a valuable skill in the future. Both of these skills require extensive education, training and professional development and means that some parts of society might be left behind. Languages, be they natural or programming languages are best and easiest learned at a young age, meaning that older generations of workers might have a harder time achieving the necessary qualifications. Migrant workers whose first language is not English may have an unequal start in training (although some studies have shown that they are not greatly disadvantaged because of the extremely logical nature of programming languages). Education and training requires time and effort outside of the regular work schedule, which has been estimated by the European Union to mean at least 40 hours per year in some occupations – while the present-day average is around 9 hours per year. This likely means, workers with children, and in particular women, will have larger issues in matching their work requirements and family duties. Workers with disabilities, especially those who are mentally impaired, have thus far been able to be included in some of the easier tasks in manufacturing plants – but with the rising complexity of tasks and the necessity for computer and programming skills, these jobs are also becoming more exclusive.<sup>80</sup>

There are a few examples in the public domain regarding firm-level preparations. At Toyota Kirloskar

Auto Parts (TKAP), the company prepares a detailed work-life plan for technical training for all employees, from operators to managers, and training modules are designed by the human resource development team and conducted by certified in-house trainers. They use the 'Skill Requirement System' (SRS) to evaluate current skill levels of employees against the ideal skill required for the troubleshooting of core machines, and then tailor the training accordingly. For example, in the grade of Manufacturing Supervisor, the company has a minimum of 50 days of training.

The company believes that smart manufacturing demands that each person is multi-skilled in the areas of production, maintenance, quality, and logistics, thus providing greater flexibility and productivity of the workforce. The company has implemented nearly 200 low-cost automation (LCA) mechanisms in their plants in the last 5–6 years and recently set up an in-house LCA Training House, called "Karakuri Dojo", for all TKAP employees to learn and implement LCA at their workplace on their own and also 'skill up' to maintain those skills.

In addition, the company facilitates skill exchange programmes for its own employees and those of the machine tool maker. "In this programme, selected employees are deputed for a fixed period at each other's facility to develop and level-up the skill and knowledge. This initiative helps to improve both depth and width and learn the best practices in the key functions of Design & Development, Machine building, Mechatronics, Jigs and fixture etc."<sup>81</sup> Employees are also sent to overseas affiliates to acquire skills and knowledge in new product and process technology.

At the Rane group, the Rane Institute for Employee Development (RIED), established in 1995, builds competencies through standardized modules. "The driving force is the need to provide anytime learning opportunit[ies] and give flexibility for employees to learn at their own convenience and pace."<sup>82</sup>

<sup>76</sup> There is a huge debate on this issue and a large amount of literature about it. See, for example: [http://164.100.47.193/lssccommittee/Labour/16\\_Labour\\_36.pdf](http://164.100.47.193/lssccommittee/Labour/16_Labour_36.pdf), [http://icrier.org/pdf/Working\\_Paper\\_313.pdf](http://icrier.org/pdf/Working_Paper_313.pdf), <https://www.nationalskills-network.in/santosh-mehrotra-skill-development/>, <https://www.thehindu.com/opinion/lead/skill-india-urgently-needs-reforms/article23447258.ece>, <https://thewire.in/business/why-is-india-inc-reluctant-to-participate-in-the-skill-india-campaign>, <https://global.oup.com/academic/product/indias-skills-challenge-9780199452774?cc=ind&lang=en&>, <http://iamrindia.gov.in/writereaddata/UploadFile/epw.pdf>, [https://www.business-standard.com/article/politics/govt-s-aim-to-skill-10-million-youth-by-2020-falling-64-short-of-target-119020300564\\_1.html](https://www.business-standard.com/article/politics/govt-s-aim-to-skill-10-million-youth-by-2020-falling-64-short-of-target-119020300564_1.html), <https://www.indiaspend.com/budget-2019-must-tackle-missed-skill-development-targets-even-as-ministries-funds-go-unutilised/>, [http://www.ncaer.org/publication\\_details.php?pid=300](http://www.ncaer.org/publication_details.php?pid=300). <sup>77</sup> NSDC (2015), National Policy for Skill Development and Entrepreneurship, <https://www.nsdcindia.org/sites/default/files/files/National-Policy-on-Skill-Development.pdf>. <sup>78</sup> Federation of Indian Chambers of Commerce and Industry (FICCI) (n.d.), Skills Development: Sector Profile, p. 17, [http://ficcii.in/sector/74/Project\\_docs/SectorProfile.pdf](http://ficcii.in/sector/74/Project_docs/SectorProfile.pdf). <sup>79</sup> The Apprentices (Amendment) Act, 2014 has been received critically especially by workers and trade unions, and is seen as a mechanism to introduce a disguised form of casualization on the shop floor; in other words giving legal cover to an existing illegal practice and reducing the collective bargaining strength of regular and unionized workers. <sup>80</sup> IndustriAll (2017), p. 15. <sup>81</sup> AutoParts Asia, "Automation to Autonomation". <sup>82</sup> AutoParts Asia (2018), "Ried Rides People-Centric Growth of Rane Group". Viewable via Rane Group: <https://ranegroup.com/updates/press/ried-rides-people-centric-growth-rane-group-coverage-auto-parts-asia-september-2018-edition/>.

Studies from Germany also suggest that Work 4.0 will require workers with interdisciplinary skills, especially social and creative intelligence and cross-functional skills. They will have to work more flexibly and independently in the future. Lifelong learning will need to be more natural and more systematically rooted in our education system. Industry and government have to prepare for this.

The foundations of such a workforce are laid prior to their entry into the workforce, as pointed out by Goutam Das.<sup>83</sup> Human capital—the capabilities of workers to read, write, comprehend and process information and instructions, be creative and innovative—are shaped by childhood health and education. The emerging world of work is dynamic, he argues, and future workers “require three basic capacities: the ability to think on their own and critically analyse, the capacity to learn and the capacity to apply knowledge.”<sup>84</sup> Conceptual clarity and understanding, for example the capacity for algorithmic thinking required for coding, require drastic changes in school curriculum, teacher training, methods of teaching and testing, and the valuing of innovative education and vocational training.

In Das’s assessment, “India’s [human capital] supply isn’t ready for the future of work.” He adds that the capacity to learn, unlearn, skill, reskill, apply knowledge—all requirements of the emerging world of work—requires a healthy brain, which in turn starts with a healthy mother. India faces a massive challenge in addressing malnutrition, stunting of children, and the general health and wellbeing of mother and child. Das finds that “the dropout rates of those skilled and placed in factories are high. Many are not physically capable of dealing with the demands of factory work.” He concludes that “there is very high vulnerability in people’s lives” but very little social protection against risks. This was evident in the unprecedented exodus of labour from Indian cities during the Covid-19 pandemic lockdown. Both industry and government need to address this weakness of India to be in a position to gain from the Fourth Industrial Revolution. A simple focus on technologies and technological change will not suffice.

In addition, it seems that “very few companies and HR functions are fully prepared to address the organisational change requirements related to automation, the opportunities offered by a larger contingent of talent pool” as reported by the Willis Towers Watson Global Future of Work Survey conducted in November 2017 across 909 companies worldwide, including 52 from India.<sup>85</sup>

The India findings of the Global Future of Work Survey reveal that the extent of workplace automation in India in the next three years is expected to be more than the Global and APAC [Asia-Pacific] average. Companies in Asia Pacific expect automation to account for on average 23 percent of work being done in the next three years as compared to 13 percent today. In India, it is expected to

rise from a current 14 percent to 27 percent in the next three years. However, contrary to the traditional outlook where automation was believed to replace humans to minimise costs, the study found that more than half the companies in India believe that automation will augment human performance and create new work, not replace it. Automation is expected to shape a new combination of work, talent, skills requirement and work relationships. While organisations in India expect the percentage of full-time employees to reduce from 85 percent to 78 percent in three years, they also anticipate using more contingent and part-time workers. The survey also found that 33 percent [of] companies in India today believe that automation enables a flexible deployment of work to other locations, compared to the APAC average of 39 percent. However, in three years, a massive 70 percent [of] companies anticipate this automation-driven work flexibility as compared to 65 percent in the APAC region.<sup>86</sup>

The survey also found that “though 54 percent of the manufacturing sector organizations realize the need for automation to augment performance and productivity, only one in three organizations is prepared to deal with such a change” and “only 12 percent [of] companies in India believe that their HR functions are fully prepared for the changing requirements of automation.”

A study from the Centre for Internet and Society (CIS) directs our attention to the crucial issue of work intensification and informality,<sup>87</sup> a concern highlighted in other studies as well. Even the Asian Development Bank (ADB) acknowledges that,

Informal work remains a prominent fixture across developing Asia, ranging from 33% of nonfarm employment in the PRC to 87% in Bangladesh. The median is over 70% in the 10 economies in developing Asia with data. Informal workers earn less than formal workers, their income only 20% of what formal workers make in Bangladesh and 64% in Pakistan. In eight countries with available data, the median informal worker wage is half that of formal workers.<sup>88</sup>

Citing the ILO Wage Report for 2016–17 on wage inequalities in the workplace, Shyam Sundar and Sapkal assert that in India, “the highest-paid top 10 per cent of income groups receive almost 43 per cent of total wages paid to all employees, whereas, the lowest-paid bottom 50 per cent of income groups receive only 17 per cent of total wages paid to all employees”. Furthermore, “the upper tail of wage distribution is highly concentrated in the hands of 1 per cent highest-paid income groups; women workers earn 33 times less than the male workers; and the persistence of wage inequality within the enterprise and industrial sector is driving total wage.” They find that “the ILO

<sup>83</sup> Goutam Das (2019), *Jobonomics: India’s Employment Crisis and What the Future Holds*, Gurgaon: Hachette India, Section II. <sup>84</sup> *Ibid.*, p. 107. <sup>85</sup> AutoParts Asia, “Workplace automation in India to double in three years”. <sup>86</sup> *Ibid.* <sup>87</sup> CIS (2019a), *The Future of Work in the Automotive Sector in India: Perspectives from the Ground*, pp. 23–24, <https://cis-india.org/internet-governance/future-of-work-in-automotive-sector.pdf>. <sup>88</sup> ADB (2018), *Asian Development Outlook: How Technology Affects Jobs*, p. 97, <https://www.adb.org/sites/default/files/publication/411666/ado2018.pdf>.

attributes employment of flexi-category workers like contract labour as responsible for declining wage share in industries.”<sup>89</sup> Shyam Sundar and Sapkal correctly point out that “wages of regular workers are determined by a bargaining process, wherein their bargaining power is curbed due to the presence of contract workers, firms have an additional incentive to hire these workers.”<sup>90</sup> IndustriAll adds that “the wages paid to contract workers are often less than the minimum prescribed by law, and usually not sufficient to support a worker and their family. Contract workers are regularly denied access to the Indian national social security and medical insurance schemes.”<sup>91</sup>

If the future workforce is required to be more educated, skilled, and have social competencies to be problem solvers as part of interdisciplinary teams, will the current trend of employing a largely contractual and informalized workforce and depression of wages continue or will this system evolve? An ILO report anticipates that a “rapidly changing technological landscape will make skilling and labour demands unpredictable and variable. This is likely to increase the preference for hiring contractual rather than permanent labour.”<sup>92</sup> However, it will be interesting to see if the disruptions caused by the Covid-19 pandemic force a rethinking of this ‘low road’ model of labour relations.

## 5 TRADE UNION 4.0: TOWARDS A JUST TRANSITION FOR WORKERS

In its Action Plan of October 2017,<sup>93</sup> the global union federation (GUF) IndustriALL declares that Industry 4.0 should not be allowed to “define a new wave of intensified work and more precarious work.” It calls upon its affiliates to “seek proper labour market policies, including improved national education, training, re-training and skilling policies that consider the changing skills and qualifications demanded by Industry 4.0, and also to be a part of the design and delivery of such education and training.” Furthermore, it calls on affiliates to demand “new rights for all categories of workers, whether blue collar or white collar, including the right to information and consultation; the right to education and training – life-long learning; and the right to defined levels of privacy, at work and at home.”

Technological skill-bias is likely to increase marginalization and labour market inequities of certain communities along gender, caste, class, and religious lines due to socio-cultural norms that inhibit access to education, skilling, and employment. The above-mentioned ILO study also flags the issue of feasibility of movement of workers across prevailing structures of employment, across organized and unorganized sectors, across formal and informal employment, urban and rural, manual and mechanized, high-caste from low-caste work, and the serious political and social consequences if such movement is not forthcoming or exacerbates existing inequities. Consequently, the ILO study poses the question of what kind of strategies

can help shape how emerging technologies play out in the complex socio-economic and cultural context of work in India, especially organized around labour protection, redistribution of technology gains, coping and adapting, and shaping technological trajectories.<sup>94</sup>

The dominant narratives on the challenges of Industry 4.0 do not adequately focus on the society-level impacts, the concentration of wealth and power in digital platforms, the ability of digital leaders to have asymmetric vertical and unilateral control over workers including surveillance, and the potential for widening inequality and resulting social strife. As IndustriAll puts it, “subsidizing and cheering for the digital transformation must not be the only role of government. Governments must create and enforce laws, standards, and public policies, in the public interest, in this rapidly changing area.”<sup>95</sup>

While data security has emerged as a specific concern for the industry, the issue of collection of workers’ personal data and access to it is only highlighted by trade unions such as IG Metall and IndustriAll. The latter in fact argues that,

Trade unions must refuse such personal data monitoring by employers because it can only lead to a cannibalistic competition among workers, undermining solidarity. How will workers compete when their work is measured against that of a machine? How will productivity be measured when an individual’s work is performed in the context of a complex technical system that must only be kept running, and there is no longer a clear relationship between hours worked and production? What becomes of our expectations of minimal privacy, even at work? ... Whose data is it to begin with – the worker’s or the company’s? It is unlikely that workers will have much say on what information is collected about their performance or what is done with it.<sup>96</sup>

Ruth Ntlokotse, second deputy president of the IndustriAll-affiliated National Union of Metalworkers of South Africa, says:

Data and artificial intelligence are central to the digital economy. Who owns this data and what are the effects on workers? We are already facing issues with biometrics at the workplaces. Employers are using surveillance systems to infringe on [workers’] privacy. We need studies that will inform us on how to respond to the 4IR.<sup>97</sup>

IndustriAll also emphasizes the need for open standards for the digital integration of manufacturing and data. If this were allowed to become a proprietary standard, too much wealth would be concentrated at one point in the value chain. Hence, IndustriAll stresses, “Industry 4.0 must not be allowed to become just another way for developed countries to punish less-developed ones.”<sup>98</sup>

<sup>89</sup> Shyam Sundar and Sapkal (2019), “Wage Disadvantage of Contract Workers”, pp. 377–78. <sup>90</sup> *Ibid.*, p. 381. <sup>91</sup> IndustriAll (2016), *Precarious Work in India*, p. 2, [http://www.industriall-union.org/sites/default/files/uploads/documents/a4\\_india\\_report\\_new2.pdf](http://www.industriall-union.org/sites/default/files/uploads/documents/a4_india_report_new2.pdf). <sup>92</sup> ILO (2018a), p. xiii. <sup>93</sup> IndustriAll (2017), pp. 30–34. <sup>94</sup> ILO (2018a), p. xv. <sup>95</sup> IndustriAll (2017), p. 6. <sup>96</sup> *Ibid.*, p. 9. <sup>97</sup> IndustriAll (2019c) “Unions can shape the future of work in the Fourth Industrial Revolution”, 1 November 2019, <http://www.industriall-union.org/unions-can-shape-the-future-of-work-in-the-fourth-industrial-revolution>. <sup>98</sup> IndustriAll (2017), p. 11.

Reflecting on the challenges facing trade unions, if they want to remain relevant within these shifting power dynamics, IndustriAll posits that not only will 'Trade Union 4.0' require reinvention, new thinking, new structures, and a culture adapted to new realities but it will also have to find ways to appeal to the younger generation of workers: this means responding to their needs and aspirations but also addressing the 'white-collarization' of the workforce and especially finding ways to organize isolated workers on individual contracts and the workers in the gig economy (crowd-workers, platform-workers).<sup>99</sup> IG Metall has initiated an outreach programme for such workers and it has also included issues of Labour 4.0 in their collective bargaining agreements such as defining what in-company training will be provided, provide for concrete qualification offers, and regulate the cost assumption by the employers. It articulates what Good Work 4.0 means to the union and the workers it represents—job security and fair remuneration, reduction of workload, revaluation of activities, better professional development and learning opportunities, more time sovereignty, informational self-determination, and involvement and participation on an equal footing.<sup>100</sup> To a similar list, IndustriAll adds "the right to defined levels of privacy, at work and at home."<sup>101</sup> It adds that the first priority is to "create, evolve, or maintain sustainable jobs" and that while social security nets are necessary for a Just Transition, they are not the answer. The International Trade Union Confederation (ITUC) has articulated a similar view to these two union federations. Furthermore, German trade unions such as the IG Metall, IG BCE, NGG, and DGB NRW have collaborated with the European Social Fund and regional Ministries of Labour on a project called 'Work 2020'.

The project aims to tackle the problem of change at the company level, and empower union representatives to take an active role in shaping 4.0 in their company. If Industry 4.0 is viewed as a challenge for companies, then, as a first step Work 2020 attempts to map the company and identify challenges to the digital transformation – for all stakeholders. Using the map, and the identified challenges, then discussions take place at e.g. the Works Council aimed at implementation of new technologies along with the necessary attention to training, working conditions, etc. so that the transformation is [as] smooth as possible and as beneficial to all as possible. Using the Work 2020 approach, German unions hope to be able to direct the path of technology at the company level, particularly if they get involved at an early stage.<sup>102</sup>

In fact, the Work 4.0 White Paper emphasizes that "we want to seize the opportunities which digitalisation offers for our economy, for the labour market, and quality jobs. In doing so, we must take concerns about job losses, the erosion of skills, work intensification and the breakdown of the boundaries between work and private life seriously; as well as taking into account the divide between people who find promise in freedom

and flexibility and those who seek stability and security."<sup>103</sup> The challenge is to encode these concerns and evolve an appropriate industrial relations framework to address the challenges brought on by the transformations of the Fourth Industrial Revolution.

## 6 INDUSTRIAL RELATIONS IN THE AGE OF INDUSTRY 4.0

Developments both at the global and national level led to fundamental transformations in the economy, industry, and industrial relations. It is instructive once again to learn from Germany as the pioneer of the Fourth Industrial Revolution and where the government has engaged in extensive consultation with all stakeholders and issued a white paper on Work 4.0 ("WeißbuchArbeiten 4.0").<sup>104</sup>

India appears to be going in the opposite direction with the current spate of labour reforms and breakdown in social dialogue with central trade unions. Since the late 1980s and accelerating rapidly thereafter, there has been a shift in focus from social justice, equity, and balance of power between employers and employees towards enterprise efficiency, innovation, the role of technology, skills, productivity, and reduction of costs as a basis of competitiveness hence a correlated shift from a collective IR system (national, industry, union-level) to enterprise-based Human Resource Management (HRM).<sup>105</sup>

While the shift in the balance of power in favour of employers is not unique to India, Sen Gupta and Sett argue that "what is unique about the Indian experience is the way democratically elected governments used their enormous discretionary powers under the industrial statutes and subverted the functioning of dispute resolution machinery, to further their narrow political interests. In the process, growth of genuine trade union power base was stifled." Debi Saini additionally notes that today, the "state's priorities are more focused on efficiency, higher growth in GDP, and foreign direct investment rather than social justice. The present state of apparent cooperation in IR is symptomatic partly of a covert pressure on workers of the state's indifference to their cause."<sup>106</sup> Similarly, Ratna Sen noted that the "dominant change in industrial relations in India has been the change in government role, with not only a tilt towards management/employer, but a progressive

<sup>99</sup> Ibid. p. 25. <sup>100</sup> Konrad Klingenburg (2017), "The future of the workforce in an age of self-organising factories", conference presentation, Internet of Manufacturing, Munich, 7–8 February 2017, [https://internetofbusiness.com/wp-content/uploads/2017/02/Konrad-Klingenburg\\_IG-Metall-Executive-Board\\_CLOSING-KEYNOTE-The-future-of-the-workforce-in-an-age-of-self-organising-factories.pdf](https://internetofbusiness.com/wp-content/uploads/2017/02/Konrad-Klingenburg_IG-Metall-Executive-Board_CLOSING-KEYNOTE-The-future-of-the-workforce-in-an-age-of-self-organising-factories.pdf). <sup>101</sup> IndustriAll (2017), p. 27. <sup>102</sup> Ibid., p. 28. <sup>103</sup> Federal Ministry of Labour and Social Affairs, Germany (2017), "Re-imagining Work: White Paper 4.0", p. 5, [https://www.bmas.de/SharedDocs/Downloads/EN/PDF-Publikationen/a883-white-paper.pdf?\\_\\_blob=publicationFile&v=3](https://www.bmas.de/SharedDocs/Downloads/EN/PDF-Publikationen/a883-white-paper.pdf?__blob=publicationFile&v=3). <sup>104</sup> Emerged from a broad 18-month-long public dialogue with experts from the social partners, associations, trade unions, employer organizations, businesses, academia, and members of the general public; coining the term Work 4.0 as a supplement to the discussion on Industry 4.0. <sup>105</sup> Ashish K. Mishra and Dinesh Narayanan (2011), "Haryana: The State of Discontent", Forbes India, 1 July 2011, <http://www.forbesindia.com/article/special/haryana-the-state-of-discontent/26432/1>.

disengagement in industrial relations, particularly compared to the earlier actively interventionist role”, leading to a “reassertion of managerial power in the workplace and the assumption of managerial initiative in industrial relations”.<sup>107</sup> She goes on to identify various IR patterns—from union avoidance and subcontracting as strategies to acquire greater managerial control over the labour process, to the introduction of HRM as a way of de-institutionalizing labour-management relations.

While the overwhelming role of the state has been noted by many scholars, there is very little discussion on other ways in which political intervention in industrial disputes plays out. Sen Gupta and Sett highlight three avenues of political intervention: “calculated use of police force, conciliation proceedings and discriminatory use of power of reference of the disputes for adjudication”.<sup>108</sup> Even less discussed or studied is the manner in which companies, especially multinational companies (MNCs) influence state response. Ratna Sen notes several examples of companies lobbying the state government, especially in Haryana, to not allow unionization. She concludes that the “Haryana Government’s solicitousness for industries’ concerns” has in fact led to the enlargement of the disputes from “company disputes into industry-wide movements”.<sup>109</sup>

Industrial relations in India are extremely diverse. Consequently, any labour relations framework has to address a range of sectors, types of work, and enterprises. These range from small workshops and home-based work that form the end of the subcontracting chains in the unorganized sector with the lesser-skilled and lesser-educated workforce; to small and medium enterprises operating with small capital, small margins, and a small workforce with some literacy and skills; to large enterprises and MNCs. The latter may produce sophisticated engineering goods with an educated and skilled workforce. What is more, this does not even mention the service sector, which again ranges from micro and small enterprises to large MNCs. In spite of this diversity, or maybe because of it, the principles guiding IR have to be based on some universal guiding principles. In the case of India, this is the Constitution, especially Part Four of the Constitution, and Articles 38, 41, 43, and 43A.<sup>110</sup>

Employers in India have been seeking to fragment and disperse employment relationships in ways that take more and more workers out of the ambit of labour law protections and transform them into unregulated, market driven, commercial relationships or contracts for service i.e. a transformation from ‘contract of service’ (employer-employee relationship) to ‘contract for service’ (applies to independent contractors).<sup>111</sup> Such a transformation is concerning anywhere as it exacerbates already existing inequalities, but particularly so in a country like India, which ranks as being the second most unequal society in the world (behind Russia.)<sup>112</sup> Skill and literacy levels are low and the balance of power between employers and workers

is for the most part extremely unbalanced in a context of social systems based on hierarchy, respect for authority, and a general culture that does not promote consultation or free communication.

With a non-functioning IR system that most workers perceive to either be broken or working in the employers’ interests, it is of little wonder that levels of conflicts and clashes are rising, despite IR statistics of strikes and lockouts not adequately capturing and reflecting these low-level conflicts. That some of these low-level conflicts erupt with great force and even violence, disrupting industry and destabilizing the region or sector, should come as no surprise.

The automotive sector in particular has seen repeated protests and incidents of violence. In the industrial areas in the national capital region (NCR)<sup>113</sup> alone there have been several incidents of violence. After a year of factory occupations and strikes by workers over registration of their union, violence erupted at the Manesar plant of Maruti Suzuki India Limited (MSIL) on 18 July 2012, in which a manager was killed and 147 workers arbitrarily incarcerated for nearly three years; 13 continue to languish in prison. Prior to that, in 2005 there was the brutal lathicharge (dispersal of crowds using batons and sticks), arbitrary arrest of 400 workers, and incarceration of 63 workers of Honda Motorcycle and Scooter India (HMSI) along with their lawyers and supporters. In 2008 there was a protest over the dismissal of 125 workers that turned violent at Graziano in Greater Noida. A CEO was killed in the incident, for which 136 workers were jailed, and a case was filed under the National Security Act against six workers, with 64 facing charges of murder and attempted murder, and with bail being denied. In 2009, a worker named Ajit Yadav was killed by private security hired by the company at Rico Auto in Gurgaon but no company supervisor or manager was arrested or charged. In 2010 a manager died at Allied Nippon in Sahibabad when violence broke out because management tried to use intimidation to stop a strike by firing several rounds of bullets inside the clutch wiring department.<sup>114</sup>

The trajectory of labour reforms is clearly making it harder for workers to access their rights, equity, and social justice. This is surprising, given that the national

<sup>106</sup> Saini (2007), “Declining Labour Power and Challenges before Trade Unions: Some Lessons from a Case Study on Private Sector Unionism”, *Indian Journal of Industrial Relations*, vol. 42, no. 4, p. 663. <sup>107</sup> Ratna Sen (1997), “Industrial Relations: Patterns and Trends”, *Indian Journal of Industrial Relations*, vol. 32, no. 3, p. 355. <sup>108</sup> Anil K. Sen Gupta and P. K. Sett (2006), “Industrial Relations Law, Employment Security and Collective Bargaining in India: Myths, Realities and Hopes”, p. 215. <sup>109</sup> Ratna Sen (2011), “Multinationals & Industrial Relations in India”, *Indian Journal of Industrial Relations*, vol. 46, no. 3, p. 382. <sup>110</sup> The Constitution of India, 1 April 2019, <http://legislative.gov.in/sites/default/files/COI-updated.pdf>. <sup>111</sup> See for example: Sen Gupta and Sett (2006). <sup>112</sup> *Economic Times* (2016), “After Russia, India most ‘unequal’ country globally”, 4 September 2016, <http://economictimes.indiatimes.com/news/economy/indicators/after-russia-india-most-unequal-country-globally/articleshow/54003020.cms>. <sup>113</sup> The NCR encompasses all of Delhi and several districts surrounding it from the states of Haryana, Uttar Pradesh, and Rajasthan. <sup>114</sup> See also: Pooja Chatterjee (2016), “10 worst labour agitations in Indian auto industry”, *ETAuto*, 23 February 2016, <https://auto.economictimes.indiatimes.com/news/industry/10-worst-labour-agitations-in-indian-auto-industry/51099922>.



government has been emphasizing employment generation as an urgent goal and has announced initiatives such as *Make in India* and *Skilling India* to put India onto a path of a higher level of industrialization, addressing the high rates of unemployment. The all-India unemployment rate was five percent in 2015–16 (4.3 percent for men, 8.7 percent for women)<sup>115</sup> and youth unemployment was 12.9 percent (in the 18–29 age group).<sup>116</sup> In a situation where the primary source of Indian competitive advantage in manufacturing and many services is cheap labour rather than innovation, productivity, value added, or efficient infrastructure, rather than reforming the country's industrial relations system to make it more democratic and effective in handling conflicts that are bound to emerge, there has instead been a marginalization of the role of the labour department in preventing, addressing, and resolving industrial conflicts.

Citing the state's dominating role in the IR system as a justification for demanding the withdrawal of the state, while the weakening of collective bargaining power for workers only leads to more volatility and conflict, further exacerbating the imbalance of power between employers and workers,<sup>117</sup> Saini argues that employers are increasingly trying to shift from different types of plurality models to types of unitarist IR or repressive pluralism, adopting policies of some kind of 'no-union model' or 'weak union model'. Thus, he argues "employers are coming [down] heavily on labour's efforts towards unionisation as they believe that trade unions adversely obstruct managerial autonomy."<sup>118</sup>

With a rise in the employment of contract, casual, part-time, and ad hoc workers, even without active engagement of employers, a decline in the ability of workers to form unions can be seen. Apart from this, a hardening stance of general and labour administration towards worker grievances and union formation, in a context of competition for investors and investment, adds to this decline. Kamala Sankaran notes that the foundation of present labour law in the South Asian region is the "curious mix of criminal and civil remedies" inherited from the British law of master and servant. This is seen in the increasing trend of transforming industrial disputes into law-and-order issues and relying on the policing functions of the state rather than the role of neutral arbiter and conciliator. Denied recourse to formal grievance redressal systems, we see that precarious employment and work conditions, as well as low skill sets, make the unionization of workers extremely challenging, leading ultimately to sporadic outbursts of violence. Even the auto sector workers are unable to break the state-capital link to force a rebalancing of power.

An alternate reading of these instances of disputes, violence, and conflict is the failure of the state, particularly the conciliation mechanisms of the labour department, in ensuring course correction after violent incidents and conflicts. This failure is especially note-

worthy given the enormous powers that the Indian State has accrued to itself for intervening in industrial relations. Saini's studies show that:

The state has endorsed disciplining process of managements with phenomenal lawless methods, both by remaining a mute witness and even by active abetment. It never enforced even the symbolic protection available to unions by way of prosecution of managements for unfair labour practices (ULPs). Not a single case of such prosecution was noticeable, whether or not unions involved were allies of the party in power.

... The IDA [Industrial Disputes Act, 1947] model in India has enabled employers to effectively use their political power through the structural contradiction of the IDA framework, as a resource for their own dominance. They used it as a legitimator of the practice of authoritarianism, fraud, and even tyranny on workers seeking redefinition of labour relations. It also enabled them to forge alliances for legitimization of structures and processes of power dispensation.<sup>119</sup>

Even the legal scholar Upendra Baxi charges the Indian state as being a saboteur of labour laws.<sup>120</sup>

Already existing structural problems in the current industrial relations framework governing collective bargaining mechanisms are compounded by recent political and economic changes that have further weakened the bargaining power of labour. Pointing to the extreme exploitation in contemporary manufacturing, G. Sampath argued that preventing the recurrence of such violence as witnessed at Maruti Suzuki in 2012 depends on industrialists' acknowledgement of the context of the violence:

When your profits go up by 2,200% over nine years (MSIL's from 2001–02 to 2010–11), when your CEO's pay goes up by 419% over four years (MSIL CEO's from 2007–08 to 2010–11), when you get a 400% increase in productivity with just a 65% increase in your workforce (from 1992–2000), when your workers' real wages increase by just 5.5% when the consumer price index rose by 50% (2007–11) (figures as reported by the researchers Prasenjit Bose and Sourindra Ghosh in *The Hindu*), when a worker can lose nearly half his salary for taking a couple of days leave in a month—you have a situation that free market economists are programmed not to register: extreme exploitation.<sup>121</sup>

Such a system of "extreme exploitation" necessitates a repressive apparatus founded on an armed police force, the securitization of society, and criminalization of dissent and protest—be they workers demanding their rights, citizens resisting development-induced

<sup>115</sup> Mint (2016), "Unemployment rate in India at 5%, highest in 5 years", 29 September 2016, <http://www.livemint.com/Politics/KxezbFSNCudZ-b6U2lfSvwl/Unemployment-paints-grim-picture-highest-in-5-years-in-2015.html>. <sup>116</sup> Nanoosh Kumar (2015), "Why Are 50% Of India's Graduates Unemployable?", *Youth Ki Awaaz*, 7 October 2015, <https://www.youthkiawaaz.com/2015/10/unemployment-indian-graduates-solution/>. <sup>117</sup> See for example: Sen Gupta and Sett (2000). <sup>118</sup> Saini (2007), p. 653. <sup>119</sup> Saini (1999). <sup>120</sup> Noted in Saini (1999). <sup>121</sup> G. Sampath (2012), "Can India Inc. Face the Truth about the Manesar Violence?" *DNA India*, 29 July 2012, <http://www.dnaindia.com/analysis/column-can-india-inc-face-the-truth-about-the-manesar-violence-1721167>.

displacement, or *adivasis* (indigenous people) resisting corporate takeover of their natural resource commons and eviction from their historical habitats. If increasing securitization of industrial spaces becomes the norm along with criminalization of labour, it does not bode well for the future of industrial relations in the country.

Some of the repressive and unbalanced industrial relations prevailing in India can be understood as a consequence of the manufacturing industries' reliance on the low labour cost comparative advantage. On the other hand, in Germany the system of collective bargaining,

has led to a production structure which is based less on 'price-competitive production', than on 'quality-competitive production'. Its strength lies in defending its competitive position of quality and innovation in technologically advanced capital goods. At the plant level this corresponds with the focus on the skilled worker in a 'diversified quality production' process again institutionally supported by the system of vocational training. A company which aims at improving its competitiveness by lowering its labour costs has to operate within very tight boundaries of centrally agreed minimum wages. Companies are forced to counteract a lack in competitiveness by an increase in productivity. Therefore, central collective agreements also have the function of increasing productivity and innovation.<sup>122</sup>

A healthy industry-worker relationship is the basis for increasing productivity and competitiveness. In order to make the transition to a competitive economy and adopt Industry 4.0 technologies, the industrial relations framework in India requires drastic reworking to evolve into a democratic and effective system based on a production system that is rooted in innovation and value addition rather than relying solely on a low-labour-cost comparative advantage.

## 7 TRADE UNION ACTION PLAN

The Fourth Industrial Revolution and adoption of Industry 4.0 technologies will significantly impact labour and industrial relations and trade unions must prepare for it. The impact on the composition of employment is still unclear while changes to job and task content are evolving and may require further intensive granular research. Managing this transition without workers bearing the brunt of the burden represents a challenge for trade unions in India.

Learning from trade unions across the globe, the broad agenda for trade unions must be to:

- Ensure that digitalization is approached as a work-force issue as well as a technological one.
- Negotiate a social compact for 4IR addressing local socio-economic conditions and societal inequality.
- Ensure digitalization does not divide our society further but rather helps promote good work and a fairer economy, and helps to improve lives and livelihoods.
- Ensure that the technological revolution is accompanied by a revolution in education, health, skills, rights, and social protection.

Trade union collective bargaining agenda with employers and governments:

- Return to industry-level organizing and collective bargaining rather than firm level.
- Clear communication by the Chief Technology Officer about changes to a production process, a reorganization of work, and consequently the need to change job descriptions and workers' tasks.
- Transparent and inclusive decision making, with involvement of unions and workers.
- Job security, regular employment contracts, and fair remuneration (shunning contractual employment and low wages).
- Up-skilling and re-skilling on the job on company time, with cost borne by the employer.
- Worker sovereignty over personal data and safety of personal data if absolutely necessary to collect it.
- Reduce hours of work and intensity of work—digital technology could be used to lessen the burden.
- Establish clear norms regarding measurement of human productivity (not measured against machines, robots, or 'cobots' i.e. collaborative robots).
- Equitable distribution of productivity gains boosted by the digital transformation between capital and labour has to be a core target—through fair wages, pensions, career support, and improvements to public services such as education, health, housing, sanitation, and public transportation.
- Universal and comprehensive social security in partnership with employer and government.
- Defending freedom of association and collective bargaining.
- Reinventing 'Trade Union 4.0' with new thinking, new structures, and a culture adapted to new realities, responsive to the needs and aspirations of a younger generation of workers, as well as workers on individual contracts and in the gig economy, while also addressing 'white-collarization' of the workforce.
- Revision of occupational health and safety norms—unions must be partners in the designing of safe workplaces used simultaneously by robots and workers, and any attendant psychosocial risks such as stress, working 'on demand' or at unsociable hours; use of new materials (powders, nano-materials), as the long-term effects of the exposure to these materials are still unknown; the shift to cobots and the requirement for operators to monitor an increasingly automated process could mean a reduction of social interaction and thus a risk of feelings of isolation, especially for shop-floor workers.
- Include crisis measures agreed in collective bargaining agreements to address economic recessions (such as the 2008 crisis) and health emergencies like the Covid-19 pandemic.

<sup>122</sup> Anke Hassel and Thorsten Schulten (1998), "Globalization and the future of central collective bargaining: the example of the German metal industry", *Economy and Society*, vol. 27, no. 4, p. 490.

- Ensure that evolving industrial relations frameworks address growing union demands for new rights.

## 8 CONCLUSION

The global discourse on the crisis in manufacturing and productivity and the disruptive innovative potential of the Fourth Industrial Revolution and Industry 4.0 technologies has to be anchored in an analysis of local social, cultural, and economic conditions that has a bearing on the ability of countries and industries to absorb technological change, and in an understanding of the potential impacts on the economy and society and how these are to be addressed.

Despite the hype around Industry 4.0, the effects of digitalization of manufacturing are not entirely clear and will vary across different countries, industries, and factories. There is little clarity on job losses and technology-induced displacement, with estimates varying significantly across countries and industries. Even where there might not be job losses, tasks and skill requirements may undergo significant transformation, putting older and less technically-skilled workers at risk. At the same time, it is anticipated that countries with weak basic education and skilling systems will also be severely disadvantaged.

Attention needs to be focused on how the technological dividend can be made to work for all workers: to improve working conditions; improve workers' lives, health, and safety; reduce working hours, increase leisure time; make workers more autonomous, and give them access to an appropriate system of social protection and social insurance suitable for an era of immense transition and transformation.

Another challenge that will require political will and design to tackle is the anticipated increase in labour market precariousness, the rise of new and more flexible forms of working, the use and abuse of insecure labour contracts, unstable employment relationships, and the possibility of splitting jobs into a series of fragmented tasks. In addition, technology will allow for new ways to monitor and measure performance, which may be disadvantageous for workers unless policies related to technology, labour, and the public address the issue. Governments need to actively make choices regarding their policy framework depending on local factors.

In the automotive industry, where the entire business model appears to be on the threshold of revolutionary change—the expected shift in balance of power between automotive manufacturers and IT companies, the emergence of newer nodes of revenue generation, and the concentration of power and wealth in technology and data innovators mostly located in developed countries—the implications for developing countries and challenges for governments need to be understood better.

In India, where manufacturing competitiveness, productivity, and technology readiness lags significantly behind other emerging Asian countries,

adoption of I4.0 technologies by Indian automotive manufacturers is likely to be constrained by productivity gaps, fragmented operations, low quality levels, and low investment in skills.

For labour, technological skill bias is a major concern as it will potentially increase marginalization and labour market inequities of certain communities along gender, caste, class, or religious lines due to socio-cultural norms that inhibit access to education, skilling, and employment. It will also likely limit labour mobility across the prevailing structures of employment, across organized and unorganized sectors, across formal and informal employment, urban and rural, and manual and mechanized. Thus, the exacerbation of existing inequities and creation of new inequities and resultant social strife is also a concern that must influence policy decisions.

Trade unions will have to begin to address the issues of improvements in national education, training, re-training, skilling, and establishing newer rights such as the right to information and consultation, the right to education, training, and life-long learning, the right to defined levels of privacy—at home and at work. Unions have to evolve strategies for shaping labour protection, redistribution of technology gains, monitoring of workers and their productivity, collection of worker-related data and protection of such data, as well as establishing rights to such data if collected. Unions need to find new ways of organizing workers, appealing to a younger generation of workers, addressing 'white-collarization' of the workforce and the isolation of workers (on individual contracts and in the gig economy).

In India, the direction of current labour reforms is taking more and more workers out of the ambit of labour law protections; failing to address the fragmentation and dispersal of employment relationships; and making it harder for workers to access their rights, equity, and social justice. In order to make the transition to a competitive economy and adopt Industry 4.0 technologies, the industrial relations framework in India requires drastic reworking to evolve into a democratic and effective system based on a production system that is rooted in innovation and value addition rather than relying solely on low-labour-cost comparative advantage.

Frameworks are required for regulating new kinds of employment generated in the platform economy, gig economy, and crowdwork; protections for hitherto unprotected workers in non-standard employment as well as protections to facilitate various transitions over a person's working life.

While attempting to understand the scope and nature of technological change in the automotive manufacturing industry, this paper has also highlighted gaps both in the global and local discourse on Industry 4.0 and the future of work. More nuanced and locally-grounded analysis is required to further our understanding of the impending transformation in the world of work.

## BIBLIOGRAPHY

## A

**AFL-CIO (2018)**, "German and US Unions: Shaping the Future of Work", *YouTube*, 20 September 2018, [https://www.youtube.com/watch?v=DC\\_BG0wtYec](https://www.youtube.com/watch?v=DC_BG0wtYec). Last accessed on 15 September 2020.

**All India Management Association (AIMA) (2018)**, *Industry 4.0: India Inc. Gearing Up for Change*, <http://resources.aima.in/presentations/AIMA-KPMG-industry-4-0-report.pdf>. Last accessed on 15 September 2020.

**Ananthanarayanan, Ravi (2014)**, "Contract workers make up 46% of workforce of India's largest industrial companies", *Mint*, 19 March 2014, <http://www.live-mint.com/Money/zSFof4LqBrTfX3dxvp8Y2I/Contract-workers-make-up-46-of-workforce-of-Indias-largest.html>. Last accessed on 15 September 2020.

**Arntz, Melanie, Terry Gregory, and Zierahn Ulrich (2019)**, "Digitalization and the Future of Work: Macroeconomic Consequences", *IZA Institute of Labor Economics*, June 2019, <http://ftp.iza.org/dp12428.pdf>. Last accessed on 15 September 2020.

**Asian Development Bank (ADB) (2018)**, *Asian Development Outlook: How Technology Affects Jobs*, June 2018, <https://www.adb.org/sites/default/files/publication/411666/ado2018.pdf>. Last accessed on 15 September 2020.

**Automotive Component Manufacturers Association of India (ACMA) (2016)**, *Automotive Electronics: Master Plan Development for Auto Components Industry in India*, [https://www.acma.in/uploads/research-studies/AUtomotive\\_Electronics\\_Study.pdf](https://www.acma.in/uploads/research-studies/AUtomotive_Electronics_Study.pdf). Last accessed on 15 September 2020.

**Autoparts Asia**, various articles (as of 14 September 2020, website is no longer online).

## B

**Baccaro, Lucio and Chris Howell (2017)**, "Unhinged: Industrial Relations Liberalization and Capitalist Instability", *Max-Planck Institute for the Study of Societies Discussion Paper 17/19*, [https://www.unige.ch/sciences-societe/socio/files/2815/0643/0235/Secular\\_stagnation.pdf](https://www.unige.ch/sciences-societe/socio/files/2815/0643/0235/Secular_stagnation.pdf). Last accessed on 15 September 2020.

**Bajpai, Nirupam and John Biberman (2019)**, *The Future of Work in India Adapting to the Fourth Industrial Revolution*, ICT India Working Paper #11, Center for Sustainable Development, Earth Institute, Columbia University, <https://academiccommons.columbia.edu/doi/10.7916/d8-0hg8-b438/download>. Last accessed on 15 September 2020.

**Barnes, Tom (2018)**, *Making Cars in the New India*, Cambridge University Press.

----- (2017), "Why Has the Indian Automotive Industry Reproduced 'Low Road' Labour Relations?", in Ernesto Noronha and Premilla D'Cruz (eds.), *Critical Perspectives on Work and Employment in Globalizing India*, London: Springer, pp. 37–56.

**Bhattacharjea, Aditya (2009)**, "The Effects of Employment Protection Legislation on Indian Manufacturing", *Economic and Political Weekly*, vol. XLIV, no. 22, pp. 55–62. Last accessed on 15 September 2020.

----- (2006), "Labour Market Regulation and Industrial Performance in India: A Critical Review of the Empirical Evidence", *The Indian Journal of Labour Economics*, vol. 49, no. 2, pp. 211–32. Last accessed on 15 September 2020.

**Boston Consulting Group (2016)**, "The Factory of the Future", 6 December 2016, <https://www.bcg.com/publications/2016/leaning-manufacturing-operations-factory-of-future.aspx>. Last accessed on 15 September 2020.

----- (2015a), *Man and Machine in Industry 4.0: How Will Technology Transform the Industrial Workforce Through 2025?* [https://image-src.bcg.com/Images/BCG\\_Man\\_and\\_Machine\\_in\\_Industry\\_4\\_0\\_Sep\\_2015\\_tcm9-61676.pdf](https://image-src.bcg.com/Images/BCG_Man_and_Machine_in_Industry_4_0_Sep_2015_tcm9-61676.pdf). Last accessed on 15 September 2020.

----- (2015b), "Industry 4.0: The Future of Productivity and Growth in Manufacturing Industries", 9 April 2015, [https://www.bcg.com/publications/2015/engineered\\_products\\_project\\_business\\_industry\\_4\\_future\\_productivity\\_growth\\_manufacturing\\_industries](https://www.bcg.com/publications/2015/engineered_products_project_business_industry_4_future_productivity_growth_manufacturing_industries). Last accessed on 15 September 2020.

----- (2015c), "Future of Indian Manufacturing: Bridging the Gap", in *CII 14th Manufacturing Summit*, September 2015, [https://image-src.bcg.com/Future-Indian-Manufacturing-Sep-2015-India\\_tcm21-28752.pdf](https://image-src.bcg.com/Future-Indian-Manufacturing-Sep-2015-India_tcm21-28752.pdf). Last accessed on 15 September 2020.

## C

**Centre for Internet and Society (2019a)**, *The Future of Work in the Automotive Sector in India: Perspectives from the Ground*, <https://cis-india.org/internet-governance/future-of-work-in-automotive-sector.pdf>. Last accessed on 15 September 2020.

----- (2019b), "Comments to the Code on Social Security, 2019", <https://cis-india.org/internet-governance/files/comments-to-the-code-on-social-security-2019>. Last accessed on 16 September 2020.

**Chandran, Subhash (2016)**, "Phased Approach for Industry 4.0 to Succeed", *Tech Mahindra*, 30 August 2016, <https://www.techmahindra.com/sites/blogs/Phased-approach-for-Industry-4-to-succeed.aspx>. Last accessed on 31 July 2017 (as of 15 September 2020, no longer online).

**Confederation of Indian Industry (CII) (2017a)**, *White Paper on Future of Work*, <https://www.mycii.in/KmResourceApplication/56878.FutureOfWork.pdf>. Last accessed on 15 September 2020.

----- (2017b), *Automotive Industry 4.0: "Connected and Intelligent" Ensuring competitiveness through technology adoption*, <https://www.mycii.in/KmResourceApplication/57205.ReportAutomotiveIndustry40.pdf>. Last accessed on 15 September 2020.

----- (2017c), *India's Readiness for Industry 4.0. A Focus on Automotive Sector*, [https://www.autonewspress.com/wp-content/uploads/2017/03/A\\_Focus\\_on\\_Automotive\\_Sector\\_v4.pdf](https://www.autonewspress.com/wp-content/uploads/2017/03/A_Focus_on_Automotive_Sector_v4.pdf). Last accessed on 15 September 2020.

----- (2016), *Automotive Advanced Manufacturing: Taking quality and productivity to the next level amid severe industry disruptions* (also referred to as the *CII-Roland Berger Report*), <https://www.mycii.in/KmResourceApplication/51762.20160729AutomotiveAdvancedManufacturingCIIvF.pdf>. Last accessed on 15 September 2020.

----- (2014a), *Automotive Landscape 2025*, <https://www.mycii.in/KmResourceApplication/38070.AutoConferenceReport2014.pdf>. Last accessed on 15 September 2020.

----- (2014b), *Next Gen Manufacturing: Industry 4.0*, <https://www.gita.org.in/Attachments/Reports/CII%20Roland%20Berger%20Industry%2040.pdf>. Last accessed on 15 September 2020.

Countouris, Nicola (2019), *Defining and Regulating Work Relations for the Future of Work*, International Labour Office (ILO), [https://www.ilo.org/wcmsp5/groups/public/---ed\\_dialogue/documents/publication/wcms\\_677999.pdf](https://www.ilo.org/wcmsp5/groups/public/---ed_dialogue/documents/publication/wcms_677999.pdf). Last accessed on 15 September 2020.

## D

Das, Goutam (2019), *Jobonomics: India's Employment Crisis and What the Future Holds*, Gurgaon: Hachette India.

----- (2017), "Going, Going, Gone: Automation can lead to unprecedented job cuts in India", *Business Today*, 18 June 2017, <https://www.businesstoday.in/magazine/cover-story/going-going-gone/story/253260.html>. Last accessed on 15 September 2020.

Deloitte (2017), *The Future of the Automotive Value Chain: 2025 and Beyond*, <https://www2.deloitte.com/content/dam/Deloitte/us/Documents/consumer-business/us-auto-the-future-of-the-automotive-value-chain.pdf>. Last accessed on 15 September 2020.

----- (2012), *Connected vehicles enter the mainstream: Trends and strategic implications for the automotive industry*, <https://www2.deloitte.com/content/dam/Deloitte/us/Documents/manufacturing/us-auto-tele-matics-06252012.pdf>. Last accessed on 15 September 2020.

----- (2011), *Unplugged: Electric vehicle realities versus consumer expectations*, [https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Manufacturing/gx\\_us\\_auto\\_DTTGlobalAutoSurvey\\_ElectricVehicles\\_100411.pdf](https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Manufacturing/gx_us_auto_DTTGlobalAutoSurvey_ElectricVehicles_100411.pdf). Last accessed on 15 September 2020.

De Silva, S. R. (1997), "The Changing Focus of Industrial Relations and Human Resource Management", paper presented at the ILO Workshop on Employers' Organization in Asia-Pacific in the Twenty-first Century. ----- (n.d.), 'Elements of a Sound Industrial Relations System', *ILO*.

Digital Transformation Monitor (2017), *Germany: Industrie 4.0*, European Commission, [https://ec.europa.eu/growth/tools-databases/dem/monitor/sites/default/files/DTM\\_Industrie%204.0.pdf](https://ec.europa.eu/growth/tools-databases/dem/monitor/sites/default/files/DTM_Industrie%204.0.pdf). Last accessed on 15 September 2020.

Dirksen, Uta (2018), "In Latin America the future of work is already here, and it is only good for some", *FES Connect*, 26 October 2018, <https://www.fes-connect.org/news-detail/in-latin-america-the-future-of-work-is-already-here-and-it-is-only-good-for-some/>. Last accessed on 15 September 2020.

## E

Economic Times (2016), "After Russia, India most 'unequal' country globally", 4 September 2016, <https://economictimes.indiatimes.com/news/economy/indicators/after-russia-india-most-unequal-country-globally/articleshow/54003020.cms>. Last accessed on 16 September 2020.

Edelweiss (2014), *Auto components: The Future Mega Trends, Mega Factors*, Mumbai: Edel Invest Research.

## F

Federal Ministry of Education and Research, Germany (2013), *Securing the future of German manufacturing industry: Recommendations for implementing the strategic initiative INDUSTRIE 4.0: Final report of the Industrie 4.0 Working Group*, <https://www.din.de/blob/76902/e8cac883f42bf28536e7e8165993f1fd/recommendations-for-implementing-industry-4-0-data.pdf>. Last accessed on 15 September 2020.

Federal Ministry for Economic Affairs and Energy, Germany (n.d.), "Industrie 4.0", <https://www.bmwi.de/Redaktion/EN/Dossier/industrie-40.html>. Last accessed on 15 September 2020.

Federal Ministry of Labour and Social Affairs, Germany (2017), *Re-imagining Work: White Paper 4.0*, [https://www.bmas.de/SharedDocs/Downloads/EN/PDF-Publikationen/a883-white-paper.pdf?\\_\\_blob=publicationFile&v=3](https://www.bmas.de/SharedDocs/Downloads/EN/PDF-Publikationen/a883-white-paper.pdf?__blob=publicationFile&v=3). Last accessed on 15 September 2020.

Federation of Indian Chambers of Commerce and Industry (FICCI) (n.d.), *Skills Development: Sector Profile*, [http://ficci.in/sector/74/Project\\_docs/Sector\\_Profile.pdf](http://ficci.in/sector/74/Project_docs/Sector_Profile.pdf). Last accessed on 16 September 2020.

Ferber, Stefan (2012a), "Industry 4.0 – Germany takes first steps toward the next industrial revolution", *Bosch ConnectedWorld Blog*, <https://blog.bosch-si.com/industry40/industry-40-germany-takes-first-steps-toward-next-industrial-revolution/>. Last accessed on 15 September 2020.

----- (2012b), "Industry 4.0: Agility in Production", *Bosch ConnectedWorld Blog*, <https://blog.bosch-si.com/industry40/industry-4-0-agility-in-production/>. Last accessed on 15 September 2020.

Financial Express (2016), "Indian workers earn 81 per cent less than Chinese, says study", 8 June 2016, <https://www.financialexpress.com/industry/indian-workers-earn-81-per-cent-less-than-chinese-says-study/276871/>. Last accessed on 16 September 2020.

## G

Geissbauer, Reinhard (2015), "How to become a digital champion in manufacturing", *Bosch ConnectedWorld Blog*, <https://blog.bosch-si.com/industry40/how-to-become-a-digital-champion-in-manufacturing/>. Last accessed on 15 September 2020.

Gereffi, G. and T. Sturgeon (2013), "Global Value Chain-Oriented Industrial Policy: The Role of Emerging Economies", in D. Elms and P. Low (eds.): *Global Value Chains in a Changing World*, Geneva: World Trade Organization, pp. 329–360, [https://www.wto.org/english/res\\_e/booksp\\_e/aid4tradeglobalvalue13\\_e.pdf](https://www.wto.org/english/res_e/booksp_e/aid4tradeglobalvalue13_e.pdf). Last accessed on 15 September 2020.

Government of India (2018), *Report of the Artificial Intelligence Taskforce*, [https://dipp.gov.in/sites/default/files/Report\\_of\\_Task\\_Force\\_on\\_ArtificialIntelligence\\_20March2018\\_2.pdf](https://dipp.gov.in/sites/default/files/Report_of_Task_Force_on_ArtificialIntelligence_20March2018_2.pdf). Last accessed on 15 September 2020.

----- (2016), *National Capital Goods Policy 2016: Building India of Tomorrow*, <https://dhi.nic.in/writereaddata/Content/NationalCapitalGoodsPolicy2016.pdf>. Last accessed on 15 September 2020.

----- (2012), *Statistics on Industrial Disputes, Closures, Retrenchments and Lay-offs Year 2011*, [http://labourbureau.new.gov.in/UserContent/Statistics\\_ID\\_Layoffs\\_2011.pdf](http://labourbureau.new.gov.in/UserContent/Statistics_ID_Layoffs_2011.pdf). Last accessed on 15 September 2020.

----- (2011), Report Of The Working Group On Occupational Safety And Health For The Twelfth Five Year Plan (2012 To 2017), [https://www.ilo.org/wcmsp5/groups/public/---ed\\_protect/---protrav/---safework/documents/policy/wcms\\_211795.pdf](https://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---safework/documents/policy/wcms_211795.pdf). Last accessed on 15 September 2020.

----- (n.d.), *Automotive Mission Plan: 2016–26 (A Curtain Raiser)*, <http://www.siam.in/uploads/file-manager/47AUTOMOTIVEMISSIONPLAN.pdf>. Last accessed on 15 September 2020.

----- (1987), *The Law Commission Report on 'Forum for National Uniformity in Labour Adjudication'* (Report 122).

## H

Hallward-Driemeier, Mary and Gaurav Nayyar (2018), *Trouble in the Making? The Future of Manufacturing-Led Development*, Washington, DC: World Bank, <https://openknowledge.worldbank.org/bitstream/handle/10986/27946/9781464811746.pdf>. Last accessed on 15 September 2020.

Hassel, Anke and Thorsten Schulten (1998), "Globalization and the future of central collective bargaining: the example of the German metal industry", *Economy and Society*, vol. 27, no. 4, pp. 484–522.

Heller, Kai, Andrew Loh, Jean François Bobier, and Mike Quinn (2019), *Rethinking How Cars Are Built—With Modern Consumers In Mind*, Boston Consulting Group, [https://image-src.bcg.com/Images/BCG-Rethinking-How-Cars-Are-Built-With-Modern-Consumers-in-Mind-Mar-2019\\_tcm9-216343.pdf](https://image-src.bcg.com/Images/BCG-Rethinking-How-Cars-Are-Built-With-Modern-Consumers-in-Mind-Mar-2019_tcm9-216343.pdf). Last accessed on 15 September 2020.

Humphrey, J. and O. Memedovic (2003), *The Global Automotive Industry Value Chain: What Prospects for Upgrading by Developing Countries*, Vienna: UNIDO, 2003, <https://open.unido.org/api/documents/4851890/download/UNIDO-Publication-2003-4851890>. Last accessed on 15 September 2020.

## I

Imran, Muhammad, Waseem ul Hameed, and Adnan ul Haque (2018), "Influence of Industry 4.0 on the Production and Service Sectors in Pakistan: Evidence from Textiles and Logistics Sector", *Social Sciences*, vol. 7, no. 12, [https://www.researchgate.net/publication/329155189\\_Influence\\_of\\_Industry\\_4\\_0\\_on\\_the\\_Production\\_and\\_Service\\_Sectors\\_in\\_Pakistan\\_Evidence\\_from\\_Textile\\_and\\_Logistics\\_Industries](https://www.researchgate.net/publication/329155189_Influence_of_Industry_4_0_on_the_Production_and_Service_Sectors_in_Pakistan_Evidence_from_Textile_and_Logistics_Industries). Last accessed on 15 September 2020.

Inamdar, Tamanna (2020), "Need to deal with labour issue with a long-term perspective: RC Bhargava", *ETAuto*, 9 May 2020, <https://auto.economicstimes.indiatimes.com/news/industry/need-to-deal-with-labour-issue-with-a-long-term-perspective-rc-bhargava/75646968>. Last accessed on 15 September 2020.

Indian Express (2020), "ILO 'expresses concern' at labour law changes in India, asks PM to intervene", 25 May 2020, <https://indianexpress.com/article/india/ilo-expresses-concern-at-labour-law-changes-in-india-6426909/>. Last accessed on 15 September 2020.

Indo-German Chamber of Commerce (n.d.), "German Investments in India".

Industrial Automation (n.d.) (1), "The objective of digitalisation is much broader than breaking silos", <https://www.industrialautomationindia.in/interviewsitm/8360/The-objective-of-digitalisation-is-much-broader-than-breaking-silos/interviews>. Last accessed on 15 September 2020.

----- (n.d.) (2), "Skilled manpower is the key to any technology to grow from Lab to Fab", <https://www.industrialautomationindia.in/interviewsitm/8506/Skilled-manpower-is-the-key-to-any-technology-to-grow-from-Lab-to-Fab/interviews>. Last accessed on 15 September 2020.

IndustrialAll Global Union (2019a), "Why are so many auto plants closing?", <http://www.industrialall-union.org/why-are-so-many-auto-plants-closing>. Last accessed on 15 September 2020.

----- (2019b), "A trade union guide to a Just Transition for workers", <http://www.industrialall-union.org/a-just-transition-for-workers>. Last accessed on 15 September 2020.

----- (2019c), "Unions can shape the future of work in the Fourth Industrial Revolution", 1 November 2019, <http://www.industrialall-union.org/a-just-transition-for-workers>. Last accessed on 16 September 2020.

----- (2018), "Understanding the challenge of Industry 4.0 from a labour perspective", <http://www.industrialall-union.org/understanding-the-challenge-of-industry-40-from-a-labour-perspective>. Last accessed on 15 September 2020.

- (2017), *The Challenge of Industry 4.0 and the Demand for New Answers*, [http://www.industrialunion.org/sites/default/files/uploads/documents/2017/SWITZERLAND/Industry4point0Conf/industry\\_4\\_en\\_web.pdf](http://www.industrialunion.org/sites/default/files/uploads/documents/2017/SWITZERLAND/Industry4point0Conf/industry_4_en_web.pdf). Last accessed on 15 September 2020.
- (2016), *Precarious Work in India*, [http://www.industrialunion.org/sites/default/files/uploads/documents/a4\\_india\\_report\\_new2.pdf](http://www.industrialunion.org/sites/default/files/uploads/documents/a4_india_report_new2.pdf). Last accessed on 15 September 2020.
- Innomantra (2011), *Patent Portfolio of Major Indian Automobile Companies: An Indicative Measure of Innovation*, Bangalore: Innomantra Consulting Private Limited, <http://www.innomantra.com/images/pdf/Innomantra%20-%20Patent%20Portfolio%20of%20Major%20Indian%20Automobile%20Companies.pdf>. Last accessed on 15 September 2020.
- International Commission for Labor Rights (2013), *Merchants of Menace: Repressing Workers in India's New Industrial Belt*, [http://www.laborcommission.org/files/uploads/2FINAL\\_Merchants\\_of\\_Menace\\_lo\\_res.pdf](http://www.laborcommission.org/files/uploads/2FINAL_Merchants_of_Menace_lo_res.pdf). Last accessed on 15 September 2020.
- International Labour Organization (2019), *Work for a brighter future – Global Commission on the Future of Work*, [https://www.ilo.org/wcmsp5/groups/public/---dgreports/---cabinet/documents/publication/wcms\\_662410.pdf](https://www.ilo.org/wcmsp5/groups/public/---dgreports/---cabinet/documents/publication/wcms_662410.pdf). Last accessed on 15 September 2020.
- (2018a), *Emerging technologies and the future of work in India*, [https://www.ilo.org/wcmsp5/groups/public/---asia/---ro-bangkok/---sro-new\\_delhi/documents/publication/wcms\\_631296.pdf](https://www.ilo.org/wcmsp5/groups/public/---asia/---ro-bangkok/---sro-new_delhi/documents/publication/wcms_631296.pdf). Last accessed on 15 September 2020.
- (2018b), *Working time and the future of work*, [https://www.ilo.org/wcmsp5/groups/public/---dgreports/---cabinet/documents/publication/wcms\\_649907.pdf](https://www.ilo.org/wcmsp5/groups/public/---dgreports/---cabinet/documents/publication/wcms_649907.pdf). Last accessed on 15 September 2020.
- (2018c), *Digital labour platforms and the future of work: Towards decent work in the online world*, [https://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/---publ/documents/publication/wcms\\_645337.pdf](https://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/---publ/documents/publication/wcms_645337.pdf). Last accessed on 15 September 2020.
- (2018d), *The economics of artificial intelligence: Implications for the future of work*, Future of Work Research Paper No. 5, [https://www.ilo.org/wcmsp5/groups/public/---dgreports/---cabinet/documents/publication/wcms\\_647306.pdf](https://www.ilo.org/wcmsp5/groups/public/---dgreports/---cabinet/documents/publication/wcms_647306.pdf). Last accessed on 15 September 2020.
- (2017), *The Future of Work in the Automotive Sector: The Challenges of Deglobalization*, [https://www.ilo.org/wcmsp5/groups/public/---dgreports/---inst/documents/publication/wcms\\_551606.pdf](https://www.ilo.org/wcmsp5/groups/public/---dgreports/---inst/documents/publication/wcms_551606.pdf). Last accessed on 15 September 2020.
- (2016), *ASEAN in transformation: The future of jobs at risk of automation*, Bureau for Employers' Activities, Working Paper No. 9, [https://www.ilo.org/wcmsp5/groups/public/---ed\\_dialogue/---act\\_emp/documents/publication/wcms\\_579554.pdf](https://www.ilo.org/wcmsp5/groups/public/---ed_dialogue/---act_emp/documents/publication/wcms_579554.pdf). Last accessed on 15 September 2020.
- International Trade Union Confederation (2017), *The Future of Work*, <https://www.ituc-csi.org/the-future-of-work-ituc-report>. Last accessed on 15 September 2020.
- Invest India (n.d.), "Sector: Automobile", <https://www.investindia.gov.in/sector/automobile>. Last accessed on 15 September 2020.
- J**
- Jain, Animesh (2019), "AI Policy Analysis: AIDP of China vs. India's NITI Aayog AI Policy Paper", *Observer Research Foundation*, <https://www.orfonline.org/expert-speak/ai-policy-analysis-aidp-of-china-vs-india-niti-aayog-ai-policy-paper-52935/>. Last accessed on 15 September 2020.
- Jakhotiya, Girish (2019), "A critical evaluation of the economics of Indian automobile industry", *Munich Personal RePEc Archive (MPRA)*, [https://mpra.ub.uni-muenchen.de/92080/1/MPRA\\_paper\\_92080.pdf](https://mpra.ub.uni-muenchen.de/92080/1/MPRA_paper_92080.pdf). Last accessed on 15 September 2020.
- Jamdade, Veerendra (2019), "Indian manufacturing must leapfrog from Industry 2.0 to Industry 4.0", *Express Computer*, 5 November 2019, <https://www.expresscomputer.in/industries/manufacturing/indian-manufacturing-must-leapfrog-from-industry-2-0-to-industry-4-0/43152/>. Last accessed on 15 September 2020.
- K**
- Kale, D. (2012), "Sources of innovation and technology capability development in the Indian automobile industry", *International Journal of Institution and Economics*, vol. 4, no. 2, pp. 121–150, <https://pdfs.semanticscholar.org/c03e/26216ebc44d-65ba473c4f6834005da6a5bf5.pdf>. Last accessed on 15 September 2020.
- Kapoor, Radhicka and P. P. Krishnapriya (2015a), "Doing away with unequal contracts", *Business Standard*, 19 September 2015, [http://www.business-standard.com/article/opinion/radhicka-kapoor-p-p-krishnapriya-doing-away-with-unequal-contracts-115091900718\\_1.html](http://www.business-standard.com/article/opinion/radhicka-kapoor-p-p-krishnapriya-doing-away-with-unequal-contracts-115091900718_1.html). Last accessed on 15 September 2020.
- (2015b), "The many things that need to change in India's semi-skilled work force", *Rediff*, 20 September 2015, <http://www.rediff.com/business/column/column-the-many-things-that-need-to-change-in-indias-semi-skilled-work-force/20150920.htm>. Last accessed on 15 September 2020.
- Kapoor, Radhicka (2014), "Creating 'Good Jobs' Assessing the Labour Market Regulation Debate", *Economic and Political Weekly*, vol. XLIX, no. 46, pp. 16–18.
- Khan, Nabeel (2020), "Who owns the Indian Component Industry", *ETA Auto*, 15 May 2020, <https://auto.economicstimes.indiatimes.com/news/auto-components/etauto-originals-who-owns-the-indian-com>

ponent-industry/74880674. Last accessed on 15 September 2020.

**Klingenburg, Konrad (2017)**, "The future of the workforce in an age of self-organising factories", conference presentation at *Internet of Manufacturing*, Munich, 7–8 February 2017, [https://internetofbusiness.com/wp-content/uploads/2017/02/Konrad-Klingenburg\\_IG-Metall-Executive-Board\\_CLOSING-KEYNOTE-The-future-of-the-workforce-in-an-age-of-self-organising-factories.pdf](https://internetofbusiness.com/wp-content/uploads/2017/02/Konrad-Klingenburg_IG-Metall-Executive-Board_CLOSING-KEYNOTE-The-future-of-the-workforce-in-an-age-of-self-organising-factories.pdf). Last accessed on 16 September 2020.

**KPMG (2020)**, *Potential Impact of Covid-19 on the Indian Economy*, <https://home.kpmg/content/dam/kpmg/in/pdf/2020/04/potential-impact-of-covid-19-on-the-indian-economy.pdf>. Last accessed on 15 September 2020.

**Kumar, Ashok (2020)**, "Mass lay-offs likely in automobile sector in the Millennium City", *The Hindu*, 22 May 2020, <https://www.thehindu.com/news/cities/Delhi/mass-lay-offs-likely-in-automobile-sector-in-the-millennium-city/article31666328.ece>. Last accessed on 15 September 2020.

**Kumar, Nanoosh (2015)**, "Why Are 50% Of India's Graduates Unemployable?", *Youth Ki Awaaz*, 7 October 2015, <https://www.youthkiawaaz.com/2015/10/unemployment-indian-graduates-solution/>. Last accessed on 16 September 2020.

**Kurt, Resul (2019)**, "Industry 4.0 in Terms of Industrial Relations and Its Impacts on Labour Life", *Procedia Computer Science*, vol. 158, pp. 590–601.

## L

**Lin, Danping, C. K. M. Lee, Henry Lau, and Yang Yang (2018)**, "Strategic response to Industry 4.0: an empirical investigation on the Chinese automotive industry", *Industrial Management & Data Systems*, vol. 118, no. 3, pp. 589–605, <https://www.emerald.com/insight/content/doi/10.1108/IMDS-09-2017-0403/full/pdf?title=strategic-response-to-industry-40-an-empirical-investigation-on-the-chinese-automotive-industry>. Last accessed on 15 September 2020.

## M

**Macdonald, David (1997)**, "Industrial Relations and Globalization: Challenges for Employers and their Organizations", paper presented at the ILO Workshop on Employers' Organization in Asia-Pacific in the Twenty-first Century, <http://www.ilo.org/public/english/dialogue/actemp/downloads/publications/dmirglob.pdf>. Last accessed on 15 September 2020.

**Make In India (2017)**, "Towards Smart Manufacturing: Industry 4.0 and India", <http://www.makeinindia.com/article/-/v/towards-smart-manufacturing-industry-4-0-and-india>. Last accessed on 15 September 2020.

----- (2016), "Sector Survey – Automobiles; India on its Way to Become the Primary Global Automobile Manufacturer", <http://www.makeinindia.com/article/-/v/make-in-india-sector-survey-automobile>. Last accessed on 15 September 2020.

**Mawii, Zothan (2019)**, *Feminist Perspectives on the Future of Work in India*, Friedrich-Ebert-Stiftung, <http://library.fes.de/pdf-files/bueros/indien/15719.pdf>. Last accessed on 15 September 2020.

**Mint (2017)**, "Focus on small businesses to drive manufacturing: Anand Mahindra", 24 August 2017, <https://www.livemint.com/Companies/IoVBznYk-8210bk8EYtZJRJ/Focus-on-small-businesses-to-drive-manufacturing-Anand-Mahi.html>. Last accessed on 15 September 2020.

----- (2016), "Unemployment rate in India at 5%, highest in 5 years", 29 September 2016, <http://www.livemint.com/Politics/KxezbFNSCudZb6U2IfSvwl/Unemployment-paints-grim-picture-highest-in-5-years-in-2015.html>. Last accessed on 16 September 2020.

**Mishra, Shruti (2020)**, "COVID-19 impact: Auto component makers may cut \$4 billion capex by 2022", *ETAuto*, 16 May 2020, <https://auto.economictimes.indiatimes.com/news/auto-components/covid-19-impact-auto-component-makers-may-cut-4-billion-capex-by-2022/75770026>. Last accessed on 15 September 2020.

**McKinsey & Company (2018)**, *The auto component industry in India: Preparing for the future*, [https://www.mckinsey.com/~/\\_/media/McKinsey/Featured%20Insights/Asia%20Pacific/The%20auto%20component%20industry%20in%20India%20preparing%20for%20the%20future/ACMA%20Vertical\\_Onscreen\\_Final.ashx](https://www.mckinsey.com/~/_/media/McKinsey/Featured%20Insights/Asia%20Pacific/The%20auto%20component%20industry%20in%20India%20preparing%20for%20the%20future/ACMA%20Vertical_Onscreen_Final.ashx). Last accessed on 15 September 2020.

----- (2006), *The road to 2020 and beyond: What's driving the global automotive industry?* [https://www.mckinsey.com/~/\\_/media/mckinsey/dotcom/client\\_service/Automotive%20and%20Assembly/PDFs/McK\\_The\\_road\\_to\\_2020\\_and\\_beyond.ashx](https://www.mckinsey.com/~/_/media/mckinsey/dotcom/client_service/Automotive%20and%20Assembly/PDFs/McK_The_road_to_2020_and_beyond.ashx). Last accessed on 15 September 2020.

**Migliani, Smita (2019)**, "The Growth of the Indian Automobile Industry: Analysis of the Roles of Government Policy and Other Enabling Factors", in K-C. Liu and U. Racherla (eds.), *Innovation, Economic Development, and Intellectual Property in India and China*, Singapore: Springer, pp. 439–463, [https://link.springer.com/chapter/10.1007/978-981-13-8102-7\\_19](https://link.springer.com/chapter/10.1007/978-981-13-8102-7_19). Last accessed on 15 September 2020.

**Mishra, Ashish K. and Dinesh Narayanan (2011)**, "Haryana: The State of Discontent", *Forbes India*, 1 July 2011, <http://www.forbesindia.com/article/special/haryana-the-state-of-discontent/26432/1>. Last accessed on 16 September 2020.

**Mitra, Raja Mikael (2019)**, "Digital Transformation and Industry 4.0 in Southeast Asia", [https://www.kas.de/documents/288143/4843367/panorama\\_digital\\_asia\\_v5a\\_Mitra.pdf/2309433a-f1dc-5c59-18be-20375225ea67](https://www.kas.de/documents/288143/4843367/panorama_digital_asia_v5a_Mitra.pdf/2309433a-f1dc-5c59-18be-20375225ea67). Last accessed on 15 September 2020.

**Mittal, Salvi (2019)**, "In All Our IT Initiatives, We Ensure That the Customer is at the Centre: Rajesh Uppal, CIO, Maruti Suzuki", *Express Computer*, <https://www.expresscomputer.in/industries/manufacturing/in-all-our-it-initiatives-we-ensure-that-the-customer-is>



at-the-centre-rajesh-uppal-cio-maruti-suzuki/36341/. Last accessed on 15 September 2020.

**Mohan, Deepanshu (2017)**, "India Is Very Much Part of the Global Productivity Slowdown", *The Wire, India*, 19 January 2017, <https://thewire.in/economy/india-global-productivity-slowdown>. Last accessed on 15 September 2020.

**Mohapatra, Prabhu (2015)**, "Unravelling the Puzzle", *Seminar*, May 2015, Issue 669 on *Reforming Labour Laws*, [http://www.india-seminar.com/2015/669/669\\_prabhu\\_mohapatra.htm](http://www.india-seminar.com/2015/669/669_prabhu_mohapatra.htm). Last accessed on 15 September 2020.

----- (2005), "Regulated Informality: Legal Constructions of Labour Relations in Colonial India 1814–1926", in Jan Lucassen and Sabyasachi Bhattacharya (eds.), *Workers in the Informal Sector: Studies in Labour History 1800–2000*, New Delhi: Macmillan India.

**More, Rahul Z. and Karuna Jain (2013)**, "Innovation and competitiveness among the firms in the automobile cluster in Pune", paper presented at Knowledge Forum: Annual International Conference, Pune, <http://fgks.in/images/pdf/papers/172.pdf>. Last accessed on 15 September 2020.

**Mukhtyar, Kavan and Yogesh Thakar (2020)**, "Life after Covid-19: How the Indian automotive sector can be future-ready", *Business Standard*, 29 April 2020, [https://www.business-standard.com/article/economy-policy/life-after-covid-19-how-the-indian-auto-sector-can-be-future-ready-120042900315\\_1.html](https://www.business-standard.com/article/economy-policy/life-after-covid-19-how-the-indian-auto-sector-can-be-future-ready-120042900315_1.html). Last accessed on 15 September 2020.

## N

**National Skill Development Corporation (NSDC) (2013)**, *Human Resource and Skill Requirement in the Auto and Auto Components Sector, Executive Summary*, pp. i-vi, <https://nscindia.org/sites/default/files/Auto-and-Auto-Components.pdf>. Last accessed on 15 September 2020.

----- (2015), *National Policy for Skill Development and Entrepreneurship*, <https://www.nscindia.org/sites/default/files/files/National-Policy-on-Skill-Development.pdf>. Last accessed on 16 September 2020.

**NITI Aayog (2017)**, *India leaps ahead: Transformative mobility solutions for all*, [https://niti.gov.in/writereaddata/files/document\\_publication/RMI\\_India\\_Report\\_web.pdf](https://niti.gov.in/writereaddata/files/document_publication/RMI_India_Report_web.pdf). Last accessed on 15 September 2020.

## O

**Obhan, Ashima and Bambi Bhalla (2020)**, "India: Suspension Of Labour Laws Amidst Covid-19", *Mondaq*, 18 May 2020, <https://www.mondaq.com/india/employment-and-workforce-wellbeing/935398/suspension-of-labour-laws-amidst-covid-19>. Last accessed on 22 September 2020.

**Okada, A. and N. S. Siddharthan (2007)**, *Industrial Clusters in India: Evidence from Automobile Clusters in Chennai and the National Capital Region*, Discussion

Paper No. 103, Chiba: JETRO Institute of Developing Economies, <https://core.ac.uk/reader/288456885>. Last accessed on 15 September 2020.

**Outlook India (2020)**, "Rico Auto lays off 119 permanent workers from Dharuhera plant", 25 May 2020, <https://www.outlookindia.com/newscroll/rico-auto-lays-off-119-permanent-workers-from-dharuhera-plant/1845733>. Last accessed on 16 September 2020.

## P

**Pardi, Tommaso (2017)**, "The Future of Work in the Automotive Sector: The Challenges of Globalization", *International Labour Organization*, [https://www.ilo.org/wcmsp5/groups/public/---dgreports/---inst/documents/publication/wcms\\_551606.pdf](https://www.ilo.org/wcmsp5/groups/public/---dgreports/---inst/documents/publication/wcms_551606.pdf). Last accessed on 15 September 2020.

**Parhi, M. (2008)**, "Indian Automotive Industry: Innovation and Growth", in *India: Science & Technology 2008*, New Delhi: NISTADS, <https://nistads.res.in/all-html/Indian%20Automotive%20Industry.html>. Last accessed on 15 September 2020.

**PricewaterhouseCoopers (2019a)**, *Indian automotive sector: Creating future-ready organisations*, <https://www.pwc.in/assets/pdfs/industries/automotive/indian-automotive-sector.pdf>. Last accessed on 15 September 2020.

----- (2019b), *GST@2: The road ahead*, <https://www.pwc.in/assets/pdfs/gst-at-2-years/gst-at-2-years.pdf>. Last accessed on 15 September 2020.

----- (2018), *Use of electric vehicles to transform mass transportation in India*, <https://www.pwc.in/assets/pdfs/publications/2018/use-of-electric-vehicles-to-transform-mass-transportation-in-india.pdf>. Last accessed on 15 September 2020.

**Pulignano, Valeria, Holm-Detlev Köhler and Paul Stewart (2016)**, "Introduction" in Valeria Pulignano, Holm-Detlev Köhler and Paul Stewart (eds.), *Employment Relations in an Era of Change: Multi-Level Challenges and Responses in Europe*, Brussels: European Trade Union Institute (ETUI), pp. 7–14, <https://www.etui.org/sites/default/files/16%20Employment%20relations%20era%20of%20change%20Pulignano%20et%20al%20Web%20version.pdf>. Last accessed on 15 September 2020.

## Q

**Qadir, Usman (2016)**, *Pakistan's Automotive Industry: A Case of Stalled Development*, Pakistan Institute of Development Economics (PIDE), Working Paper No. 137, <https://www.pide.org.pk/pdf/Working%20Paper/WorkingPaper-137.pdf>. Last accessed on 15 September 2020.

**Qadri, Azhar (2018)**, "Road Map for Pakistan Smart Industries: Industry 4.0", *International Supply Chain Education Alliance*, <https://www.iscea-emea.com/post/road-map-for-pakistan-smart-industries-industry-4-0>. Last accessed on 15 September 2020.

## R

**Raj, Amrit (2017)**, "What are CAFE norms and why do they matter in the proposed Toyota-Suzuki deal?", *Mint*, 6 February 2017, <https://www.livemint.com/Companies/FpQ6YCFfJHYPGiX6in4AN/What-are-CAFE-norms-and-why-do-they-matter-in-the-ToyotaSuz.html>. Last accessed on 15 September 2020.

**Ramachandran, J. (2011)**, "India entry strategy of auto majors", *tejas@iimb*, <https://tejas.iimb.ac.in/articles/91.php>. Last accessed on 15 September 2020.

**Remesh, Babu P. (2017)**, "Informal Work in the Formal Sector: Conceptualizing the Changing Role of the State in India", in Ernesto Noronha and Premilla D'Cruz (eds.), *Critical Perspectives on Work and Employment in Globalizing India*, London: Springer. pp. 83–94.

**Rathod, Mohit (2019)**, "SAS Will Continue to Emphasise Industry-Specific Solutions Relevant to India: Kunal Aman", *Express Computer*, 1 October 2019, <https://www.expresscomputer.in/big-data-analytics/sas-will-continue-to-emphasise-industry-specific-solutions-relevant-to-india-kunal-aman/42225/>. Last accessed on 15 September 2020.

**Raval, Abhishek (2019)**, "Bharat Forge achieves complete realisation from its IIoT investments", *Express Computer*, 4 June 2019, <https://www.expresscomputer.in/news/bharat-forge-achieves-complete-realisation-from-its-iiot-investments/36465/>. Last accessed on 15 September 2020.

**Ray, Saon and Smita Miglani (2018)**, *Upgrading in the Indian automobile sector: the role of lead firms*, ICRIER Working Paper No. 360, [http://icrier.org/pdf/Working\\_Paper\\_360.pdf](http://icrier.org/pdf/Working_Paper_360.pdf). Last accessed on 15 September 2020.

----- (2016a), "The role of FDI in fostering growth in the automobile sector in India", *Tech Monitor*, April–June 2016, [http://techmonitor.net/tm/images/7/75/16apr\\_jun\\_sf3.pdf](http://techmonitor.net/tm/images/7/75/16apr_jun_sf3.pdf). Last accessed on 15 September 2020.

----- (2016b), *Innovation (and upgrading) in the automobile industry: the case of India*, ICRIER Working Paper 320, [http://icrier.org/pdf/Working\\_Paper\\_320.pdf](http://icrier.org/pdf/Working_Paper_320.pdf). Last accessed on 15 September 2020.

**Reuters (2018)**, "Switch to electric cars threatens 75,000 German auto industry jobs", 5 June 2018, <https://www.reuters.com/article/us-germany-electromobility-jobs/switch-to-electric-cars-threatens-75000-german-auto-industry-jobs-idUSKCN1J115L?feedType=RSS&feedName=technology-News>. Last accessed on 16 September 2020.

**R. P., Srikanth (2019)**, "How Hero MotoCorp is using emerging technologies to accelerate its growth", *Express Computer*, 17 October 2019, <https://www.expresscomputer.in/archive/case-study/how-hero-motocorp-is-using-emerging-technologies-to-accelerate-its-growth/42489/>. Last accessed on 15 September 2020.

**Roy, Mousumi (2018)**, "Asia's Role in the Four Industrial Revolutions", in *Education About Asia*, vol. 23, no. 1, pp. 51–56, <http://aas2.asian-studies.org/EAA/EAA-Archives/23/1/1531.pdf>. Last accessed on 15 September 2020.

## S

**Sagar, Ambuj D. and Pankaj Chandra (2004)**, "Technological Change in the Indian Passenger Car Industry", BCSIA Discussion Paper 2004–2005, Energy Technology Innovation Project, Kennedy School of Government, Harvard University, [https://www.belfercenter.org/sites/default/files/files/publication/2004\\_Sagar\\_Chandra.pdf](https://www.belfercenter.org/sites/default/files/files/publication/2004_Sagar_Chandra.pdf). Last accessed on 15 September 2020.

**Saggi, Kamal (2002)**, "Trade, Foreign Direct Investment, and International Technology Transfer: A Survey", *World Bank Research Observer*, no. 17, pp. 191–235, <http://documents1.worldbank.org/curated/en/701391468326137113/pdf/766750JRN0WBRO00Box374385B00PUBLIC0.pdf>. Last accessed on 15 September 2020.

**Salhotra, Ketan (2015)**, "Indian auto electronics industry gearing up to accelerate", *Economic Times*, 4 November 2015, <https://auto.economictimes.indiatimes.com/autologue/indian-auto-electronics-industry-gearing-up-to-accelerate/1001>. Last accessed on 15 September 2020.

**Saini, Debi S. (2014)**, "Indian Industrial Relations Law: Case for Reform", *The Indian Journal of Industrial Relations*, vol. 50, no. 1, July 2014, pp. 118–132.

----- (2011), "Employment Law Framework: Structure and Potential Hurdles", in Pawan Budhwar and Arup Verma (eds.), *Doing Business in India: Building Research-Based Practice*, London: Routledge, pp. 23–45.

----- (2007), "Declining Labour Power and Challenges before Trade Unions: Some Lessons from a Case Study on Private Sector Unionism", *Indian Journal of Industrial Relations*, vol. 42, no. 4, pp. 652–677.

----- (1999), "Labour Legislation and Social Justice: Rhetoric and Reality", *Economic and Political Weekly*, vol. 34, no. 39 (25 Sep.–1 Oct. 1999), pp. L32–L40.

----- (1995), "Leaders or Pleaders: Dynamics of Briefcase Trade Unionism under the Existing Legal Framework", *Journal of the Indian Law Institute*, vol. 37, no. 1, pp. 73–91.

----- (1993), "Reference Power of State in Industrial Disputes Adjudication: A Study with Reference to Industrial Disputes in Faridabad", *Journal of the Indian Law Institute*, vol. 35 (Part II), no. 4, pp. 233–252.

**Sampath, G. (2012)**, "Can India Inc. Face the Truth about the Manesar Violence?" *DNA India*, 29 July 2012, <http://www.dnaindia.com/analysis/column-can-india-inc-face-the-truth-about-the-manesar-violence-1721167>. Last accessed on 15 September 2020.

**Sankaran, Kamala (2007)**, *Labour laws in South Asia: The need for an inclusive approach*, Geneva: International Institute for Labour Studies (IILS).

**Saraf, Priyam (2017)**, "What's holding back India's automotive sector?" *World Bank Blogs*, 16 August 2017, <https://blogs.worldbank.org/psd/what-s-holding-back-india-s-automotive-sector>. Last accessed on 15 September 2020.

- (2016), *Automotive in South Asia: From Fringe to Global*, The World Bank, <https://openknowledge.worldbank.org/bitstream/handle/10986/25119/108826revdOctober2016.pdf?sequence=5&isAllowed=y>. Last accessed on 15 September 2020.
- Saripalle, Madhuri (2012)**, "Learning and Capability Acquisition: A Case Study of the Indian Automobile Industry", Working Paper 65/2012, Chennai: Madras School of Economics, <http://www.mse.ac.in/wp-content/uploads/2016/09/Working-Paper-65-Web.pdf>. Last accessed on 15 September 2020.
- Sarmadi, Dario (2014)**, "Germany's Industry 4.0 in full swing, despite dissent from unions", *EURACTIV* Germany, 26 November 2014, <https://www.euractiv.com/section/innovation-industry/news/germany-s-industry-4-0-in-full-swing-despite-dissent-from-unions/>. Last accessed on 15 September 2020.
- Saxer, Marc (2017)**, *The future of work in Asia: How can India create livelihoods in the digital age?* New Delhi: Friedrich-Ebert-Stiftung, <http://library.fes.de/pdf-files/bueros/indien/13226.pdf>. Last accessed on 15 September 2020.
- Schroeder, Wolfgang (2016)**, *Germany's Industry 4.0 Strategy: Rhine Capitalism in the Age of Digitalisation*, London: Friedrich-Ebert-Stiftung, [https://www.fes-london.org/fileadmin/user\\_upload/publications/files/FES-London\\_Schroeder\\_Germanys-Industrie-40-Strategy.pdf](https://www.fes-london.org/fileadmin/user_upload/publications/files/FES-London_Schroeder_Germanys-Industrie-40-Strategy.pdf). Last accessed on 15 September 2020.
- Seconded European Standardization Expert in India (SESEI) (2018)**, *Indian Automobile Industry*, [http://www.sesei.eu/wp-content/uploads/2018/12/Automotive-Sector-Report\\_Final.pdf](http://www.sesei.eu/wp-content/uploads/2018/12/Automotive-Sector-Report_Final.pdf). Last accessed on 22 September 2020.
- Sehgal, Rakhi (2015)**, "Neoliberalism is Criminalising Labour", *Teheka*, Issue 52, vol. 12, 17 December 2015, <http://old.teheka.com/neoliberalism-is-criminalising-labour/>. Last accessed on 15 September 2020.
- (2013), "Attempts at Union Busting by a Giant Automobile Corporation: the Struggle of Maruti Suzuki Workers", 12 June 2013, <http://www.ritimo.org/Attempts-at-Union-Busting-by-a-Giant-Automobile-Corporation-the-Struggle-of>. Last accessed on 15 September 2020.
- (2012a), "'Maruti Workers Are the 'Villains': Truth or Prejudice?" *Economic and Political Weekly*, vol. 47, no. 31, pp. 12–15.
- (2012b), "Notes from the warfront: Maruti workers 'on trial'", *Kafila*, 21 August 2012, <https://kafila.online/2012/08/21/notes-from-the-warfront-maruti-workers-on-trial-rakhi-sehgal/>. Last accessed on 15 September 2020.
- (2005), "Gurgaon, July 25: Police Brutality Not an Aberration", *Economic and Political Weekly*, vol. 40, no. 35, pp. 3796–3797.
- Sen, Ratna (2011)**, "Multinationals & Industrial Relations in India", *Indian Journal of Industrial Relations*, vol. 46, no. 3, pp. 367–383.
- (1997), "Industrial Relations: Patterns and Trends", *Indian Journal of Industrial Relations*, vol. 32, no. 3, pp. 354–366.
- Sen Gupta, Anil K. and P. K. Sett (2006)**, "Industrial Relations Law, Employment Security and Collective Bargaining in India: Myths, Realities and Hopes" in Herbert J. Davis, Samir R. Chatterjee, and Mark Heuer (eds.), *Management in India: Trends and Transition*, Thousand Oaks, CA: Response Books, a division of Sage Publications, pp. 205–220. Earlier version published in *Industrial Relations Journal* (2000), vol. 31, no. 2, pp. 144–153.
- Sethi, Aman (2014)**, "India's young workforce adopts new forms of protest", *Business Standard*, 5 May 2014, [http://www.business-standard.com/article/current-affairs/india-s-young-workforce-adopts-new-forms-of-protest-114050500049\\_1.html](http://www.business-standard.com/article/current-affairs/india-s-young-workforce-adopts-new-forms-of-protest-114050500049_1.html). Last accessed on 15 September 2020.
- Sharma, R. C. (2016)**, *Industrial Relations and Labour Legislation*, New Delhi: PHI Learning Pvt. Ltd.
- Singh, Jaivir (2000)**, "Judicial Intervention in the Contract of Employment: Some Reflections on Labour Adjudication in India", Working Paper No. 82, Centre for Development Economics, Delhi School of Economics, <http://www.cdedse.org/pdf/work82.pdf>. Last accessed on 15 September 2020.
- Shibad, Namita (2019)**, "Startup Saturday: At MCCIA's Innovation Conclave Gadkari cites power, logistics, capital as prime factors for Industry 4.0", *Hindustan Times*, 16 November 2019, <https://www.hindustan-times.com/cities/mccia-s-innovation-conclave-gadkari-cites-power-logistics-capital-as-prime-factors-for-industry-4-0/story-w6j6Lo1BBhbfMvobBlyFnJ.html>. Last accessed on 15 September 2020.
- Shukla, Shantam (2019)**, "So you wish to leapfrog to Industry 4.0", *Express Computer*, 10 October 2019, <https://www.expresscomputer.in/news/so-you-wish-to-leapfrog-to-industry-4-0/42467/>. Last accessed on 15 September 2020.
- Shyam Sundar, K. R. (2019a)**, "The pursuit of too much labour flexibility", *The Hindu Business Line*, 25 November 2019, <https://www.thehindubusinessline.com/opinion/the-pursuit-of-too-much-labour-flexibility/article30075921.ece#>. Last accessed on 15 September 2020.
- (2019b), "A skewed approach to labour issues", *The Hindu Business Line*, 3 January 2019, <https://www.thehindubusinessline.com/opinion/a-skewed-approach-to-labour-issues/article25902566.ece>. Last accessed on 15 September 2020.
- (2019c), "Trade unions in India: From politics of fragmentation to politics of expansion and integration", [https://www.researchgate.net/publication/331064672\\_0\\_Trade\\_unions\\_in\\_India\\_From\\_politics\\_of\\_fragmentation\\_to\\_politics\\_of\\_expansion\\_and\\_integration](https://www.researchgate.net/publication/331064672_0_Trade_unions_in_India_From_politics_of_fragmentation_to_politics_of_expansion_and_integration). Last accessed on 15 September 2020.
- Shyam Sundar, K. R. and Rahul Suresh Sapkal (2019)**, "Wage Disadvantage of Contract Workers", *The Indian Journal of Industrial Relations*, vol. 54, no. 3,

pp. 377–395, [https://www.researchgate.net/publication/330010184\\_Wage\\_Disadvantage\\_of\\_Contract\\_Workers](https://www.researchgate.net/publication/330010184_Wage_Disadvantage_of_Contract_Workers). Last accessed on 15 September 2020.

Sil, Rudra (2003), “Globalization, the State, and Industrial Relations: Common Challenges, Divergent Transitions”, in T. V. Paul, John A. Hall, and G. John Ikenberry (eds.), *The Nation-State in Question*, pp. 260–287, Princeton University Press.

Sivananthiran, A. and C. S. Venkata Ratnam (2003), *Prevention and Settlement of Disputes in India*, New Delhi: ILO & IIRA.

Springer, Markus and Judith Schnelzer (2019), *Differentiation of Industry 4.0 Models: The 4th Industrial Revolution from different Regional Perspectives in the Global North and Global South*, Vienna: UNIDO, [https://www.researchgate.net/publication/332762483\\_Differentiation\\_of\\_Industry\\_40\\_Models\\_The\\_4th\\_Industrial\\_Revolution\\_from\\_different\\_Regional\\_Perspectives\\_in\\_the\\_Global\\_North\\_and\\_Global\\_South](https://www.researchgate.net/publication/332762483_Differentiation_of_Industry_40_Models_The_4th_Industrial_Revolution_from_different_Regional_Perspectives_in_the_Global_North_and_Global_South). Last accessed on 15 September 2020.

Stierle, Steffen (2018), “Work 4.0 – opportunities and risks”, *EURACTIV* Germany, 2 March 2018, <https://www.euractiv.com/section/economy-jobs/news/work-4-0-opportunities-and-risks/>. Last accessed on 15 September 2020.

Stoten, Philip (2015), “Could ‘Industry 4.0’ be ‘Made in China 4.0’?” *US Tech*, [http://www.us-tech.com/Relld/1425747/ISvars/default/Could\\_Industry\\_4\\_0\\_be\\_Made\\_in\\_China\\_4\\_0\\_.htm](http://www.us-tech.com/Relld/1425747/ISvars/default/Could_Industry_4_0_be_Made_in_China_4_0_.htm). Last accessed on 15 September 2020.

Sutton, John (2004), “The Auto-component Supply Chain in China and India – A Benchmarking Study”, London School of Economics, STICERD Research paper no. 34, <https://pdfs.semanticscholar.org/2115/dafbce110a279f153aff72803e0ef2f6229e.pdf>. Last accessed on 15 September 2020.

## T

Tandem Research (2018), *Work 2030: Scenarios for India*, [https://tandemresearch.org/assets/Tandem\\_Work2030-Small.pdf](https://tandemresearch.org/assets/Tandem_Work2030-Small.pdf). Last accessed on 15 September 2020.

Tandon, Suneera (2019), “Up to 12 mn Indian women may lose their jobs to automation by 2030: study”, *Mint*, 4 June 2019, <https://www.livemint.com/news/india/up-to-12-mn-indian-women-may-lose-their-jobs-to-automation-by-2030-study-1559669338838.html>. Last accessed on 15 September 2020.

Tiwari, R. and K. Kalogerakis (2017), “Innovation Pathways and Trajectories in India’s Auto Component Industry”, Working Paper No. 98, Hamburg University of Technology (TUHH) Institute for Technology and Innovation Management, <https://www.econstor.eu/bitstream/10419/163554/1/894155784.pdf>. Last accessed on 15 September 2020.

Tordjman, Karen Lellouche, and Benjamin Rehberg (2019), *Agile Creates a Seamless Experience for Car Buyers*, Boston Consulting Group, <http://image-src.bcg.com/Images/BCG-Agile-Creates-a-Seamless-Ex>

[perience-for-Car-Buyers-Apr-2019\\_tcm9-218505.pdf](http://image-src.bcg.com/Images/BCG-Agile-Creates-a-Seamless-Experience-for-Car-Buyers-Apr-2019_tcm9-218505.pdf). Last accessed on 15 September 2020.

Tummalapalli, Srinivasa Reddy, and Ryan Robinson (2018), *Plugging Into the Future: Electrifying the Global Automotive Industry*, Deloitte Insights, [https://www2.deloitte.com/content/dam/insights/us/articles/4931\\_plugging-in-to-the-future/DI\\_Plugging-into-the-future.pdf](https://www2.deloitte.com/content/dam/insights/us/articles/4931_plugging-in-to-the-future/DI_Plugging-into-the-future.pdf). Last accessed on 15 September 2020.

## U

Uchikawa, Shuji and Satyaki Roy (2013), “The Development of Auto Component Industry in India”, Institute for Human Development, <http://www.ihdindia.org/Formal-and-Informal-Employment/Paper-6-The-Development-of-Auto-Component-Industry-in-India.pdf>. Last accessed on 15 September 2020.

United Nations Industrial Development Organization (UNIDO) (2018a), *You Say You Want a Revolution: Strategic Approaches to Industry 4.0 in Middle-Income Countries*, Inclusive and Sustainable Industrial Development Working Paper Series, no. 19, <https://www.unido.org/api/opentext/documents/download/10031392/unido-file-10031392>. Last accessed on 15 September 2020.

----- (2018b), *What Can Policymakers Learn From Germany’s Industrie 4.0 Development Strategy?* Inclusive and Sustainable Industrial Development Working Paper Series, no. 22, <https://www.unido.org/api/opentext/documents/download/11712839/unido-file-11712839>. Last accessed on 15 September 2020.

## V

Vashisht, Pankaj and Jay Dev Dubey (2018), *Changing Task Contents of Jobs in India: Implications and Way Forward*, Indian Council for Research on International Economic Relations, Working Paper No. 355, [https://icrier.org/pdf/Working\\_Paper\\_355.pdf](https://icrier.org/pdf/Working_Paper_355.pdf). Last accessed on 15 September 2020.

Vu, Truong-Minh and Nguyen Vu Nhat Anh (2017), *The Fourth Industrial Revolution: A Vietnamese Discourse*, Hanoi: Friedrich-Ebert-Stiftung, <http://library.fes.de/pdf-files/bueros/vietnam/14005.pdf>. Last accessed on 15 September 2020.

## W

Wallenstein, Judith and Urvesh Shelat (2017), *What’s Next for the Sharing Economy*, Boston Consulting Group, <https://www.bcg.com/publications/2017/strategy-technology-digital-whats-next-for-sharing-economy.aspx>. Last accessed on 15 September 2020.

Wardhani, Artanti (2018), “Reform of skills systems needed in Asia”, *FES Connect*, 29 October 2018, <https://www.fes-connect.org/news-detail/reform-of-skills-systems-needed-in-asia/>. Last accessed on 15 September 2020.

World Bank (2017), “The Automotive Sector Can Transform South Asia Economically”, 4 January 2017, <https://www.worldbank.org/en/news/feature/2016/12/15/>

the-automotive-sector-can-transform-south-asia-economically. Last accessed on 15 September 2020.

---- (2016), *World Development Report 2016: Digital Dividends*, <https://openknowledge.worldbank.org/bitstream/handle/10986/23347/9781464806711.pdf>. Last accessed on 15 September 2020.

World Economic Forum (2018), *The Future of Jobs Report 2018*, [http://www3.weforum.org/docs/WEF\\_Future\\_of\\_Jobs\\_2018.pdf](http://www3.weforum.org/docs/WEF_Future_of_Jobs_2018.pdf). Last accessed on 15 September 2020.

## Y

Yadav, Anumeha (2015), "Workers' problems: The more things change at Maruti's Manesar plant, the more they stay the same", *Scroll*, 14 December 2015, <https://scroll.in/article/773241/workers-problems-the-more-things-change-at-marutis-manesar-plant-the-more-they-stay-the-same%5b>accessed. Last accessed on 15 September 2020.

