

7. Manufacture of Transport: Manufacturing of Motor Vehicles and Its Parts and Accessories, and Repair and Maintenance of Motor Vehicles

7.1 Definition of the Sector

Within the sector, manufacturing of transport, this chapter focusses on two sub-sectors namely manufacturing of motor vehicles and manufacturing of parts & accessories of motor vehicles. The third sub-sector of 'repair and maintenance of motor vehicles' is derived from the selected sector of 'trade'. These three sub-sectors include the following:¹

- NIC 2910: Manufacture of motor vehicles
 - 29101: Manufacture of passenger cars
 - 29102: Manufacture of commercial vehicles such as vans, lorries, over-the-road tractors for semi-trailers, etc.
 - 29103: Manufacture of chassis fitted with engines for the motor vehicles included in this class
 - 29104: Manufacture of motor vehicle engines
 - 29109: Manufacture of motor vehicles n.e.c.
- NIC 2930: Manufacture of parts and accessories for motor vehicles
 - 29301: Manufacture of diverse parts and accessories for motor vehicles such as brakes, gearboxes, axles, road wheels, suspension shock absorbers, radiators, silencers, exhaust pipes, catalysers, clutches, steering wheels, steering columns and steering boxes, etc.
 - 29302: Manufacture of parts and accessories of bodies for motor vehicles such as safety belts, airbags, doors, bumpers
 - 29303: Manufacture of car seats
 - 29304: Manufacture of motor vehicle electrical equipment, such as generators, alternators, spark plugs, ignition wiring harnesses, power window and door systems, assembly of purchased gauges into instrument panels, voltage regulators, etc.
- NIC 4520: Maintenance and repair of motor vehicles²

7.2 Value Chain

The automotive sector in India is large and growing. From an economic standpoint, the sector's importance emerges from its contribution to India's manufacturing GDP and GVA, as well as the number of people employed in the sector—directly and indirectly.

The manufacturing segment of the automotive value chain, comprising component and vehicle manufacturers, is organised in a tiered structure. Manufacturers at the lower tiers (say at tier 2 or 3) supply smaller components to tier 1 sub-assembly

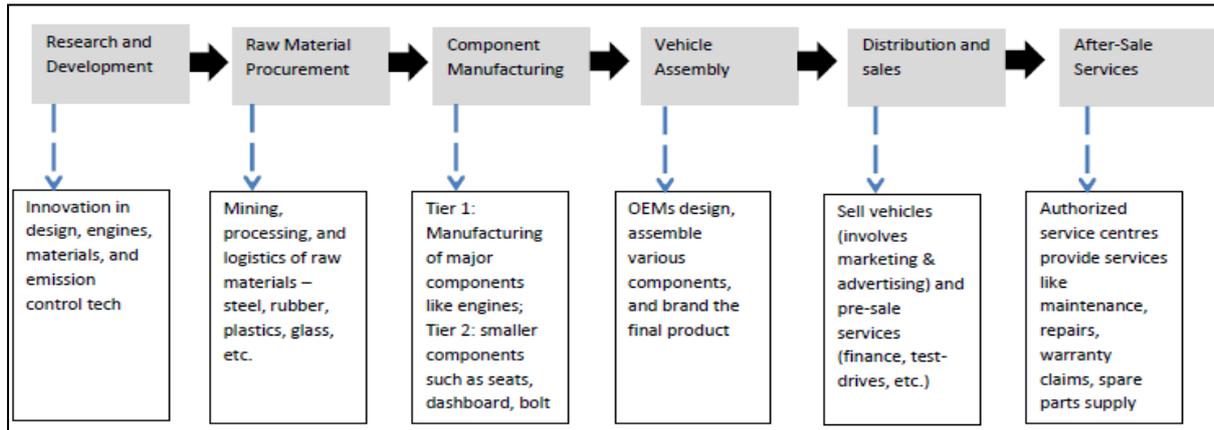
¹ Central Statistical Organisation, Ministry of Statistics and Programme Implementation. 2008. National Industrial Classification (All Economic Activities). 2008. https://www.ncs.gov.in/Documents/NIC_Sector.pdf.

² While this sector is classified under retail, it will be included in the auto sector, enabling a holistic skill gaps assessment of motor vehicles sector.

manufacturers, with the final vehicle assembly undertaken by the vehicle manufacturer (Figure 7.1). Manufacturing is preceded by research and development and procurement of raw materials, and followed by marketing and sales. These stages are outside the scope of the present study.

The focus of the study is concerns component manufacturing, vehicle manufacturing and assembly, and after-sales services—thereby aligning with the definition of the sector, as presented through the NIC 4-digit codes above.

Figure 7.1: Automotive value chain



Source: NCAER compilation, adapted from various sources³.

With the growing advent of Electric Vehicles (EVs), flex-fuels, and connected cars, the type and number of components required in a motor vehicle are changing, and hence the manufacturers involved in the value chain are changing too. For instance, the powertrain of an Electric Vehicle (EV) is completely different from that of an internal combustion engine (ICE) vehicle—requiring the need for specialised EV component manufacturers and assemblers in the value chain. The use of artificial intelligence and electronic features in connected cars has brought in the need for another set of hardware and software suppliers.

Changes in technology are therefore constantly bringing in the need for new skills in the auto sector. To meet the government’s vision of 30 per cent EV adoption by 2030, a recent report released by Society of Indian Automobile Manufacturers (SIAM) highlights the need to double the number of EV-ready workers joining the sector from 15,000 per year to 30,000 per year till 2030, if 100 per cent localisation of EV components has to be achieved.⁴ It particularly highlights the need for fresh skilling, given the technical differences between EVs and ICE vehicles; as well as re-skilling in job roles where there may be certain technical overlap. At the same time, with the

³ Key references include:

Sturgeon, T., Chagas, L. and Barnes, J. 2017. “Inovar Auto: Evaluating Brazil’s Automotive Industrial Policy to Meet the Challenges of Global Value Chains”. 10.1596/28947.

Sturgeon, T.J., Daly, J., Frederick, S., Bamber, P.G., and Gereffi, G. 2016. “The Philippines in the Automotive Global Value Chain”.

⁴ SIAM and Deloitte 2024. *EV Talent Landscape in India: Bridging the Skill Gap for 2030*. SIAM. The report has received wide media coverage: https://www.business-standard.com/industry/auto/auto-industry-needs-200k-skilled-people-by-2030-to-meet-30-ev-target-124071600619_1.html; accessed on 16 July 2024.

advent of flex fuels, AI, robotics, automation, and connected vehicles, Automotive Skill Development Council (ASDC) has introduced new skilling courses as well as qualification packs (QPs) for job roles to meet the changing needs of the automotive manufacturing sector.⁵

The following sections delve into the employment, skills and jobs in the sector, using a wide variety of secondary data available in public domain.

7.3 Workforce Characteristics

- a. ***Share of female workers***: 3.8 per cent of the workforce in the sector, ‘manufacture of parts and accessories for motor vehicles’ are females. The corresponding number for ‘manufacturing of motor vehicles’ is 3.1 per cent and ‘maintenance and repair of motor vehicles’ is 0.6 per cent.
- b. ***States***: The workers are concentrated in four States—Tamil Nadu, Maharashtra, Gujarat and Karnataka (Table 7.1).
 - The PLFS data shows that:
 - The maximum share of workers employed in ‘manufacturing of motor vehicles’ is in Maharashtra, Tamil Nadu, and Madhya Pradesh.
 - The maximum share of workers employed in ‘manufacturing parts & accessories of motor vehicles’ are located in Gujarat, Maharashtra, and Tamil Nadu. There is little or negligible presence of female workers in the States.
 - The maximum share of workers employed in ‘*maintenance and repair of motor vehicles*’ are located in Tamil Nadu, Maharashtra, Gujarat, Karnataka, and Uttar Pradesh.
 - Figure 7.2 shows that the presence of female workers across the States in these three sectors is few and far between. Haryana is a notable exception where the share of female workers is 50.8 per cent in the manufacture of motor vehicles.
 - The enterprises data from ASI 2021–22 and ASUSE 2021–22 broadly conform to the PLFS data trends. However, they both throw up some surprises like Jharkhand, which employs 5 per cent of the workers in ‘manufacturing of motor vehicles’ as per the ASI data. The ASUSE data shows that 53 per cent of the workers in unincorporated enterprises in this sector are located in West Bengal and 41.3 per cent in Punjab. Haryana also shows much larger presence of auto workers as per both the data sources across the three sectors than PLFS does.

⁵ Courses include: Fundamentals of Connected Vehicle (V2X) Technology, IIoT Application in Cyber Security (Manufacturing), IIoT Application in Predictive Maintenance (Manufacturing), Foundation course in Flex Fuel Engine Design. Job roles include: Automotive Robotics and Automation Manager, Automotive Robotics and Automation Simulation Engineer, Automotive IIoT Application Engineer/ Technician/ Specialist, Automotive Automation and Robotics Engineer, Automotive Flex Fuel Engine Designer, Automotive Cyber Security Engineer/ Specialist, Advanced Driver Assistance System (ADAS) Engineer (Source: ASDC).

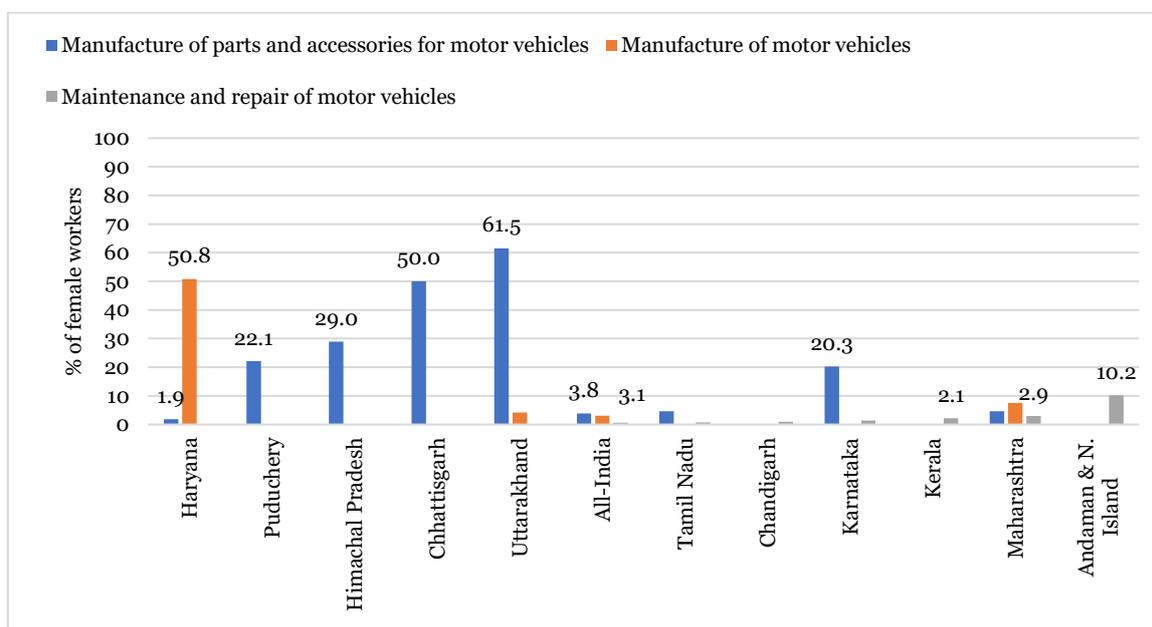
Table 7.1: State-wise percentage share of workers engaged in motor vehicles sector

State/UT	NIC 2910 Manufacture of motor vehicles			2930. Manufacture of parts and accessories for motor vehicles			4520. Maintenance and repair of motor vehicles		
	PLFS 2022-23	ASI 2021-22	ASUSE 2021-22	PLFS 2022-23	ASI 2021-22	ASUSE 2021-22	PLFS 2022-23	ASI 2021-22	ASUSE 2021-22
Maharashtra	29.4	24.8	0.0	18.8	20.4	8.3	9.5	10.8	12.0
Tamil Nadu	19.6	20.5	0.0	18.3	23.8	14.2	9.6	14.0	7.9
Madhya Pradesh	14.3	4.4	0.0	2.4	2.2	0.3	4.2	2.7	5.1
Rajasthan	7.3	3.3	3.7	3.1	2.5	5.6	6.3	4.6	8.9
Andhra Pradesh	6.3	3.5	0.0	0.1	1.8	0.3	5.0	5.6	2.7
Uttar Pradesh	6.1	2.0	0.5	4.4	4.1	11.0	7.3	8.8	10.6
Karnataka	4.5	6.0	0.8	6.8	6.6	3.6	8.3	8.5	7.2
Uttarakhand	3.5	4.5	0.7	0.4	4.4	0.0	1.3	0.5	1.1
Gujarat	3.3	8.3	0.0	27.8	3.7	7.1	9.1	6.2	8.1
West Bengal	2.3	0.1	53.1	1.7	2.1	3.8	4.5	2.8	3.9
Haryana	1.4	14.8	0.0	8.1	21.7	16.5	2.2	5.8	1.2
Telangana	0.7	1.6	0.0	0.0	0.2	0.0	3.1	3.3	3.2
Kerala	0.6	0.0	0.0	0.0	0.1	3.2	7.0	7.6	9.4
Jharkhand	0.5	5.0	0.0	1.4	2.3	4.6	1.1	2.1	3.5
Andaman & Nicobar Island	0.0	0.0	0.0	0.0	0	0.0	0.1	0.02	0.02
Assam	0.0	0.0	0.0	0.0	0.002	1.0	2.1	0.9	0.7
Bihar	0.0	0.0	0.0	0.0	0.0	4.4	7.1	0.8	1.5
Chandigarh	0.0	0.0	0.0	0.2	0.0	0.4	0.1	0.6	2.5
Chhattisgarh	0.0	0.0	0.0	0.1	0.0	0.8	1.5	2.0	1.2
Delhi	0.0	0.0	0.0	0.3	0.2	6.4	1.1	4.5	0.6
Himachal Pradesh	0.0	0.0	0.0	0.3	0.7	0.0	1.3	0.4	0.7
Jammu & Kashmir	0.0	0.0	0.0	0.0	0.0	3.1	1.1	0.9	0.7
Manipur	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.2
Meghalaya	0.0	0.0	0.0	0.1	0.0	0.5	0.2	0.1	0.4
Nagaland	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.1
Odisha	0.0	0.0	0.0	0.2	0.1	1.6	2.7	1.6	3.0
Puducherry	0.0	0.0	0.0	0.9	0.3	0.0	0.0	0.2	0.1
Punjab	0.0	1.0	41.3	4.5	2.5	3.2	3.5	3.4	2.6
Tripura	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.1
Arunachal Pradesh		0.0	0.0		0.0	0.0		0.0	0.1
Dadra & Nagar Haveli & Daman & Diu		0.0	0.0		0.2	0.0		0.0	0.1
Goa		0.0	0.0		0.0	0.0		0.7	0.6
Mizoram		0.0	0.0		0.0	0.0		0.0	0.1

Sources: NCAER analysis using PLFS 2022-23, ASI 2021-22 and ASUSE 2021-22.

Notes: 1. PLFS gives age-wise data but ASI and ASUSE do not. PLFS is a household survey data and the latter two are enterprises data. 2. All three sources of data report zero labour employed for the missing States in the table.

Figure 7.2: State-wise distribution of female workforce in the ‘manufacturing of motor vehicles’, ‘manufacturing of parts and accessories for motor vehicles’ and ‘maintenance and repair of motor vehicles’, 2022–23 (%)



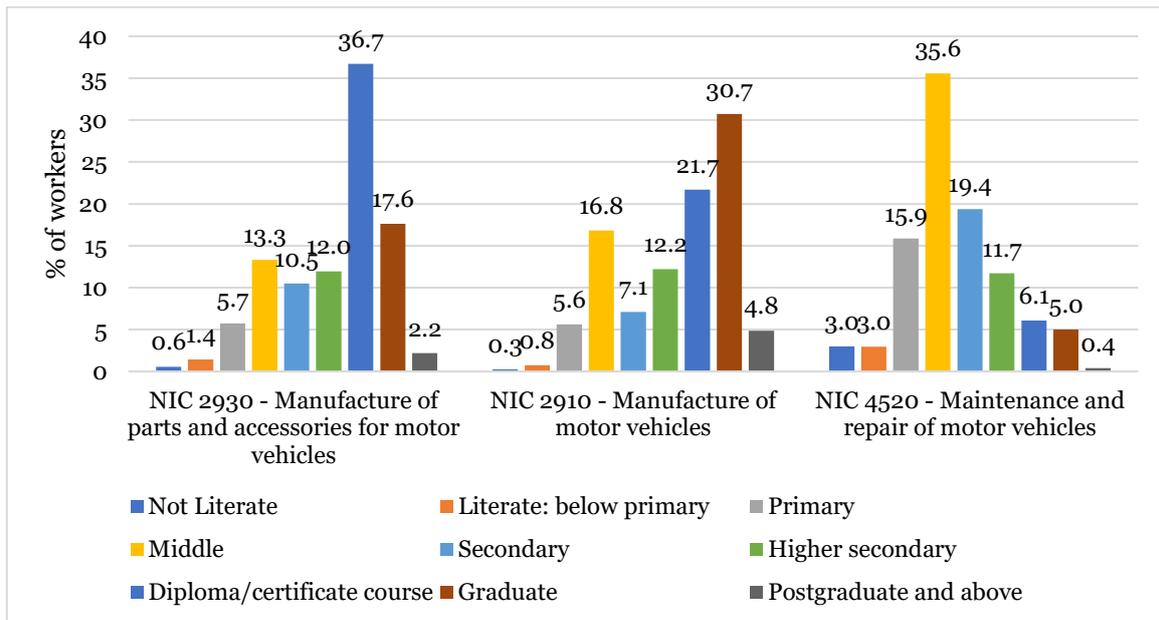
Source: NCAER analysis from PLFS 2022–23.

c. Across Education Levels:

- When analysed across levels of general education (Figure 7.3), majority of workers involved in:
 - Manufacture of motor vehicles are graduates.
 - Manufacture of parts and accessories of motor vehicles are diploma / certificate course holders.
 - Maintenance and repair of motor vehicles are educated until middle school.
- When analysed across levels of technical education (Figure 7.4), majority of workers involved in:
 - 53 per cent workers in manufacture of motor vehicles do not have technical education. 22 per cent of workers have technical degree, 16.6 per cent of workers have technical education in engineering/technology below graduate level and 0.9 per cent above graduate level. 5.4 per cent of workers also have technical education in other subjects.
 - 57 per cent workers in manufacture of parts and accessories of motor vehicles do not have technical education. 35 per cent of workers have technical education below graduate level.
 - 93 per cent workers in maintenance and repair of motor vehicles do not have technical education. Barely 3.4 per cent of workers have technical education in engineering/technology below graduate level.

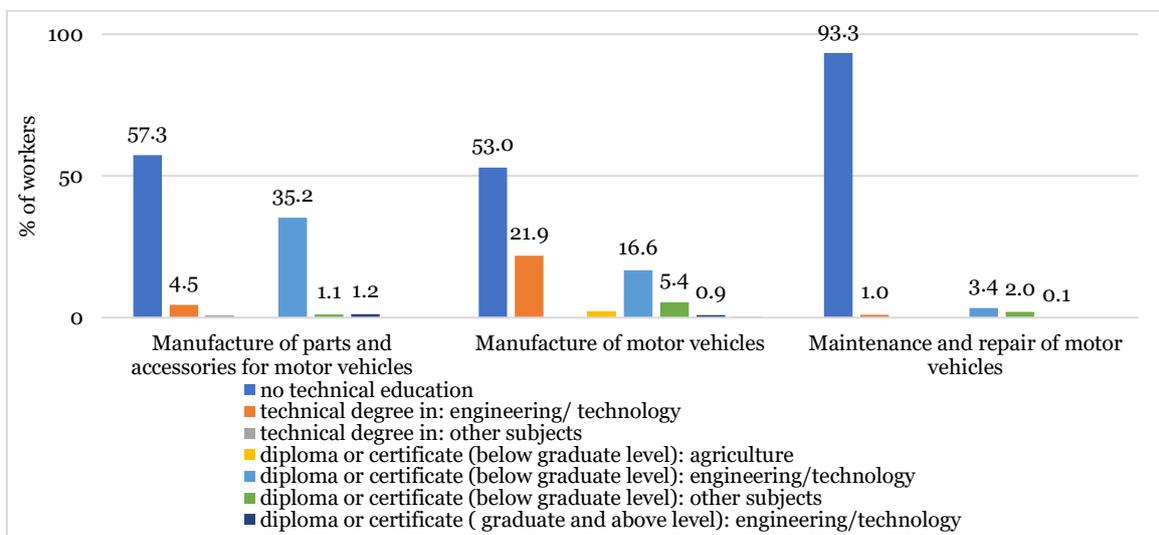
- Vocational Education (Figure 7.5): A third of the workers in the manufacturing of parts and accessories for motor vehicles have formal vocational training and a third non-formal vocational training. 23 per cent of workers engaged in manufacturing of motor vehicles have received formal vocational training. However, in repair and maintenance of motor vehicles sector, 60 per cent of workers have received non-formal vocational training.

Figure 7.3: General educational attainment of workers engaged in manufacturing of motor vehicles, its parts & accessories and its maintenance and repair, 2022–23 (%)



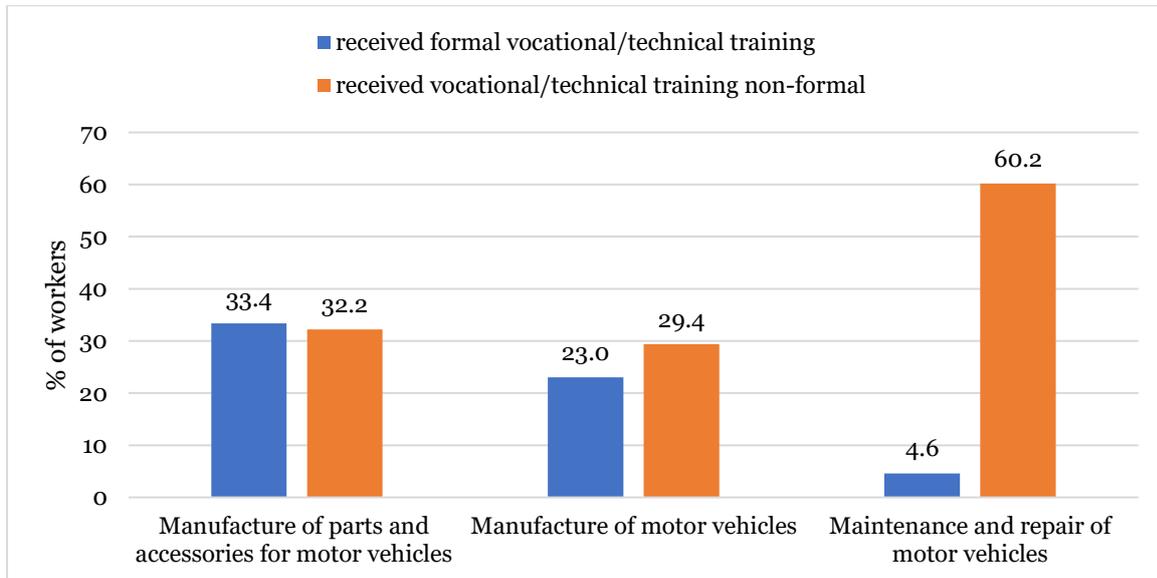
Source: NCAER analysis using PLFS data 2022–23.

Figure 7.4: Technical educational attainment of workers engaged in manufacturing of motor vehicles, its parts & accessories and its maintenance and repair, 2022–23 (%)



Source: NCAER analysis using PLFS data 2022–23.

Figure 7.5: Vocational educational attainment of workers engaged in manufacturing of motor vehicles, its parts & accessories and its maintenance and repair, 2022–23 (%)

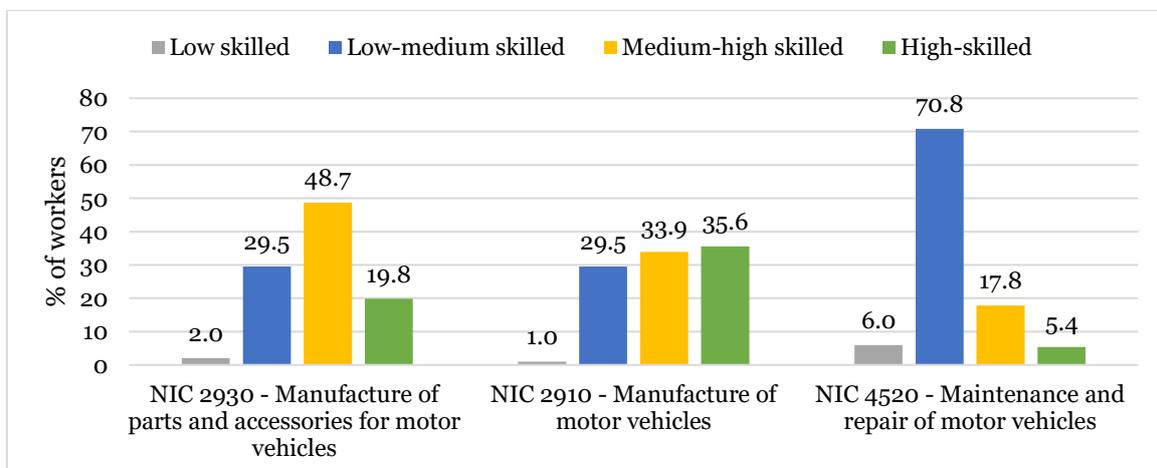


Source: NCAER analysis using PLFS data 2022–23

d. **Across Skills:** Aligned with the levels of education, majority of workers involved in (Figure 7.6):

- Manufacture of motor vehicles are high skilled.
- Manufacture of parts and accessories of motor vehicles are medium skilled.
- Maintenance and repair of motor vehicles are low medium skilled.

Figure 7.6: Skill level of workers engaged in manufacturing of motor vehicles, its parts & accessories and its maintenance and repair, 2022–23 (%)



Source: NCAER analysis using PLFS data 2022–23.
 Note: Look at Annexure 4.2 for the definition of skills.

- e. **Across Occupations:** In the auto industry, workers are involved in several occupations. Certain occupations however stand-out, given the relatively large number of workers engaged in them. For instance:
- Majority of workers in manufacture of motor vehicles (NIC 2910) are Assemblers (14 per cent), and Physical and Engineering Science Technicians (12 per cent).
 - Majority of workers in manufacture of parts and accessories of motor vehicles (NIC 2930) are Machinery Mechanics and Repairers (27 per cent) and Manufacturing Labourers (20 per cent).
 - Majority of workers in repair and maintenance of motor vehicles (NIC 4520) are Machinery Mechanics and Repairers (79 per cent of workers in NIC 4520)
- f. **Engagement Status:** 96.3 per cent of workers are regular-wage workers in the manufacture of parts and accessories for motor vehicles (Table 7.2). The corresponding number for workers in manufacture of motor vehicles are 93.8 per cent. However, in the sector, repair and maintenance of motor vehicles, the trends are markedly different—29 per cent are own-account workers, 8.2 per cent are employers, 3.5 per cent are unpaid family workers, 53.3 per cent work as regular wage employees, and 6.0 per cent as casual wage workers. This sector employs a very small proportion of females but 97 per cent of them are regular wage employees.

Table 7.2: Engagement status of workers (%)

Items	All Workers (aged 15+)					Total
	Self-employed			Regular salaried/ wage employee	Casual Wage Labour	
	Own account worker	Employer	Worked as helper in h.h. enterprise (unpaid family worker)			
Manufacture of parts and accessories for motor vehicles	1.5	1.4	0.4	96.4	0.3	100.0
Manufacture of motor vehicles	0.5	4.0	0.0	93.8	1.7	100.0
Maintenance and repair of motor vehicles	28.9	8.2	3.5	53.3	6.0	100.0
All Male Workers (aged 15+)						
Manufacture of parts and accessories for motor vehicles	1.6	1.5	0.3	96.3	0.3	100.0
Manufacture of motor vehicles	0.5	4.1	0.0	93.6	1.7	100.0
Maintenance and repair of motor vehicles	29.1	8.3	3.5	53.0	6.0	100.0
All Female Workers (aged 15+)						
Manufacture of parts and accessories for motor vehicles	0.0	0.0	1.4	98.6	0.0	100.0
Manufacture of motor vehicles	0.0	0.0	0.0	100.0	0.0	100.0
Maintenance and repair of motor vehicles	0.0	0.0	1.9	97.9	0.2	100.0

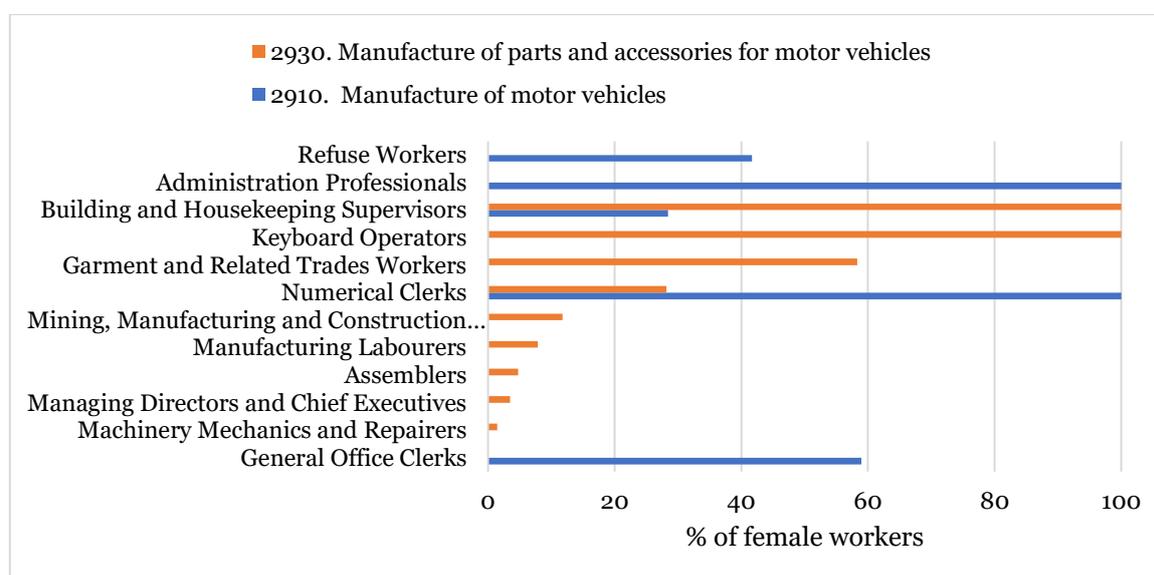
Source: NCAER Analysis from PLFS 2022–23.

g. ***Concentration of Females in Specific Job Roles:*** While there are very few women employed in the auto industry, these too are concentrated in specific job roles, in particular (Figure 7.7):

- For manufacture of motor vehicles, occupations such as Numerical Clerks and Administration Professionals have only women workers. Among all General Office Clerks, more than 50 per cent are women.
- For manufacture of parts and accessories of motor vehicles, occupations such as Keyboard Operators and Building and Housekeeping Supervisors only have women workers.
- For repair and maintenance of motor vehicles, occupations such as Administration Professionals, Keyboard Operators, and Garment and Related Trades Workers have only women. Among all Finance professionals, 71 per cent are women (Figure 7.8).

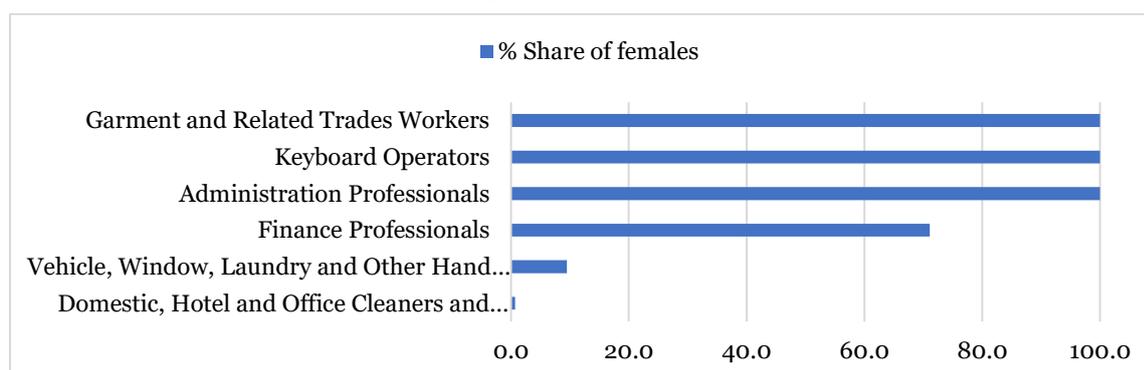
It is evident that women are employed in job roles which ‘support’ the core activities of manufacturing and repair and maintenance in the auto industry, considering that the ‘core’ occupations’, which have the largest share of workers in all the three NIC categories, i.e., Physical and Engineering Science Technicians, and Manufacturing Labourers, Machinery Mechanics and Repairers, and Assemblers – primarily have men engaged in them.

Figure 7.7: Percentage share of female workers (aged 15+) in job roles in manufacturing of motor vehicles and its parts & accessories, 2022–23 (%)



Source: NCAER analysis using PLFS data 2022–23.

Figure 7.8: Percentage share of female workers (aged 15+) in job roles in maintenance and repair of motor vehicles, 2022–23 (%)



Source: NCAER analysis using PLFS data 2022–23.

7.4 Geographical Clusters

“Clusters are geographic concentrations of interconnected companies and institutions in a particular field”, encompassing “an array of linked industries”, including for instance “suppliers of specialised inputs such as components, machinery, and services, and providers of specialised infrastructure.” (Porter 1998, p.78⁶).

The automobile industry in India is organised around key geographic clusters, with the presence of automobile original equipment manufacturers (OEMs) and their component suppliers in close proximity. Services and infrastructure facilities, supporting the automobile and auto component units, can also be found within these clusters. The clustering feature of automobile manufacturing industry in India is well documented, with the key clusters located in Delhi-Gurgaon-Faridabad (Delhi-NCR) in the North, Mumbai-Pune-Nashik-Aurangabad (Maharashtra) and Sanand-Hansalpur-Vithalpur (Gujarat) in the West, Chennai- Bengaluru-Hosur (Tamil Nadu/Karnataka) in the South, and Jamshedpur-Kolkata in the East (Ministry of MSME & KPMG 2020, p.287; IBEF⁸; Govt of Gujarat 2024⁹).

Latest available data from Annual Survey of Industries (2021–22) and ASUSE (2021–22) helps identify the States where there are a rather large number of units engaged in manufacturing, as well as repair and maintenance, of motor vehicles and

⁶ Porter 1998, Clusters and the New Economics of Competition, *Harvard Business Review*, November-December 1998. Available at:

https://backonline.apswiss.ch/6001/porter_clusters_and_the_new_economics_of_competition.pdf

⁷ Ministry of MSME & KPMG 2020, White Paper – Automotive Industry, Technology Cluster Manager (TCM) Technology Centre System Program (TCSP), Office of DC MSME, Ministry of MSME, October 2020. Available at: https://www.dcmsme.gov.in/white_paper/1.%20Whitepaper-Automotive%20Sector-Year%201.pdf

⁸ Automobile and components clusters depicted on a map: <https://www.ibef.org/industry/india-automobiles>; <https://www.ibef.org/industry/autocomponents-india>; accessed on 15 May 2024.

⁹ Government of Gujarat. 2024, Setting up of Multiskilling & Certification Centre for Automotive Sector at Sanand, Gujarat Skill Development Mission, Industrial Extension Bureau, Govt of Gujarat. Available at: https://indextb.com/files/2024/2/a66c536e-5033-4b01-84e2-3f744a8144c3_Setting%20up%20of%20Multiskilling%20&%20Certification%20Centre%20for%20Automotive%20Sector.pdf; <https://indextb.com/sector/automobile-component>; accessed on 15 May 2024.

parts and accessories for motor vehicles (Table 7.3). A larger number of manufacturing units (i.e., factories) and repair and maintenance units (i.e., workshops) in a State, which represents a higher concentration of units associated with automotive manufacturing and repair and maintenance, in effect depicts the geographical locations *where* there is also a demand for skilled workers in the sector.

Considering that the units in existing automobile clusters are also accommodating technological changes, concerning Electric Vehicles (EVs), and batteries and bio-fuels, *future skills and job roles* are also likely to be demanded within the existing clusters—be they within the existing units, or within new units added to the existing clusters.

It may be noted that the data available from ASI and ASUSE are at the State-level. To identify units at the district level within the State, information from Ministry of Corporate Affairs (MCA)/Goods & Services Tax Network/Economic Census or industry associations such as Society of Indian Automobile Manufacturers (SIAM¹⁰) and Automotive Component Manufacturers Association of India (ACMA¹¹) may be requested.

At the State-level, it is clear that Tamil Nadu and Maharashtra are the top clusters for the three sub-sectors in the motor vehicles industry. Table 7.4 shows that there are differences between concentration of labour force and geographical clusters such as Haryana and West Bengal in the case of ‘manufacturing of motor vehicles’. Their respective rankings based on shares of labour force are much lower compared to their concentration of automotive units. This happens in the case of Kerala too in the sector ‘manufacture of parts & accessories for motor vehicles’. The correlation of the rankings for the sector, ‘maintenance and repair of motor vehicles’ is 0.99 indicating that that both are giving the same information.

It must also be noted that the rankings are based on data relating to formal as well as informal automotive units, as are available with India’s national industrial statistics of ASI and ASUSE respectively. It is potentially due to this reason that States which may not normally be associated with a large concentration of automotive units (and hence considered a ‘cluster’), tend to come up among the top automotive clusters in this exercise, such as West Bengal in manufacture of motor vehicles and Uttar Pradesh in manufacture of parts and accessories for motor vehicles.

Considering that any automotive unit, formal or informal, will be hiring workers—any exercise on skilling of workers in the sector should be considerate to the skill needs of informal enterprises as well.

¹⁰ SIAM members list: <https://www.siam.in/members.aspx?mpgid=1&pgidtrail=4>; accessed on 15 May 2024.

¹¹ ACMA member search: <https://www.acma.in/index.php>; accessed on 15 May 2024.

Table 7.3: Geographical clusters in the auto sector

<i>Parts and Accessories of Motor Vehicles</i>			<i>Motor Vehicles</i>			<i>Repair and Maintenance of Motor Vehicles</i>					
<i>State/UT</i>	<i>ASI Rank</i>	<i>ASUSE Rank</i>	<i>Avg. Rank</i>	<i>State/UT</i>	<i>ASI Rank</i>	<i>ASUSE Rank</i>	<i>Avg. Rank</i>	<i>State/UT</i>	<i>ASI Rank</i>	<i>ASUSE Rank</i>	<i>Avg. Rank</i>
Maharashtra	2	2	2	Maharashtra	1	7	4	Maharashtra	3	2	2.5
Tamil Nadu	1	3	2	Haryana	2	7	4.5	Tamil Nadu	1	4	2.5
Uttar Pradesh	5	1	3	Karnataka	4	5	4.5	Uttar Pradesh	5	1	3
Haryana	3	5	4	Tamil Nadu	3	7	5	Kerala	2	6	4
Gujarat	7	4	5.5	West Bengal	10	1	5.5	Gujarat	6	5	5.5
Karnataka	4	8	6	Gujarat	4	7	5.5	Karnataka	4	7	5.5
Punjab	8	7	7.5	Uttar Pradesh	8	4	6	Rajasthan	11	3	7
Rajasthan	11	10	10.5	Madhya Pradesh	6	7	6.5	Andhra Pradesh	7	12	9.5
Jharkhand	10	12	11	Jharkhand	7	7	7	Telangana	8	11	9.5
Kerala	20	6	13	Rajasthan	12	3	7.5	Madhya Pradesh	14	8	11
Uttarakhand	6	22	14	Punjab	14	2	8	Punjab	10	13	11.5
Madhya Pradesh	9	19	14	Uttarakhand	10	6	8	West Bengal	13	10	11.5
Delhi	12	16	14	Telangana	9	7	8	Jharkhand	15	9	12
West Bengal	15	15	15	Andhra Pradesh	12	7	9.5	Haryana	12	17	14.5
Odisha	20	11	15.5	Odisha	15	7	11	Delhi	9	23	16
Andhra Pradesh	14	18	16	Kerala	15	7	11	Odisha	19	14	16.5
Jammu & Kashmir	25	9	17	Jammu & Kashmir	17	7	12	Bihar	18	16	17
Himachal Pradesh	13	22	17.5	Himachal Pradesh	17	7	12	Chhattisgarh	17	18	17.5
Chandigarh	18	20	19	Chandigarh	17	7	12	Chandigarh	22	15	18.5
Puducherry	16	22	19	Delhi	17	7	12	Assam	16	21	18.5
Bihar	25	13	19	Bihar	17	7	12	Uttarakhand	20	19	19.5
Assam	24	14	19	Sikkim	17	7	12	Himachal Pradesh	23	20	21.5
Telangana	17	22	19.5	Arunachal Pradesh	17	7	12	Goa	21	24	22.5
Chhattisgarh	23	17	20	Nagaland	17	7	12	Jammu & Kashmir	24	22	23
D & N. Haveli & Daman & Diu	19	22	20.5	Manipur	17	7	12	Tripura	25	29	27
Goa	22	22	22	Mizoram	17	7	12	Manipur	30	25	27.5
Meghalaya	25	21	23	Tripura	17	7	12	Meghalaya	29	26	27.5
Sikkim	25	22	23.5	Meghalaya	17	7	12	Puducherry	28	27	27.5
Arunachal Pradesh	25	22	23.5	Assam	17	7	12	Nagaland	26	30	28
Nagaland	25	22	23.5	Chhattisgarh	17	7	12	Mizoram	27	32	29.5
Manipur	25	22	23.5	D & N. Haveli & Daman & Diu	17	7	12	Arunachal Pradesh	33	28	30.5
Mizoram	25	22	23.5	Goa	17	7	12	Andaman & N. Island	30	33	31.5
Tripura	25	22	23.5	Lakshadweep	17	7	12	D & N. Haveli & Daman & Diu	33	31	32

Parts and Accessories of Motor Vehicles				Motor Vehicles				Repair and Maintenance of Motor Vehicles			
State/UT	<i>ASI Rank</i>	<i>ASUSE Rank</i>	<i>Avg. Rank</i>	State/UT	<i>ASI Rank</i>	<i>ASUSE Rank</i>	<i>Avg. Rank</i>	State/UT	<i>ASI Rank</i>	<i>ASUSE Rank</i>	<i>Avg. Rank</i>
Lakshadweep	25	22	23.5	Puducherry	17	7	12	Sikkim	32	35	33.5
Andaman & N. Island	25	22	23.5	Andaman & N. Island	17	7	12	Ladakh	33	34	33.5
Ladakh	25	22	23.5	Ladakh	17	7	12	Lakshadweep	33	36	34.5

Sources: 1. Ministry of Statistics and Program Implementation (MOSPI), Govt. of India. 2024. Annual Survey of Industries 2021-22. DDI-IND-NSO-ASI-2021-22. <https://microdata.gov.in/nada43/index.php/catalog/188>.

2. MoSPI. 2024. Annual Survey of Unincorporated Sector Enterprises (ASUSE) of 2021-2022. DDI-IND-MOSPI-NSSO-ASUSE2122.

<https://microdata.gov.in/nada43/index.php/catalog/196>.

Note: Units in ASUSE refers to number of establishments. ASUSE includes surveys on medium and small industrial establishments and own-account enterprises not covered by ASI.

Table 7.4: Rankings based on share of labour force and geographical clusters

<i>Manufacture of motor vehicles</i>			<i>Manufacture of parts and accessories for motor vehicles</i>			<i>Maintenance and repair of motor vehicles</i>		
<i>State/UT</i>	<i>Ranking based on Geographical Clusters</i>	<i>Ranking based on Shares of Labour Force</i>	<i>State/UT</i>	<i>Ranking based on Geographical Clusters</i>	<i>Ranking based on Shares of Labour Force</i>	<i>State/UT</i>	<i>Ranking based on Geographical Clusters</i>	<i>Ranking based on Shares of Labour Force</i>
Maharashtra	1	1	Maharashtra	1	3	Maharashtra	1	1
Haryana	2	8	Tamil Nadu	1	1	Tamil Nadu	1	2
Karnataka	2	3	Uttar Pradesh	3	5	Uttar Pradesh	3	3
Tamil Nadu	4	2	Haryana	4	2	Kerala	4	5
Gujarat	5	6	Gujarat	5	4	Gujarat	5	4
West Bengal	5	11	Karnataka	6	6	Karnataka	5	5
Uttar Pradesh	7	10	Punjab	7	8	Rajasthan	7	7
Madhya Pradesh	8	5	Rajasthan	8	7	Andhra Pradesh	8	8
Jharkhand	9	12	Jharkhand	9	9	Telangana	8	11
Rajasthan	10	4	Kerala	10	18	Madhya Pradesh	10	10
Punjab	11	13	Delhi	11	11	Punjab	11	12
Telangana	11	14	Madhya Pradesh	11	13	West Bengal	11	9
Uttarakhand	11	6	Uttarakhand	11	12	Jharkhand	13	16
Andhra Pradesh	14	8	West Bengal	14	10	Haryana	14	13
Kerala	15	15	Odisha	15	16	Delhi	15	18
Odisha	15	16	Andhra Pradesh	16	16	Odisha	16	15
			Jammu & Kashmir	17	22	Bihar	17	14
			Himachal Pradesh	18	15	Chhattisgarh	18	17
			Assam	19	24	Assam	19	18
			Bihar	19	19	Chandigarh	19	22
			Chandigarh	19	20	Uttarakhand	21	20
			Puducherry	19	14	Himachal Pradesh	22	22
			Telangana	23	22	Goa	23	24
			Chhattisgarh	24	21	Jammu & Kashmir	24	20

<i>Manufacture of motor vehicles</i>			<i>Manufacture of parts and accessories for motor vehicles</i>			<i>Maintenance and repair of motor vehicles</i>		
<i>State/UT</i>	<i>Ranking based on Geographical Clusters</i>	<i>Ranking based on Shares of Labour Force</i>	<i>State/UT</i>	<i>Ranking based on Geographical Clusters</i>	<i>Ranking based on Shares of Labour Force</i>	<i>State/UT</i>	<i>Ranking based on Geographical Clusters</i>	<i>Ranking based on Shares of Labour Force</i>
			D & N. Haveli & Daman & Diu	25	24	Tripura	25	26
			Goa	26	27	Manipur	26	27
			Meghalaya	27	24	Meghalaya	26	25
						Puducherry	26	29
						Nagaland	29	28
						Mizoram	30	31
						Arunachal Pradesh	31	30
						Andaman & N. Island	32	32
						D & N. Haveli & Daman & Diu	33	33
Correlation		0.7			0.9			0.99

Sources: NCAER computations based on Table 7.1 and Table 7.3.

Note: Lower rankings means higher concentration of labour force or manufacturing units.

7.5 Occupational Maps

The National Classification of Occupations (NCO) are occupations in which workers are employed within the automotive manufacturing and repair and maintenance sectors, according to the periodic labour force survey (PLFS) data. NCAER has mapped and supplemented these occupations with the job roles from Automotive Skills Development Council (ASDC) for a complete occupational mapping of the sector (Annexure 7.1).¹² The latter has been useful for incorporation of new job roles which have emerged over the years, since NCO occupations (2015) are dated.

7.6 Stakeholders' Survey

The scope of the auto sector included manufacture of passenger and commercial vehicles, manufacture of automotive components, and repair and maintenance of motor vehicles. To assess skill shortages in the sector, a variety of stakeholders were contacted, including the sector skill council, industry associations, skilling institutions, automotive firms, and experts and other stakeholders.¹³ This section provides the methodology adopted to assess skill shortage in the sector, determine specific job roles in which firms are faced with a shortage at present and are likely to face a shortage in next three years, and the reasons thereof. Based on the findings, suggestions to carry forward the exercise have been provided.

7.6.1 Sampling

Data on the number of automotive factories and service workshop across States, both formal and informal from the Annual Survey of Industries (ASI) and Annual Survey of Unincorporated Sector Enterprises (ASUSE) respectively, helped identify the automotive clusters, i.e., States where there are a large number of automotive units, and where there are fewer. Given that the present stage of the study only involved reaching out to a small sample of firms, it was considered useful to have a spatial spread of units in the choice of firms (a firm can have several automotive units)– to capture any regional variation in skill shortage. In the case of the auto sector, it was attempted to interview firms with factories and workshops across Maharashtra, Tamil Nadu, Gujarat, Delhi-NCR, Uttarakhand and West Bengal. Within these States, automotive clusters are known to be in the belts in and around Pune, Chennai, Sanand-Hansalpur-Vithalpur, Delhi-Gurgaon-Manesar, Pantnagar-Haridwar and Kolkata. To understand if skill shortage varied by firm size, it was also attempted that firms operating across the selected regions are of different sizes.

To achieve an ideal sample, it is necessary to have a comprehensive list of all the automotive firms in India, with details of their size, where their plants and workshops are located, as well as a guarantee that personnel at the chosen firms are willing to meet to discuss the issue of skill shortages. Amidst a glaring lack of such data, NCAER

¹² The exercise has been proof-read by ASDC staff, and is aligned with their NCO code mapping.

¹³ In line with the study's agenda, interviews involve meetings with 25 stakeholders, including the sector skill council (1 no.), industry association (1 no.), training centres (2 no.s), firms (20 no.s), and a recruitment agency. Depending on the scope of the sector and stakeholder availability, these numbers have varied in practice. For instance, instead of one industry association, NCAER has met with 3 industry associations, to cover all three aspects of motor vehicle manufacturing, auto component manufacturing, and repair and maintenance workshops. Meeting industry experts, belonging to different firms, has also been insightful to understand the issues of skill shortages. As of 8 Nov. 2024, NCAER has met with sector skill council (1), industry associations (3), training centres (2), firms and industry experts (20), recruitment agency (1) – taking the total stakeholder meetings to 27.

tried to seek help from the stakeholders (in particular the sector skill council and the industry associations), and also tried to reach out to any known prior contacts.

A total of 55 firms were contacted over email and telephone, of which personnel from only 13 firms have met to discuss skill shortages, resulting in a response rate of 24 per cent. Response rate tends to be low in business surveys, despite reaching out to multiple personnel within the same firm. Yet, NCAER has been successful in ascertaining a spatial spread in firms' plant locations, as well as in conducting interviews with firms of different sizes. In addition to the firms who have provided their insights to the questionnaire, expert consultations with personnel from some other firms and industry members have also been useful in supplementing the findings (Table 7.5).

Table 7.5: Stakeholder consultations

Stakeholders (No.)		Location of Firms (No.)		Ownership Type (No. of Firms)		Designation of Interviewees (No. of Interviewees *)	
Ministry	No response	Delhi	2	Public Sector	0	Proprietor	2
Sector Skill Council	1	Gujarat	1	Public Limited	4	Human Resource/ Learning & Development Managers/ Director (Training)	8
National-level Industry Association	3	Haryana	3	Private Limited	2	Managing Director/ CEO	1
No. of Firms	Micro/ Small	Maharashtra	3	Individual Ownership/Partnership	4	Senior Managerial Positions-Operations	4
	Medium	Rajasthan	1	MNC	3		
	Large	Tamil Nadu	1	Limited Liability Partnership	0		
	Total	Telangana	1	Cooperatives	0		
No. of Placement Cells/TVET Institutions	2	West Bengal	1	Others	0		
Recruitment Agencies	1						
Other Stakeholders	7						
Firms plus Other Stakeholders	20						
Total	27						

Source: NCAER Survey

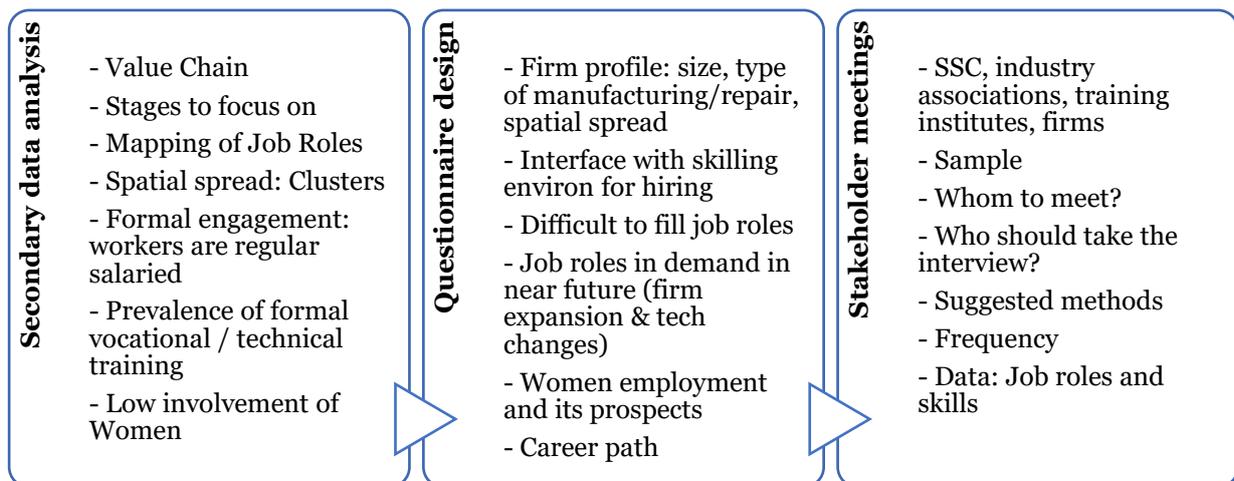
Note: * NCAER team attempted to speak with multiple personnel at the firms.

7.6.2 Methodology of Assessing Skill Shortages

The NCAER recommends to approach the assessment of skill shortages from the lens of 'data triangulation'—by utilising different sources of data (secondary and primary), accessing multiple personnel at firms to speak with, and collating data through a team of investigators.

In the methodology adopted and tested by NCAER, NCAER undertook detailed secondary analysis to understand the sector, developed the key instrument for data collection (i.e. the questionnaire), and undertook stakeholder meetings to gather detailed insights on the sector and test the questionnaire and methodology of data collection on skill shortages. This process is summarised in Figure 7.9.

Figure 7.9: Methodology



Source: NCAER's conceptualisation.

7.6.3 How to Assess Skill Gaps?

A firm is faced with a skill shortage when they find difficulty in, or are unable to fill an advertised job role. To get the stakeholders familiar with the various job roles, NCAER put together a list of occupations where personnel in the sector are employed (from the PLFS data) and mapped it onto the different job roles for which qualification packs have been designed by the sector skill council.

To collate specific job roles in which there is a skill shortage, questionnaires were structured to profile the firm on its size (small/medium/large), type of manufacturing/repair, spatial spread of plants/workshops, and the interface with the skilling environment for hiring purposes. They were designed particularly to help the respondents think through:

- Given the firm profile, what are the different job roles at the company
- For which job roles has there been a difficulty in finding the 'right' candidates
- For such 'difficult to fill job roles', what are the qualifications and skills that the company is looking out for in the 'right' candidate
- In near future, given the firm-level/technological changes, which job roles (and corresponding skills) will be required at the company, and how easy or difficult would it possibly be to find the appropriately skilled people
- Also, if difficulty in finding the appropriate skill sets are across India, or only in particular States/geographic regions
- Women employment at the firm—overall, specific job roles where there are more / no women, and prospects of increasing women employment in particular job roles
- Availability of factors supporting employee retention and gender diversity at workplace—career path, creche facility, policies to hire female employees, and policy and procedures for prevention of sexual harassment at workplace (POSH).

The questionnaire is an important instrument facilitating the collation of detailed information on job roles, and it has worked well on-field. Three questionnaires and

supporting documents have been designed for firms involved in manufacturing of motor vehicles, manufacture of auto components, and workshops in repair and maintenance of motor vehicles. The firms' questionnaires are attached at the end of the report (Questionnaires 5, 6, and 7).

- Based on the job roles identified during stakeholder meetings, the occupational map has been updated to segregate the job roles, where: i) workers are employed according to PLFS (at NCO-3 digit), ii) those which do not show workers employed in PLFS but the NCOs are aligned with a qualification pack of Automotive Skill Development Council (ASDC), and iii) those which neither show PLFS worker data nor are aligned with any ASDC qualification pack (QP). This has been useful to highlight the job roles which do not get captured in the PLFS survey, but are in-demand in the sector – with the skill council running training programs for some of these.¹⁴
- Salary is an important component as came up during the stakeholder meetings, and appears to be a key deciding factor whether an individual takes up a job in the automotive sector. Therefore, it is recommended to collect information on the 'salary offered' by the firm for the respective in-demand job roles, within the supporting document of the questionnaire.

7.6.4 Who to Talk to?

The first task is to find the right person to speak with at the firm. A firm is a black box, where individual contact details are difficult to find.¹⁵

Tasks related to preparing job descriptions, advertising job roles and facilitating interviews and onboarding, fall under the purview of the firms' human resource (HR) departments. Given the present aim to find details of 'difficult to fill' job roles, it is quite natural to consider the HR personnel as the key points of contact. However, the HR personnel are usually at the corporate/head office and responding to the demands of the operation managers, learning and development divisions, and senior directors while advertising job roles. While the HR may be able to check the data concerning number of jobs advertised and those which took longer or were not filled, further details on the skills of the applicants and how well they meet/do not meet the requirement of the company can be better gauged by the individuals overseeing the manufacturing / servicing operations and on-the-job training (OJT). Also, in large firms, the HR personnel are a group of people, managing different departments, and therefore one person is unlikely to have all the information. In addition, before sharing any information with an outside party, consent from the corporate bosses is likely to be needed.

¹⁴ The list of job roles where there are workers accounted for in PLFS, and the qualification packs (QPs) developed by the sector skill council appear to be comprehensive, with the latter advancing towards recognizing design and new technology as well. Yet, there are nuances. For instance, job roles which are gaining importance amidst the increasing use of software in cars but found to be missing among the PLFS NCOs and ASDC QPs, are Embedded Software Engineer and Vehicle Software Developer. These have been added to the occupational mapping.

¹⁵ As noted earlier, NCAER requested the sector skill council for contacts at firms located within the chosen clusters. While they did share the names and contact numbers of several firms, covering all selected regions, many contacts turned out to be of personnel at junior levels (storage department, technician, spare part manager, manufacturing operator, ex-apprentice, and ex-supervisor), who said they cannot talk about skill shortages.

In NCAER's experience of talking to senior HR personnel, from firms with several plants around India, the respondent was able to talk about their specific department (e.g., plastic processing and painting department) at their base plant location only. HR personnel at the group level, overseeing multiple departments, were able to provide a relatively bigger picture.

It may be noted that instead of bypassing the HR, the above pointers highlight the need to keep the individuals in the position of CEOs, Manager—Plant and Operations, individuals heading the R&D Divisions and Global Capability Centres,¹⁶ and those heading the learning and skill development divisions, among the key points of contact. Reaching out to these sets of personnel at the firm should be ideal to get a full understanding of skill shortages, at every level, department, and plant location of the firm.

At the OEMs, upon sharing the study agenda with the available contact, NCAER was directed to reach out to personnel heading the training and skill development divisions who were able to provide details on the skill gaps they were attempting to bridge and the difficulty in finding industry-ready personnel. They were also able to share details about the firms' interface with the skilling ecosystem, such as tie-ups with ITI and colleges for imparting skills, providing internships / apprenticeships, and deployment procedures. It is important to note that OEMs are large firms, where the skill development division looking after the needs of manufacturing will tend to be different from that looking after the skill needs of workshops and dealerships. To capture skill shortages on each side, personnel from each of these divisions—manufacturing and repair and maintenance—would need to be met.

Apart from the training and skill development divisions, the plant / workshop managers, who look after all the operations, were also able to share details about the jobs they are unable to find people for, and the full set of skills they look out for.

Therefore, if the task is to carry out a large-scale survey of all automotive firms, the following steps may be followed:

- **Organise an awareness creation workshop/webinar**
 - At the outset, an awareness creation workshop or webinar must be organised, in partnership with the national and regional / State level industry associations, with invitations going to the Chief Executive Officer (CEOs) and all senior personnel at the corporate office of the firms.
 - Once all senior members of the corporate office have been explained the agenda and they find the usefulness of the labour market information system, they should be able to help connect with the HR heads, R&D divisions, plant / workshop managers, and learning and skill development personnel at all of the firms' plant locations. After all, the firms' organisational chart is known best by those at the top.

¹⁶ Several stakeholders have highlighted how the automotive industry in India is upgrading to higher value-added segments, such as those of design and R&D, and there are skill requirements there too. The present exercise's focus on manufacturing and repair and maintenance segments of the value chain has rendered design and R&D outside of scope. While it was attempted to include aspects of design and R&D in the questionnaire, along with manufacturing and servicing aspects, the respondents primarily focused on the core manufacturing and servicing job roles. It is likely that meeting CEOs and heads of design and R&D divisions at firms would be useful for insights on the in-demand design and R&D job roles and the skill shortages thereof.

- **Compile a database of firm-level contacts, which should be periodically updated (Ideally the universe of firms should be sourced from Ministry of Corporate Affairs/Goods & Services Tax Network/Economic Census)**
 - A comprehensive database should be created from the above exercise, which should also be updated on at least a semi-annual basis if the aim is to have a dynamic labour market information system, since:
 - Firms may be opening new plants, workshops, R&D divisions, or even closing some
 - Individuals may be shifting between companies, and those who are the key points of contact at one point in time, may have shifted to another company when the survey is repeated.
- **Frequency of conducting the survey**
 - While the exercise is extensive, data on skill shortages should be collated from the firms on an annual basis—due to the dynamic nature of the industry and constant changes in technologies.

7.6.5 Who Should Take the Interview?

Given the novel nature of this exercise, it is important that the interviews are conducted in-person—either online or offline. On average, each interview takes about one hour, and hence the respondents should be requested to spare at least an hour to ensure completeness of information.

Taking the interviews requires a team of interviewers who should be talking to the firms' key points of contact (discussed in the previous section), to gather holistic data on skill shortages.

Considering the seriousness of this exercise and the benefit it promises, even the individuals communicating with the key points of contact (i.e. the respondents)—either through written or verbal means—should be 'skilled interviewers', with the following traits:

- *Clarity of thought*: The interviewer should be able to impart the importance and essence of the exercise to the respondents in a clear and concise manner, and have a keen understanding of all components of the questionnaire to be able to explain it well to the respondents.
- *Focused, polite and persistent*: It must be remembered that the senior personnel being contacted for the survey are busy, and a single email or tele-call cannot guarantee an interview. One has to remain focused on the task and be polite and persistent with regular follow-ups. Of course, if one proceeds with gathering contact details using the steps mentioned in the previous section (i.e., via the Corporate HQ), the chances of easily getting an interview, without much persistence, are higher.
- *Organised, detail-oriented, and honest*: They should be able to keep a log of all data—who was contacted, when were they contacted, and what were the responses, to be able to undertake follow-ups and organise meetings in a professional manner. The task would also be useful in helping with constant updation of the firm level data and key points of contact. All of this should be done with full transparency and honesty, if the real benefit of the exercise has to be achieved. That is, the interviewers should neither fudge data, nor talk to just about 'anybody' and claim they have collated accurate data. Just fulfilling hollow 'numbers' (i.e. 'this' many firms and respondents were contacted),

instead of striving for good quality information, will lead to a failure of this extensive exercise.¹⁷

- *Confident, curious, transparent*: The interviewer should be able to engage in a discussion with confidence, keep the discussion on track, and ask questions as necessary to ensure completeness of information. It is also a good idea if the interviewer is transparent with sharing the questionnaire with the respondent, and noting the answers in consultation with respondents as it helps enhance trust and in turn allows the respondent to be confident in sharing data. It also helps ensure data accuracy and replicability of the method by overcoming the bias / inaccuracy that may arise in translating respondents' answers to the skills framework in the questionnaire. In an online meeting, screen-sharing while filling answers is a good idea, which has also worked well in practice.
- *Advanced communication skills and knowledge of language*: To confidently deliver on each of the above, the interviewer needs to have advanced communication skills, with a superior knowledge of grammar and sentence structure to be able to communicate with respect and clarity in written (e.g., emails, filling questionnaire) and verbal (e.g., tele-calls, in-person meetings) formats. In a diverse country like ours, in addition to knowledge of English and Hindi, having interviewers who are conversant (or even proficient) in the local language will be extremely useful in helping the respondents be at ease in sharing the requisite details.
- *Teamwork and cultural sensitivity*: Considering that firms in the sector are spread across the country, with plants and workshops in diverse geographies, it would be useful to have a team of interviewers, who can take on conducting interviews for the same sector, while focusing on different geographies depending on their knowledge of language and culture. Given the vastness of India, and the automotive sector, a culturally diverse team will make the task at hand more efficient in terms of time and cost, and effective in assimilating the requisite information.
- *Computer skills*: Along with a knowledge of MS Office and email communication, the interviewers should also be skilled at conducting online interviews through software such as Zoom, MS Teams, Webex, etc. Online interviews tend to be more convenient and time and cost effective, from the side of the respondents and interviewers, and the screen-sharing feature helps maintain transparency—in what is being asked of the respondent, and the answers being noted by the interviewer.
- *Ability to reflect towards the bigger picture*: Firms are profit oriented, and in many instances, it is likely that the respondent will ask: “what benefit do I get?”, “will you train those people for me?”, “what if you take information from me on what the industry needs, but the skilled people join another firm?”. The interviewers should be ready for such questions, and be able to explain how the contribution of each firm helps build an information system to benefit the industry and each of its players.

¹⁷ Incidentally, among the contacts shared by the sector skill council, several contacts in locations away from Delhi (such as Chennai, Gujarat, and Kolkata) belonged to personnel who had never worked in the auto sector or they did not know of the sector skill council itself. This raises questions on ‘who is conducting the interviews’ and if the on-ground field team have been: i) honest about speaking with personnel from automotive firms, ii) while providing full information on their own role of collating data for the sector skill council.

- *Education and knowledge:* While the above traits are necessary, it is more likely that an advanced degree in economics or a related field, with an interest / work / research experience in the particular sector and the skilling literature, will be helpful. Not only would it allow the interviewer to always have the bigger picture at the back of their mind (as economists are taught how to connect the micro with the macro), but an interest in the sector will be a constant source of curiosity.

7.6.6 Key Findings from the Stakeholders' Survey

This section provides an overview of the findings from interviews with the stakeholders, followed by details on the in-demand job roles.

Skill shortage is an issue in the automotive sector, and is intensified due to the technologically dynamic nature of the sector:

- With India leapfrogging from BS4 to BS6 (and now looking at a transition to BS7) in internal combustion engine technology
- The advent of electric, hybrid, and flex fuel vehicles
- The increasingly integral role of electronics, software, and cybersecurity in motor vehicles
- The adoption of automation, robotics, artificial intelligence (AI) and machine learning (ML) in manufacturing and repair and maintenance
- Advent of new materials and efforts towards light-weighting components

Therefore, while the traditional blue-collar job roles, requiring ITI trained people to work on the shop floor are, and will continue to remain, in-demand (with training updated to new technology, as required), there will also be an increasing demand for new and niche engineering job roles. The point to note is that for each of these sets of job roles, finding people is perceived to be rather 'difficult'. There were found to be several reasons behind this, both from the side of the skilling ecosystem (supply-side) and the industry (demand-side).

Supply side issues:

- According to the PLFS data on employment characteristics, vocational and formal education and training is rather high in demand in the automotive sector, thereby laying emphasis on the curriculums of the ITI and engineering colleges. A key reason for 'difficulty' in filling job roles was that the candidates lack the "skills to do the job". While they may have the theoretical understanding, lack of practical knowledge of working with the latest machines renders them unemployable, and even if employed, unable to actually do the job at hand.
- Performing well on-the-job requires soft-skills as well. These include good communication skills, team-spirit, conscientiousness, self-discipline, emotional stability, psychomotor skills, safety awareness, cultural and gender sensitivity, etc. While these are meant to be a part of the curriculum (especially at ITI), training on these parameters is said to be missing.
- Some firms' requirements are very specific, which are not imparted at any ITI. One such is that for the automotive wiring harness, where it was learnt that there are no courses in India providing any skilling with respect to the job roles concerning the manufacture of wiring harness.
- Firms usually look out for a locally available workforce, especially since people prefer to work closer to home and in familiar environments (culture, language, food, weather). This means that a locally trained workforce must be available,

which in many instances may not be enough to fulfil the firms' requirements—be it at manufacturing plants or repair and maintenance workshops. Uttarakhand came out as a classic case, where stakeholder firms with plants in Pantnagar pointed at not being able to fill vacancies due to lack of a young, locally trained workforce in blue-collar automotive trades. Another stakeholder stated the issues of not finding enough blue-collar workers from automotive ITI trades in Gujarat.

- Engineering colleges have not kept up pace with the changing technologies and demands of new job roles in the automotive sector, be it in design, EV batteries, software, or cybersecurity.
 - The training institutes and the sector skill council particularly highlighted advanced job roles in electric vehicles, battery technology, software, and cybersecurity, which were attempted to be captured through meetings with some stakeholders dealing with new technologies. The training ecosystem is trying to meet the demand for these job roles by offering short-term top-up courses to the standard ITI and engineering training—which in their view is in line with industry requirements. How far the skilling ecosystem has been able to match up to the demand of the industry in such advanced job roles can only be ascertained from firm-level interviews with senior personnel at the corporate office and those at the R&D divisions. Though, according to a few stakeholders: i) availability of other well-paying avenues (particularly in IT sector) for software and data science personnel, ii) lack of well-trained engineers (particularly in specialised fields, e.g., mechatronics), and iii) absence of courses for battery technologies have resulted in a shortage of skilled personnel to fill such job roles in the auto sector.
- Questions have also arisen on 'who is training' and the need to bring in personnel from the industry to impart practical and socio-emotional knowledge at both ITI and engineering colleges, and provide the necessary guidance, counselling, and mentoring to students—which can help them be placed in jobs that align with their interest and ambitions. The sector skill council admitted that while several new courses / qualification packs (QPs) have been formulated on automation and robotics, talks are still on with engineering colleges to start these, since there are no trainers at present. In addition, some certification courses introduced at engineering colleges, on EV technology and design, are all 'online'—and there is no data with regard to student placements.¹⁸

The poor education and skilling environment have rendered it necessary for automotive firms to provide on-the-job practical and soft-skill training to all freshers, which in their view, should already have been imparted through the education and skilling system. All engineering and diploma graduates, too, are commonly employed as Graduate Engineer Trainees and Diploma Engineer Trainees. Along with being an added cost to the firm, it is a factor that increases their manufacturing lead times as well.

Some firms have tie-ups with ITI, where they offer inputs to curriculum by offering practical training and insights, and set up labs with latest machines and bring in

¹⁸ This is especially since one of the stakeholders highlighted that the training institutes did not have idea of where the students were being placed, if automotive industry was the employer, and whether they were being placed at all. Rather, the prime focus was the financial considerations and how the money from the fees was divided between the marketing organisation (which mobilized students) and the college that ran the courses and gave certification.

industry trainers. This is for training workers across the automotive value chain—manufacturing, sales, and repair and maintenance—from where the candidates may potentially be hired by the firm engaged in training, or even by other firms in the industry. While this has helped build an industry-ready pool of workers, the numbers trained are nowhere enough to fulfil the industry’s demand.

Given the disconnect with industry, and the need for ITI/diploma/engineering graduates to be trained again at the firm, smaller firms (particularly the independent service workshops and component manufacturers) resort to hiring unskilled workers who can be moulded and trained to the firms’ requirements, even multi-skilled (for instance the same individual performing the role of AC technician and electrician)—at a lower salary, and thereby also helping the firm save on cost.

Despite the firms’ efforts to skill their workforce (and any parallel improvements in the skilling ecosystem itself), it must be noted that the automotive industry is likely to still face a shortage due to certain issues arising from the side of the industry (demand-side):

Box 7.1: Which job is more attractive?

As highlighted in this section, automotive job roles are not-aspirational, particularly with the availability of alternative work avenues. Stakeholders in automotive manufacturing, be they in the national capital territory region or in Gujarat, have pointed out that youth may prefer to take up the job of a delivery worker in a city, rather than that of a motor mechanic at an automotive plant in the suburbs. A comparison of recent job offerings in Delhi-NCR and Gujarat, from well-known leading companies in the two sectors, indicates why the auto sector is potentially facing a shortage of its much-needed workforce.

Comparator	Motor Vehicle Mechanic (Gurgaon) / Technician (Hansalpur)	Food Delivery Worker (Delhi) / Delivery Boy (Surat)
Education required	10 th pass + ITI	All education levels acceptable (at least 10 th pass)
Skills required	Knowledge of ITI Trades - Fitter, Welder, Painter (General), Electrician, Turner, Diesel Mechanic, Machinist, Tool & Die, Motor Mechanic Vehicle, Tractor Mechanic, Electronic, plastic processing operator	<ul style="list-style-type: none"> Deliver packages from one place to another safely and on time Collect payments where needed Good communication with customers (English and local language)
Entry conditions	<ul style="list-style-type: none"> Min. 40% marks in class 10th and 50% marks in ITI Year of passing ITI: 2017, 2018, 2019, 2020, 2021, 2022 & 2023 18-26 years (on the day of joining) Interview in Gurgaon / Ahmedabad Documents required: Resume, 10th Marksheet, ITI Marksheet & Certificate, Aadhar Card, Pan Card, Passport Size Photo 	<ul style="list-style-type: none"> Interview in Delhi / Surat Vehicle, driving license, Smartphone, PAN Card, Aadhaar Card
Work experience	Freshers	Freshers (0 - 6 months)
Type of contract	Contractual / Fixed term (Duration: as per company requirement)	Pay structure based on delivery performance
Benefits	Uniform, shoes, subsidised meals, subsidised dormitory accommodation, leaves (as per company policy)	<ul style="list-style-type: none"> Day shift (full-time), insurance, medical benefits (Delhi); Day shift (full-time or part time), performance-based incentives and additional benefits (Surat)
Place of work	Gurgaon (Delhi-NCR) / Hansalpur (Gujarat)	Delhi / Surat (Gujarat)
Gender	Only males (Hansalpur)	Male and females (Delhi and Surat)
No. of vacancies	50 (Gurgaon)	30 (Delhi) / 50 (Surat)
Salary per month	Rs. 15,001 to Rs.25,000 (Gurgaon)/ 21,500 CTC (Hansalpur)	Rs. 30,000-Rs. 40,000 (Delhi) / Rs. 35,000 – Rs. 40,000 (Surat)

Source: NCAER Analysis, using information from advertised positions on online job-portals.

Note: The Motor Vehicle Mechanic / Technician details are taken from two Maruti Suzuki advertisements for their Delhi-NCR and Hansalpur plants, available at: <https://www.shramin.com/job/workmen-marutisuzukiindialimited-manesar-007461f7-3a8c-4f15-9e78-8599cf816574>; <https://www.justjob.co.in/6734/fix-term-contract>

The Food Delivery worker / Delivery Boy details are taken from two Zomato advertisements, for work in Delhi and Surat, available at: <https://www.jobhai.com/delivery-food-delivery-job-in-zomato-ashok-vihar-south-delhi-delhi-o-to-o-years-1726223091-4608934-jid>; <https://www.vihu.com/in/en/job/P-106016/Delivery-Boy-Jobs-in-Zomato-Surat-Gujarat-India>

- The automotive job roles, particularly the blue-collar job roles, are non-aspirational. The work environment is perceived to be physically taxing and dirty, and connected with employing primarily a male workforce.
- Even if people may be trained in a relevant automotive trade at the ITI or engineering colleges, they may not necessarily join the automotive sector, especially if there are alternative avenues available at the same or higher salary. For blue-collar workers, working as a delivery worker in the hometown may be more lucrative (see Box 7.1), and for advanced engineering graduates, joining the IT sector may be more lucrative. Once people join the auto firm, they may quickly leave resulting in high attrition rates.
- That the automotive sector offers a career path, where an entry-level technician can rise up to managerial level positions and firms themselves offer support for reskilling and upskilling, is a facet which needs to be promoted and imparted to potential candidates at ITI and engineering colleges.

- Any question concerning female employees, particularly in non-traditional job roles, raises eyebrows—with the perception that women cannot perform manufacturing-related jobs. At a time when machines are involved with lifting/loading /unloading, policies pertaining to prevention of sexual harassment (POSH) becoming a norm, and at a time when it is anyway difficult to find male candidates for the job—this perception needs to change. There are success stories of all-female automotive assembly lines functioning efficiently, which indicate the benefits that can be garnered from a simple change of perception and enacting policies and facilities (e.g., toilets and crèche) to support a female workforce. A stakeholder mentioned how advent of EVs is helping change the perception and paving the way for more involvement of women on the EV assembly line. The potential for employment of women in the auto sector is provided in Box 7.2.
- As highlighted by a stakeholder, the attitude of the staff which hires for the industry matters in attracting and retaining potential employees. If the human resource personnel and supervisory staff are not sensitive to the questions and concerns of the potential and present employees, a skill shortage at the firm is likely.

Box 7.2: Prospect for women employment in the auto sector

As found from secondary data and primary assessment, there are few women in the automotive industry. The number is minuscule among blue-collar workers on the shop floor (although it varies between firms), and women are mostly in the administrative and customer support positions.

Several firms have expressed their willingness to have gender diversity in the core manufacturing roles, but most are unable to fulfil the same due to:

- Lack of women at ITI which offer training in automotive manufacturing trades. It is also highlighted that ITI need hostels to ensure safety for all students, particularly women commuting over long distances.
- Lack of women applicants for core automotive roles (as women themselves are hesitant to take up automotive job roles due to social norms)
- Pre-conception among shop-floor workers / managers about women being unable to perform physically taxing tasks.

Stakeholders highlighted the importance of firm level policies in attracting more women. Examples include the successfully operating all-women assembly lines at Kirloskar Brothers and Ola Electric. Rather, it was pointed out by a stakeholder that the experience of Ola Electric is encouraging other EV manufacturers to also hire more women in the core manufacturing and assembly job roles. This shift in technology to EVs could possibly help increase the number of female employees in the automotive sector.

While the perceptions may take time to change, a positive finding has been the emphasis placed by several firms in enacting POSH policies and committees, and providing crèche facilities on office/plant premises. It is also being perceived that prospects of increasing women employment are higher in:

- White-collar roles, particularly in finance and human resources, and R&D
- Computer/keyboard operators and customer support executives
- Core manufacturing job roles, such as plastic moulding, parts assembly, machine operators, packing labourers, and other blue-collar job roles (where machines are involved, and physical workload is less).

Source: NCAER Stakeholders' Survey.

It is important for the automotive industry to take serious note of the above. If the industry requires people for its growth, it is important that they create the right conditions to attract the skilled workforce—be it by i) offering a competitive salary, ii) mentorship and counselling to set expectations, better skill matching, and inform trainees of a career path and growth within the firm, iii) generating awareness of a physically non-strenuous work environment to attract male and female candidates, and/or iv) creating an environment of inclusivity, respect, and consent.

The existence of skill shortage in the automotive sector is not new. A study undertaken in 2019¹⁹ by the Automotive Skill Development Council (ASDC) and in 2024²⁰ by the industry association Society of Indian Automobile Manufacturers (SIAM) have highlighted the job roles which are endangered, which require re-skilling and up-skilling and those which will be entirely new. The expected number of jobs which will be created by the industry in future is also estimated. However, persistence of skill shortage requires digging deeper into the reasons, as came out during NCAER's stakeholder meetings. A stakeholder from the skill council, when asked how their 2019 predictions have performed thus far, was frank to note that the qualitative findings on the expected job roles had performed well, while the quantitative estimations on the number of jobs did not. There was also an emphasis laid on conducting surveys more frequently, to regularly tweak the skilling programs and number of people required in line with the industry needs.

Job Roles in-Demand

Having had detailed discussions with the firms, training institutes, and sector skill council, several job roles came into view, where:

- There is a skill shortage at present (i.e., there are not enough people, but the skills are high in demand by industry).
- There is likely to be a skill shortage in near future, three years from now (i.e., which will be in demand in future, but finding skilled personnel for the same may be difficult too).

Although the study's aim has been to develop a methodology and results from a small sample of firms cannot determine all possible job roles in shortage, yet there was an overlap between the views of the different stakeholders. Job roles mentioned by the stakeholders are detailed in Table 7.6.

Incidentally, all job roles in shortage at present are also perceived to remain in shortage in near future. This is because of the issues on the 'supply side' of the skilling ecosystem and the lack of aspiration on part of candidates to join the auto industry. It reflects the quality of training and mentoring at ITI and engineering colleges, which is not up to the mark to meet the firms' requirements.

All stakeholders agreed that along with technical training, soft-skills are equally important and are in-demand for the stated job roles. Interviews with stakeholders have been successful at collating details on job descriptors, including the different cognitive, socio-emotional and technical and vocational skills needed for the job role, at different levels of proficiency. Considering that cognitive and socio-emotional skills start developing at the school level, the importance of good quality school education has also been reiterated in stakeholder meetings.

Along with a list of qualifications and skills, the questionnaire has also helped capture the number of personnel required by firms in the stated job roles—both at present and in near future to help anticipate demand, along with the geographic

¹⁹ ASDC and EY 2019. Human Resource and Skill Requirements in the Automotive Sector (2026). Available at: <https://www.asdc.org.in/uploads/reports/1097810937280524030736.pdf>; accessed on 1 April 2024.

²⁰ SIAM and Deloitte 2024. EV Talent Landscape in India: Bridging the Skill Gap for 2030. SIAM. The report has received wide media coverage: https://www.business-standard.com/industry/auto/auto-industry-needs-200k-skilled-people-by-2030-to-meet-30-ev-target-124071600619_1.html; accessed on 16 July 2024.

regions where the skilled personnel are required. Though it must be highlighted that these numbers are only indicative. It is rather difficult for the companies themselves to make projections on the ‘numbers’, considering that auto companies will be going for automation where use of automated systems and robotics will decrease the need for people / lesser people will be needed (i.e., a lot of manual roles will get automated), and additionally there will be a convergence in job roles (i.e., job roles will also be fewer).

Additionally, any attempt to project the number of jobs required in the sector in the future using the existing PLFS database (as performed using the input-out analysis) is likely to be misleading (Chapter 3). There are several job roles in-demand now and in the near future, but there are no individuals employed in their corresponding NCOs according to the PLFS database. It implies that while people may be working in those job roles now and increasingly in near future, any labour demand projections using PLFS will exclude such workers. This includes job roles relating to data science, cybersecurity, and automotive software—which emerged among the in-demand job roles by the interviewed firms, and the sector skill council (ASDC) has even developed some qualification packs (QPs) for training personnel in these in-demand roles (see Table 7.6).

Therefore, an annual national survey of automotive firms is recommended to ascertain the demand for job roles and associated skills in times to time, while working alongside to improve the skilling ecosystem and industry-academia collaborations in line with the sector’s evolution.

The top 5 job roles are shown in Table 7.6. It may be noted that there were certain other job roles which also came up in stakeholders’ meetings—that are in-demand but difficult to find people for. However, they are covered under NCOs other than those in the Table 7.6 and were mentioned by a single firm / stakeholder. All the job roles and their brief descriptions are given below:

1. Machine/Computer Numerical Control (CNC) operator; Turner; Grinder; Tool and die maker (Table 7.6)
 - The tasks a CNC Operator is expected to perform include;²¹
 - Maintaining and operating the CNC machine
 - Monitoring gauges and dials
 - Programming and setting CNC machinery
 - A turner works Turner; Lathe Operator makes metal articles to required specifications using lathe and cutting tools. Studies drawings and other specifications of parts to be made.²²
 - Grinder, Tool and Cutter grinds machine tools and cutter to correct specifications by special grinding machines and wheel. Studies drawings and other specifications to understand nature of grinding operation required.²³

²¹ National Career Service website. <https://www.ncs.gov.in/content-repository/Pages/ViewNcoDetails.aspx?List=8db9be14%2D2b47%2D4f30%2D97fb%2D5de315d871c0&ID=3496&ContentTypeId=ox01003FEA8C7117A78D4F93DC52780D878B2F0015F91119E23A874E9006BoFo68F1089C>

²² National Career Services. 2016. National Classification of Occupations 2015. https://www.ncs.gov.in/Documents/National%20Classification%20of%20Occupations%20_Vol%20I-%202015.pdf. Directorate General of Employment, Ministry of Labour and Employment, Government of India, New Delhi.

²³ Ibid.

- Tool and Diemaker: Tool and Die Makers build, repair and modify custom made prototypes or special tools, Dies, Moulds, Die casting Moulds and various types of mechanical devices.²⁴
2. Technician / Mechanic; Motor mechanic (Table 7.6): Mechanic, Automobile repairs overhauls and services motor vehicles to keep them in good running condition.²⁵
 3. Power / Microelectronics engineers; AI/ML expert (Table 7.6)
 - Microelectromechanical Systems (MEMS) Engineer: Designing and developing miniature mechanical and electrical devices, such as sensors and actuators, for various applications, including biomedical devices, consumer electronics, and automotive systems.²⁶
 - AI/ML expert: In the automotive sector, AI/ML experts develop and implement machine learning models for various applications, from autonomous driving and predictive maintenance to enhancing the driver experience and optimising manufacturing processes.²⁷
 4. Embedded Software Engineers; Vehicle Software Developer (Table 7.6)
 - The Embedded Software Engineer is also called ‘Embedded Software Developer’, the Embedded Software Engineer is responsible for developing software module for the embedded system. The individual at work assesses the embedded systems’ specification requirement, develops software, tests and validates the software in co-ordination with Design Engineers for system integration.²⁸
 - A vehicle software developer, or automotive software engineer, designs, develops, and tests software for various vehicle systems, encompassing everything from engine control to infotainment and autonomous driving technologies.²⁹
 5. AI Data Science Engineers; Automotive Cybersecurity Specialist (Table 7.6)

²⁴ Directorate General of Training, Ministry of Skill Development and Entrepreneurship, Government of India. 2022. “Tool & Die Maker (Dies and Moulds)”. https://dgt.gov.in/sites/default/files/2023-12/TDM%20%28D_M%29_CTS2.0_NSQF-4.pdf. July.

²⁵ National Career Services. 2016. National Classification of Occupations 2015. https://www.ncs.gov.in/Documents/National%20Classification%20of%20Occupations%20_Vol%20I-%202015.pdf. Directorate General of Employment, Ministry of Labour and Employment, Government of India, New Delhi.

²⁶ Rochester Institute of Technology. [https://www.rit.edu/articles/hot-careers-in-microelectronics#:~:text=Microelectromechanical%20Systems%20\(MEMS\)%20Engineer%3A,consumer%20electronics%2C%20and%20automotive%20systems](https://www.rit.edu/articles/hot-careers-in-microelectronics#:~:text=Microelectromechanical%20Systems%20(MEMS)%20Engineer%3A,consumer%20electronics%2C%20and%20automotive%20systems).

²⁷ Bharadwaj, C. 2025. “How is AI in Automotive Industry Transforming the Future of Business? Benefits and Use Cases”. <https://appinventiv.com/blog/ai-in-automotive-industry/#:~:text=AI%20in%20the%20automotive%20industry%20is%20used%20to%20improve%20vehicle,decisions%20based%20on%20that%20data>. March 21.

²⁸ National Career Services. 2016. National Classification of Occupations 2015. https://www.ncs.gov.in/Documents/National%20Classification%20of%20Occupations%20_Vol%20I-%202015.pdf. Directorate General of Employment, Ministry of Labour and Employment, Government of India, New Delhi.

²⁹ Moontechnolabs website. <https://www.moontechnolabs.com/blog/automotive-software-development/#:~:text=Automotive%20software%20development%20is%20pivotal,to%20enabling%20autonomous%20driving%20capabilities>.

- AI Data Science Engineers: Application of Data science and machine learning to the processes and products with automatic learning and optimisation to be used in the automotive industry of the future.³⁰
 - Automotive Cybersecurity Specialist: Individuals at this job are responsible for the execution of security processes, the detection of threats and security incidents to devices, automation systems, robots and machineries in the IIOT networks and report to appropriate people for investigation and action. He /She also enhance analytics on security & threat data to improve decision making & data accuracy.³¹
6. Customer relationship manager (NCO: 3322.1101 or ASC/Q1104: Automotive Customer Relationship Manager) /customer care executive (NCO: 5242.0301): This occupation requires personnel to handle customer communication, tends to employ some women, and a locally available workforce at auto workshops across the country is preferred. More than any educational qualification, good communication skills are necessary for this role—reading, writing, speaking, listening, communication, language skills (English, local language), along with skills relating to MS office, problem solving, critical thinking, decision making, time management, value of cultural and gender diversity, positive attitude, emotional stability, and physically fit and cheerful to talk to customers on phone and in-person. It is difficult for the firm to find people with good communication skills, and additionally there is the problem of attrition—resulting in skill gap as well as a shortage. The firm requires 300–400 people for this role, and provides specialised on-the-job training for this role. When asked about any formal automotive training programmes for this role, the firm mentioned that no training centre offers training on the sector skill council’s QP for ‘Automotive Customer Relationship Managers’. This is a gap must be noted for taking forward local skilling initiatives.
 7. EV service technician (NCO: 3115.0602 = ASC/Q1429: Electric Vehicle Service Technician); Battery management system engineer (NCO: 8212.0100 ASC/Q8315: Automotive Battery Management System (BMS) Engineer; ASC/Q8314: Automotive Electric Vehicle BSS (Battery Swapping System) Planning Engineer); Autonomous vehicle engineer/ Automotive IIOT Application Engineer (NCO: 2144.0801 = ASC/Q6412: Automotive IIOT Application Engineer): These job roles were mentioned by stakeholders on the training side, and ASDC has developed QPs for training personnel in these roles. EV technician is for auto service workshops, and engineering roles are at the design and R&D stage. More information with regard to their shortage and firms’ skill requirements can be garnered from interviews with the firms which are hiring personnel in such occupations.

³⁰ Hofmann, Martin & Neukart, Florian & Bäck, Thomas. 2017. “Artificial Intelligence and Data Science in the Automotive Industry”. 10.48550/arXiv.1709.01989.

³¹ Automotive Skills Development Council and National Skills Development Corporation. 2024. “Automotive Cyber Security Specialist Quality Pack”. https://www.asdc.org.in/job-roles-2024/Automotive_Cyber_security_Specialist/ASC_Q8313_v1.0.pdf. New Delhi, India.

Table 7.1: Details of in-demand job roles

Job roles	1) Machine/CNC operator; Turner; Grinder; Tool and die maker	2) Technician / mechanic; Motor mechanic	3) Power / Microelectronics engineers; AI/ML expert	4) Embedded software engineers; Vehicle software developer	5) AI Data science engineers; Automotive cybersecurity specialist
NCO 3/8-digit	722- Blacksmiths, Tool Makers and Related Trades Workers	7231.0100: Mechanic, Automobile	215- Electrotechnology Engineers	2512.0501: Embedded Software Engineer	252- Database and Network Professionals ASC/Q8313: Automotive Cybersecurity Specialist
NCO 8-digit (QP code) [@]	ASC/Q3503: Automotive CNC Machining Technician ASC/Q3510: Automotive Conventional Machining Technician (matched to Turner) ASC/Q4101: Automotive Tool Room Technician (matched to tool maker)		ASC/Q6415: Automotive IIOT Application Specialist		ASC/Q6419: Automotive Data Science Head ASC/Q1438: Automotive Dealership Data Analyst ASC/Q1440: Automotive Dealership Data Science Specialist ASC/Q8313: Automotive Cybersecurity Specialist
No. of stakeholders which mentioned this	7	6	2	2	2
Match from job projections (723, 932, 112, 821, 312 and 311) *	No	Yes	No	No	No
Extent of the need (sum of the numbers from stakeholder consultations)	15,000 + (now) & 20,000+ (three years from now)	15,000 + (now) & 20,000+ (three years from now)	100 (now) & 150 (3 years from now)	400 (now) & 2000 (3 years from now)	300 (now) & 1500 (3 years from now)
Geography (where?)	RJ (Alwar), HR (Gurgaon), UK (Rudrapur), MP (Bhopal), GJ (Sanand-Hansalpur), MH (Pune), TN (Hosur), KR (Bangalore), JH (Jamshedpur)	Repair & maintenance: At workshops/dealerships across the country, in every city Manufacturing: HR (Gurgaon); GJ (Hansalpur)	MH (Pune); UK (Pantnagar); JH (Jamshedpur); UP (Lucknow); GJ (Sanand); KA (Dharwad); TN (Chennai)	MH, TN(Chennai), KA	TN (Chennai), Delhi NCR, MH (Pune), KA (Bangalore)
Monthly income (₹)	~ 15,000 – 20,000	~ 15,000 – 20,000	~ 1,00,000 – 3,50,000	1,00,000 – 4,00,000	1,25,000 – 1,70,000
Educational qualifications	Diploma /ITI (electrical/ automotive/ fitter) / B.E. (automobile, mechanical or production engineering)	ITI (motor mechanics)	B. Tech /M. Tech Engg (Power electronics/ Electrical/ Electronics / Communication / Instrumentation) ; M.Tech/PhD. Engg + AI/ML programmes	B. Tech /M. Tech Engg (Electronics / Computer Science)	B. Tech /M. Tech Engineering (AI and Data Science; or Computer Science/IT + Cybersecurity Certificate)
Skills required at the	Cognitive Skills: Reading; writing; speaking;	Cognitive Skills: Reading; writing; speaking;	Cognitive Skills: Reading; writing;	Cognitive Skills: Reading; writing;	Cognitive Skills: Reading; writing;

Job roles	1) Machine/CNC operator; Turner; Grinder; Tool and die maker	2) Technician / mechanic; Motor mechanic	3) Power / Microelectronics engineers; AI/ML expert	4) Embedded software engineers; Vehicle software developer	5) AI Data science engineers; Automotive cybersecurity specialist
competency level (3)	<p>communication skills; language (English/Hindi/local); Numeracy/ Mathematics; Active listening / learning; problem solving; creativity, independent research; time-mgmt; gender diversity;</p> <p>Socio-emotional Skills: Conscientiousness; Agreeable; emotional stability; Persuasion Physical skills TVET: Work on computers that runs machines involved in manufacturing wiring harness, knowledge of industrial safety (Machine operator in wire harness industry); operate the CNC machine which is numerically computerised, understand component drawing, tolerance, able to read instruments, Vernier caliper, micrometer and air gauges, etc. (CNC operator)</p>	<p>communication skills (communication to supervisors); language (English/Hindi or Local); Numeracy/ Mathematics; Active listening / learning; problem solving; critical thinking; judgement; systems mgmt.; diversity; ICT skills, gender diversity</p> <p>Socio-emotional Skills: Conscientiousness (punctuality, discipline, target-oriented, workplace etiquette, personal grooming, safety & quality mindset); open to experience; agreeable (teamwork); emotional stability (anger management) Physical skills Global competence TVET: Perform vehicle repair & maintenance, basic knowledge of computers, knowledge of electrical & electronic components (and familiar with high voltage modules), diagnostic tools, assembly operations, component loading & unloading of machines (motor technician), cost consciousness, environmental focus, information security, fire safety, use of personal protective equipment, and <i>familiarity with hydrogen vehicles (future)</i></p>	<p>speaking; communication skills; language (English); Numeracy/ Math (advanced); digital skills; Active listening / learning; science; problem solving; critical thinking; creativity; independent research; judgement; systems analysis/evaluation; resource/time mgmt.; diversity;</p> <p>Socio-emotional Skills: Conscientiousness; Agreeable; emotional stability; instructing; negotiation; Persuasion TVET: Power electronics engineer: Apply power electronics in auto industry, design power conversion devices (convertors, AC/DC convertors, charges), develop test protocols, analyze performance in lab and in-field; Micro electronics engineer: Apply power electronics in auto industry, design PCB and controllers (every aspect of automobile is controlled by hyper-controllers); AI/ML expert: Knowledge of bringing intelligence into the system (working on sensors, gesture control etc.), develop a training programme in AI/ML which is specific to</p>	<p>speaking; communication skills; language (English); Numeracy/ Math (advanced); digital skills; Active listening / learning; science; problem solving; critical thinking; creativity; independent research; judgement; systems analysis/evaluation; resource/time management; diversity;</p> <p>Socio-emotional Skills: open to exp.; conscientiousness; Agreeable; emotional stability; Adaptability TVET: Knowledge of automotive software, embedded systems, real-time operating systems, write embedded software (efficient codes) that can run micro controllers, develop and test software for vehicle control systems and diagnostics, Languages: 'C' (C/C++), Python, AUTOSAR, MATLAB</p>	<p>speaking; communication skills; language (English); Numeracy/ Math (advanced); digital skills; Active listening / learning; science; problem solving; critical thinking; creativity; independent research; judgement; systems analysis/evaluation; resource/time management; diversity;</p> <p>Socio-emotional Skills: open to exp.; conscientiousness; Agreeable; emotional stability; Adaptability TVET: AI Data Science Engineers: Use legacy/big data to predict vehicle diagnostics (for predictable replacement cycles), predict demand to avoid buildup of inventory and cater to emerging demand as well, knowledge and applications of Gen AI, knowledge of 'R' Automotive Cybersecurity Specialist: Analyze and secure automotive systems, security analysis, Fundamental cybersecurity principles and Cybersecurity frameworks, automotive protocols (like CAN), knowledge of security analysis tools, intrusion detection systems</p>

Job roles	1) Machine/CNC operator; Turner; Grinder; Tool and die maker	2) Technician / mechanic; Motor mechanic	3) Power / Microelectronics engineers; AI/ML expert	4) Embedded software engineers; Vehicle software developer	5) AI Data science engineers; Automotive cybersecurity specialist
			automobile sector		
Skills Shortage	Yes	Yes	Yes	Yes	Yes
Skills Gap	Yes	Yes	Yes	Yes	Yes
Relevance of TVET system	No training for wiring/harness industry; Lack of practical experience	ITI graduates do not have practical experience—do not have knowledge of manufacturing process (casting, welding, machining, painting and Japanese guiding principles of productivity); handling and usage of tools, working on conveyor lines, knowledge of process related defects Lack of training on communication and socio-emotional skills, i.e., they are part of the curriculum but not being taught well ITIs have poor maintenance and upkeep, tools & machines are old/outdated/not working Shortage of Master trainers Little interest from ITIs to allow industry players to set up practical training facility Lack of automotive trades at ITI in particular regions close to auto clusters (e.g., Uttarakhand)	Specialists in the auto sector are needed	Low availability of specialised training in software development for automotive application	Limited cybersecurity expertise with application in automotive sector.
Gender (Challenges)**	Not perceived as a female job both from demand and supply sides		Entry level challenge is not there but it is harder to retain women in higher positions as other industries offer higher returns and flexibility		
Challenges faced by industries in meeting skill requirements	Incur costs in making the hired workforce industry ready, resulting in longer lead-times; high attrition as workforce does not want to 'work with hands' and demands high salary		Need demand-supply matching, so that what is needed at industry can be provided by our education system (E.g., Students taking up electrical engineering has seen a drop in the last 5 years, resulting in their shortage. Seeing this fall in demand from students, even the universities have stopped BTech/MTech programs in electrical stream.)		
Industry-specific interventions that facilitate skill & capacity development (best practices)	L&D divisions; Training on the job; Graduate Engineer Trainees; industry-academia collaborations (model ITI)		Firms are developing engineers for all these roles internally		
Policy Recommendations	Skill Training Programme: Needs to be expanded; Practical experience with latest machines and technologies, aligned with industry requirements; Model ITI programmes or Dual Vocational Training programmes need to be encouraged; Overcome spatial mismatch in terms of		Skill Training Programme: Need to be expanded, i.e., more programmes need to be introduced to train people in these fields Curriculum Development: Curriculum development needs to take place at all levels of education. curriculum should be updated with industry guidelines Specialised/advanced courses, combining traditional engineering fields (mechanical/ electrical/		

Job roles	1) Machine/CNC operator; Turner; Grinder; Tool and die maker	2) Technician / mechanic; Motor mechanic	3) Power / Microelectronics engineers; AI/ML expert	4) Embedded software engineers; Vehicle software developer	5) AI Data science engineers; Automotive cybersecurity specialist
	<p>where the jobs are and where the skilled workers are (and even training centres)</p> <p>Curriculum Development: Curriculum needs to be encouraged with industry guidelines; ITIs equipped with latest technologies, teachers from industry; field visits; improve pedagogy</p> <p>Gender: More women at ITI and engineering colleges in relevant trades (hostel facilities; foresee automatic growth with EVs and automation (fewer physical tasks))</p> <p>Skill Initiatives: Compulsory OJT components during education/training; involvement of industry trainers for teaching and mentoring (aligning students interests and expectations for better matching and lowering attrition); encouraging women candidates in automotive trades (by awareness on POSH, creche, equal opportunity, etc.); openness to new culture, language, and food may also be included to help people transition to new places and language training</p>			<p>electronics/comp. science) with latest cross-cutting technologies such as mechatronics (mechanical+ electronics), power electronics (electrical+ electronics), automotive software & AI/ML (engineering specialised courses in AI/data science with automotive industry in mind); development of soft skills should be integral to the curriculum</p> <p>Gender: Creche and flexible working hours</p> <p>Skill Initiatives: Academia-industry collaboration where traditional field develop specialisations in the auto sector</p>	

Source: NCAER stakeholder interviews

Notes:

@ Advanced measurement based cutting jobs (Maecotei) (NCO: 3122.4200), painter (NCO: 7132.0201), plastic processing operator (NCO: 8142.1301=ASC/Q4402: Automotive Plastic Moulding Assistant and ASC/Q4401: Automotive Plastic Moulding Technician), operator level in press shop (NCO: 7211.0101= ASC/Q3402: Automotive Press Shop Technician): The findings relating to these male-dominated blue-collar occupations match those reported for Job role no. 1 in the above table (i.e. Machine/CNC operator; Turner; Grinder; Tool and die maker). It is difficult for firms to find trained workers (poor ITI training, no practical experience, and high salary expectations result in both skill gap and skill shortage), and the firms provide on-the job training for each of these roles.

* This refers to the job roles which are expected to find maximum employment in next three years according to the input-output analysis (see Chapter 3). Pink shade indicates no match between I-O quantitative top 5 occupation projections and survey-based top 5 occupation projections. Green shade indicates a match.

** Current practices to encourage female participation include implementing POSH in establishments; crèche; active look-out for female candidates in manufacturing roles; treat all applications at par; adopt female specific ITI.

7.7 Recommended Methodology

Based on the above, the recommended methodology to assess skills shortages and skill gaps for this sector is the following:

1. Map the sub-segments of the sector to the NIC code. Moving forward, it would be a good idea to expand the definition of the automotive sector, to also include the stages of design and R&D, as well as sale of motor vehicles through dealerships, where skill shortages are present. In this report, while the focus was on motor vehicles, the automotive sector is further divided into other sub-sectors namely two-wheelers & three-wheelers.³²
2. Update mapping of NCO 2015 job roles with job roles identified by the Sector Skill Councils. This should be an annual exercise. For example, the automotive cyber security specialist has a SSC code but no corresponding NCO-2015 code. The NCO needs a more dynamic and regular update of job roles and

³² Bhandari, B., Pratap, D. and Sahu, A.K. 2022. Contribution to Overall Employment by the Auto Industry: Jobs and Skills Contribution to Overall Employment by the Auto Industry: Jobs and Skills. <https://ncaer.org/publication/contribution-to-overall-employment-by-the-auto-industry-jobs-and-skills/>. NCAER, New Delhi, India. March.

descriptions of jobs. For example, the all the newer job roles in the automotive industry do not find any mention partly because they have evolved in the last one or two years.

3. In coordination with the Ministry of Skill Development and Entrepreneurship, the Sector Skill Council needs to implement surveys on a regular (at least annual) basis, which captures vacancies of firms. The job roles should be mapped/matched with job roles previously identified. Ideally the Economic Census forms the frame for any survey. Given the lack of data, the Ministry of Corporate Affairs' database or Goods and Services Tax Network are the other sources of universal data, from where data may be used to derive the universe. That universe needs to be divided into the sub-sectors as defined previously. Then proper sampling strategy needs to be adopted to understand the validity of the results. Biases needs to be addressed. Response rates should also be estimated.
4. Big Data analysis is highly recommended for SSCs using various job sites.³³ They should also use/assess data from National Career Services and various employment exchanges around the country. The job roles should be mapped/matched with previously identified job roles.

The questionnaires asked respondents of the mediums used for hiring employees. While direct recruitment through job fairs at ITI and campus recruitments from engineering colleges were common, several firms also advertised positions on websites such as LinkedIn, Naukri.com, and Workindia.in and National Career Services. The job details from advertised positions on these portals can help create a good database to understand the kind of job roles which are in demand by the industry along with the corresponding educational qualifications, skill-sets, and salaries. Constant tracking of such data can also help keep the job-roles and skills database dynamic.

5. Stakeholder interactions needs to be carried out as an annual exercise based on templates designed by the MSDE. It will capture jobs which are difficult to fill but also get a holistic view of the sector in terms of emerging technological trends, emerging jobs, detailed qualitative needs for qualifications and skills, hiring practices, best practices of firms, migration trends, practices to encourage female labour force participation, etc.
6. Last but not the least, the MSDE, Ministry of Labour and Employment and Ministry of Statistics and Programme Implementation should design an occupation-wage-employment survey. It is absolutely important to identify the occupation codes mentioned in Step 2. Ideally the Economic Census forms the frame for any survey.

This chapter puts forth the methodology and the instrument which can be useful to gather insights on skill shortages in the automotive sector, and how it may be captured on a dynamic basis. Through the challenges faced in testing out the methodology, the chapter also attempts to present practical solutions to the same. Given the novel nature of the exercise, in-person interviews are recommended at the start. Though, MSDE may consider moving to direct submission of details by the firms

³³ Big data should only be used as a 'supplement': As many job roles, especially the core manufacturing job roles which tend to be filled through campus placements from engineering colleges and ITI, may not to be advertised online. They will hence be missed in the big data analysis, despite being in-demand and faced with a skill shortage.

once the Labour Market Information System (LMIS) goes online, and the process of data collection has been regularised and popularised. This direct submission could involve uploading an electronic version of the questionnaire on the MSDE website, which can be accessed by the firms to submit their answers.

Though the usefulness of a labour market information system was acknowledged by the respondents, the workforce will be able to fulfil the skill demands only when the education and skilling ecosystem can keep up with designing their curriculums in the desired manner as well. Having realised this, the sector skill council and industry associations are working towards enhancing industry-academia collaboration. A stakeholder also highlighted the need to ‘empower companies’ and provide the necessary assistance to them to enable them to train their workforce. ITI and engineering colleges must look up to such collaboration possibilities to prepare an industry-ready workforce.