Skill Shortages and Gaps in the Motor Vehicles Sector: Case for a Labour Market Information System in India

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Introduction

The automotive sector contributes significantly to India's manufacturing output and employment (Bhandari, Pratap and Sahu 2022). Among those employed, most are skilled individuals, having undergone formal or non-formal vocational/technical education and training, according to the Periodic Labour Force Survey (PLFS). Despite this, skill shortages and skill gaps abound, as found through stakeholder consultations for NCAER's National Skill Gap Study for High Growth Sectors (Bhandari et al. 2025). There are in-demand automotive jobs for which people are difficult to find, across geographies (resulting in overall, as well as spatial skill shortages); and if people are available, they lack the necessary skillsets (resulting in skill gaps) (Green 2013).

Key Policy Problem

There is a mismatch– on quantity (i.e. skill shortage) and quality (i.e. skill gap) – between the demands of the industry, and those supplied through the education/skilling ecosystem in India (Figure 1).

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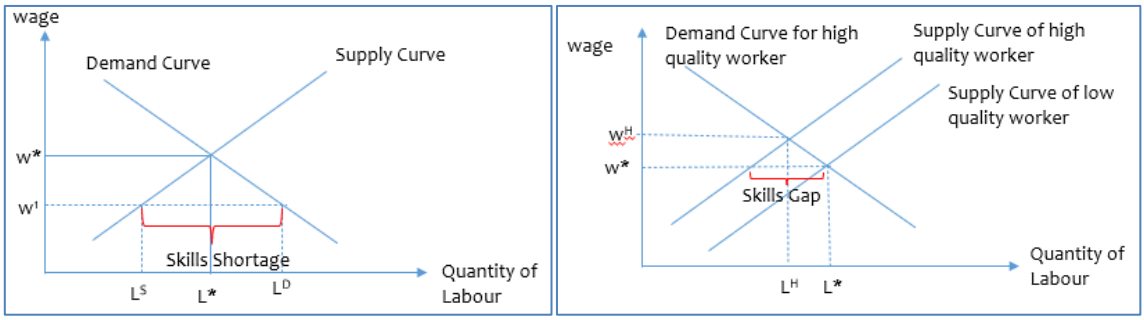
Figure 1: Graphical Representation[2] of Skill Shortage and Skill Gap



Source: NCAER Conceptualization

Are there any institutional mechanisms to dynamically track the job roles in-demand, along with their skill requirements (including knowledge of any local language), wages, how many people are required, and in which locations? Is there transparency on these aspects between the industry (on the labour demand side), and the aspirants, and education/skilling institutions (on the labour supply side)? Figure 1 illustrates that this is neither just a quantity nor a quality problem, but also one of price, i.e. how much are you willing to pay for a high-quality worker.

Online job portals, including National Career Service portal of the Ministry of Labour and Employment, help connect job seekers with employers. One could say that a Labour Market Information System (LMIS) that utilises big data can help collate such information to build transparency regarding job roles. Still, such a database would remain incomplete as many automotive jobs– the blue-collar ones, and those filled through networks and campus placements – are typically not advertised online. They would hence be excluded from any LMIS that relies solely on big data.

In effect, we have 'information asymmetry' between the demand and supply sides of the labour market.

Overcoming the Problem: Methodology Proposed by NCAER

NCAER adopted, tested, and put forth a methodology at the behest of the Ministry of Skill Development and Entrepreneurship (MSDE), to dynamically capture the job roles and associated skills in demand, and mitigate the demand-supply mismatch (Figure 2).

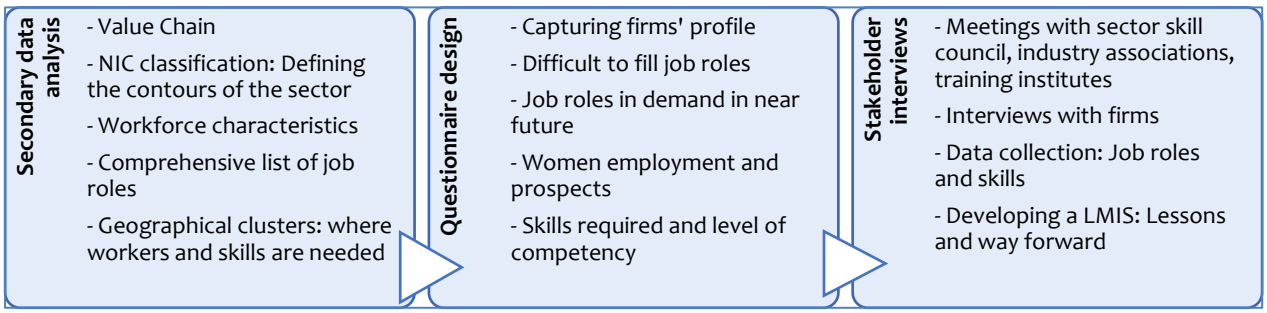
The objective of the MSDE-NCAER's National Skill Gap Study for High Growth Sectors (Bhandari et al. 2025) was to develop a unified dynamic framework for assessing skill shortages and gaps in the country. This framework could be applied either to sectors or to States/districts. The framework was developed using seven high growth sectors, one of them being the 'motor vehicles' sector. It included manufacturing of motor vehicles (passenger and commercial vehicles), manufacturing of parts and

[2] The graphs are simplistic economic depictions of a labour market, using the labour demand (L^D) and labour supply (L^S) curves. They show that industry demand (either of enough workers, or of requisite skills in available people) is not being met by the labour supply, resulting in skill shortage and gaps. Wages (w) play an important role, and it may be argued that an increase in wages (from w^1 to w^* in left graph) may help overcome skill shortage. However, firms argue that an increase in wages is unjustified when people lack the requisite skills (for instance, paying w^H instead of w^* in right graph). Also, shortages may continue despite a competitive wage, as people may prefer alternative (easier) career options, or choose a sector aligned with their aspirations (e.g. choose to be delivery workers instead of working in an automotive factory). These challenges are detailed in the full report.

accessories of motor vehicles, and maintenance and repair of motor vehicles.

NCAER undertook a thorough secondary analysis to understand the automotive sector. Detailed questionnaires were developed, and meetings with automotive firms and other stakeholders were conducted to test the questionnaire and methodology of data collection on skill shortages and gaps.

Figure 2: Methodology



Source: NCAER Conceptualization

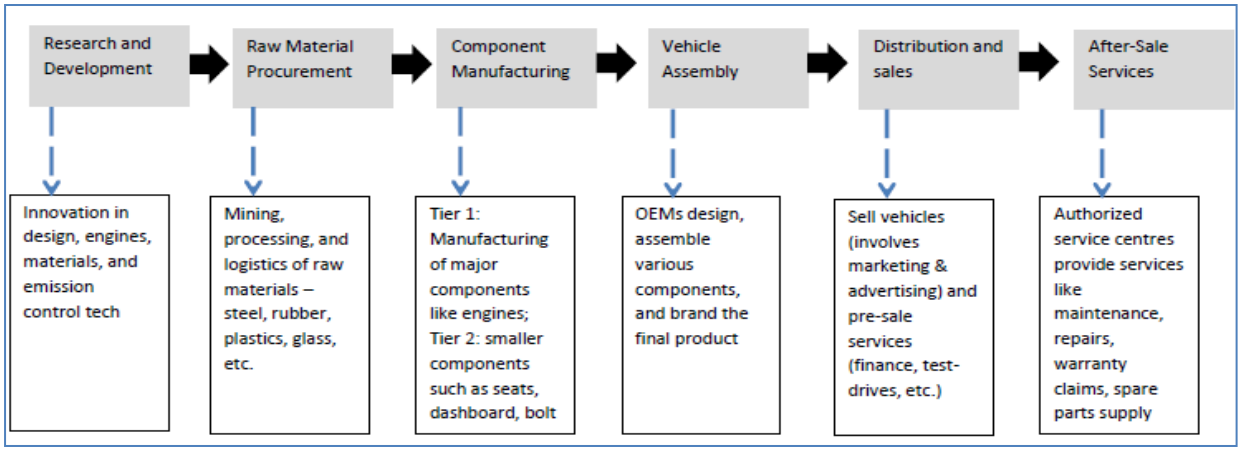
The process followed, as well as the key results from the report, are elucidated below.

Secondary Data Analysis: Identification of the Value Chain, Workforce Characteristics, Job Roles, and Geographical Clusters

i) Value Chain

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 manufacturers, with the final vehicle assembly undertaken by the vehicle manufacturer. Manufacturing is preceded by research and development (R&D) and procurement of raw materials, and is followed by marketing and sales – stages which were outside the scope of the present study. The focus of the study was component manufacturing, vehicle manufacturing and assembly, and after-sales services (Figure 3).

Figure 3: Automotive Value Chain



Source: NCAER compilation, adapted from Sturgeon et al (2016 and 2017)

Data from the Annual Survey of Industries (ASI), Annual Survey of Unincorporated Sector Enterprises (ASUSE), and Periodic Labour Force Survey (PLFS) was utilised to understand

the demand (i.e. number and location of automotive units) and the supply (i.e. automotive worker characteristics – numbers, education level, location, and type of employment).

Identification of the National Industrial Classification (NIC), of the specific segments of automotive sector of interest (MoSPI 2008), helped define the boundaries of the sectoral analysis and ascertained that the secondary data pertained to the same industry segments across datasets. The identified NICs, used to collate the relevant industry data (from ASI, ASUSE and PLFS), were as follows:

- 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 vehicles

ii) Workforce Characteristics

Insights concerning workers' education levels, vocational training, occupations, type of engagement as well as gender inclusion were captured using the PLFS 2022-23 data. The key findings were:

a. *General education*: Majority of workers in manufacture of motor vehicles were graduates, in manufacture of parts and accessories of motor vehicles were diploma / certificate course holders, and in maintenance and repair of motor vehicles were educated until the middle school.

b. *Technical education*: The share of workers without technical education were 53 per cent in manufacture of motor vehicles, 57 per cent in manufacture of parts and accessories of motor vehicles, and 93 per cent in maintenance and repair of motor vehicles.

c. *Vocational training*: 23 per cent of workers engaged in manufacturing of motor vehicles had received formal vocational training. A third of workers in manufacturing of parts and accessories for motor vehicles had formal vocational training and a third non-formal vocational training. However, in repair and maintenance of motor vehicles, 60 per cent had

received non-formal vocational training.

d. *Skill level*: The above three definitions of education imply that majority of workers were high-skilled in manufacture of motor vehicles, medium-skilled in manufacture of parts and accessories of motor vehicles, and low-medium skilled in maintenance and repair of motor vehicles.

e. *Occupations*: Majority of workers in manufacture of motor vehicles were assemblers and physical and engineering science technicians; in manufacture of parts and accessories of motor vehicles were machinery mechanics and repairers and manufacturing labourers; and in repair and maintenance of motor vehicles were machinery mechanics and repairers.

f. *Engagement type*: More than 90 per cent of workers in manufacturing of motor vehicles and parts and accessories for motor vehicles were regular wage workers. In repair and maintenance of motor vehicles, 53 per cent worked as regular wage employees.

g. *Female workers*: The share of female workers in manufacture of parts and accessories for motor vehicles was 3.8 per cent, 3.1 per cent in manufacturing of motor vehicles, and 0.6 per cent in maintenance and repair of motor vehicles.

- As regards occupations, women were employed in job roles which 'supported' the core activities of manufacturing and repair and maintenance, such as: numerical clerks, administration professionals, general office clerks, keyboard operators, housekeeping, and finance professionals. 'Core' occupations which have the largest share of workers – such as physical and engineering science technicians, manufacturing labourers, machinery mechanics and repairers, and assemblers – primarily have men engaged in them.

The PLFS data highlighted that automotive workers are typically regular wage/salaried employees, and engaged in specific occupations– implying that workers are hired at automotive firms. Thus, firms can tell the job roles where they face skill shortages and gaps, and what their skill requirements are.

iii) Job Roles

Each of the job roles (i.e. occupations) identified in the sector is classified by a National Classification of Occupation (NCO) code (MoLE 2015). While the PLFS data helped identify the occupations where workers were employed in the sector, these occupations were matched and supplemented with the qualification packs (i.e. job role QPs) developed by the Automotive Skills Development Council (ASDC), to build a comprehensive list of job roles.

This exercise facilitated identification of job roles which: i) were in-demand and provided training for by the sector skill council (such as: automotive manufacturing data science specialist, automotive data science head, automotive dealership data analyst/ data science specialist, automotive cybersecurity engineer/specialist), and ii) neither showed workers in PLFS nor had an ASDC QP, but came up as being in-demand during the stakeholder interviews (such as: embedded software engineer and vehicle software developer).

iv) Geographical Clusters

Indian automotive industry is organised in clusters, where the vehicle manufacturer and its suppliers are

concentrated in particular locations[3]. It is well known that Maharashtra and Tamil Nadu house automotive clusters, and this is also evidenced in secondary data through largest number of automotive firms and employment in these States, using the ASI and PLFS data respectively. However, due consideration of ASUSE data for numbers and location of informal enterprises also threw up States such as West Bengal and Uttar Pradesh in manufacture of motor vehicles and components respectively– which otherwise would not be associated with housing automotive clusters.

In specific, the top three states in terms of maximum automotive firms (using ASI and ASUSE 2021-22) and share of workers (using PLFS 2022-23) were found to be:

a. *Manufacturing of Motor Vehicles*:

- Firms: Maharashtra, Haryana, Karnataka
- Workers: Maharashtra, Tamil Nadu, Karnataka

b. *Manufacturing of parts and accessories of motor vehicles*:

- Firms: Maharashtra, Tamil Nadu, Uttar Pradesh
- Workers: Tamil Nadu, Haryana, Maharashtra

c. *Maintenance and repair of motor vehicles*:

- Firms and workers: Maharashtra, Tamil Nadu and Uttar Pradesh

Spatial spread of firms– both formal and informal– indicates the automotive clusters and geographic regions where skilled personnel for the automotive sector are required. Therefore, regions with varying concentrations of automotive firms as well as employment underscored 'where' the stakeholder interviews should be conducted to understand the job roles and skills in-demand.

Primary Data Analysis: Questionnaire Development and Stakeholder Interviews

i) Questionnaire Development

A set of firm-level questionnaires were developed for each of the three segments of the automotive sector: manufacturing of motor vehicles, manufacturing of parts and accessories of motor vehicles, and maintenance and repair of motor vehicles. They were designed to help the firms think through:

- Different job roles at the company
- Which job roles are difficult to fill, and qualifications and skills required for them
- Which job roles (and corresponding skills) will likely be in-demand in the next three years, and how easy or difficult would it be to find skilled people for them
- If the identified job roles are difficult to fill in particular States/geographic regions

Information regarding salary is important, since several automotive jobs are regarded non-aspirational and 'difficult to fill' due to the payout. Plus, firms were asked about number of current job role vacancies, and the number of people they would need in three years' time in these roles, to ascertain the extent of current and anticipated demand.

Suited to the Indian context, the questionnaire also delved into firm-level practices to encourage female

[3] "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.78).

employment, with questions concerning:

- Percentage of female employees in the firm, and specific job roles that employ women
- Job roles likely to see a demand for women in next three years
- Hiring policies to encourage female employment in non-traditional job roles
- Creche facility, and sexual harassment policies, prevention systems, procedures and service rules for employees (implementation of prevention of Sexual Harassment at Workplace (POSH) Act)

These questionnaires were supported with the compiled list of job roles, and a comprehensive list of skills with the level of competency[4] sought for each skill (Figure 4).

Figure 4: List of Skills

Cognitive skills	*Socio-emotional skills*	*Job-specific Skills*
• Reading, writing, learning, listening • Communication, language • Math / numeracy • Digital skills /ICT • Problem solving, critical thinking, creativity • Decision-making, managing resources (financial, material, personnel), time management	• Respect for diversity (gender, cultural, social) • Conscientiousness • Openness to experience, extraversion • Agreeableness, teamwork • Emotional stability • Instructing, negotiation, persuasion	• Occupation specific knowledge • Physical skills (including job-specific complex psychomotor skills) • Global competence

Sources: NCAER Compilation, adapted from NCAER (2018) and Bhandari (2021)

ii) Stakeholder Interviews

Interviews with senior personnel at automotive firms were conducted to test the questionnaires, across the states of Delhi, Gujarat, Haryana, Maharashtra, Rajasthan, Tamil Nadu, Telangana and West Bengal. It was found that skill shortages and gaps are an issue, which are intensified due to the technologically dynamic nature of the sector– given the advent of electric/green vehicles, increasing use of electronics in automobiles, as well as automation and artificial intelligence in manufacturing and servicing.

Skill shortages and gaps were reported across the different job roles, from entry level technicians at the shop-floor up to niche engineering job roles, namely: machine/CNC operator, turner, grinder, tool and die maker, technician / mechanic, motor mechanic, power / micro-electronics engineers, artificial intelligence (AI) and machine learning (ML) expert, embedded software engineer, vehicle software developer, AI data science engineer, and automotive cybersecurity specialist.

It was noted that 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). But there will also be an increasing demand for new and niche engineering job roles. For both, relevant skilling is required to achieve the desired level of competency– across cognitive, socio-emotional, and job specific skills (Box 1).

Key findings concerning women employment across job roles are provided in Box 2.

[4] Competency levels: Beginner/ intermediate/ competent/ advanced/ very advanced

Box 1: In-demand Job Roles		
Job roles	**Machine/CNC operator; Turner; Grinder; Tool and die maker**	**AI Data Science Engineers; Automotive Cybersecurity Specialist**
Occupation code (NCO code)	**722**- Blacksmiths, Tool Makers and Related Trades Workers	**252**- Database and Network Professionals
How many are needed? (sum of the numbers from stakeholder consultations)	15,000 + (now); and 20,000+ (three years from now)	300 (now); and 1,500 (3 years from now)
Geography (where are they needed?)	Rajasthan (Alwar), Haryana (Gurgaon), Uttarakhand (Rudrapur), Madhya Pradesh (Bhopal), Gujarat (Sanand-Hansalpur), Maharashtra (Pune), Tamil Nadu (Hosur), Karnataka (Bangalore), Jharkhand (Jamshedpur)	Tamil Nadu (Chennai), Delhi-NCR, Maharashtra (Pune), Karnataka (Bangalore)
Monthly income (₹)	~ 15,000 – 20,000	~ 1,25,000 – 1,70,000
Educational qualifications	Diploma /ITI (electrical/ automotive/ fitter) / B.E. (automobile, mechanical or production engineering)	B. Tech /M. Tech Engineering (AI and Data Science; or Computer Science/IT + Cybersecurity Certificate)
Competency required in following skills	**Cognitive skills:** Reading; writing; speaking; communication skills; language (English/Hindi/local); numeracy/ mathematics; active listening and learning; problem solving; creativity, independent research; time-management **Socio-emotional skills:** Gender diversity; conscientiousness; agreeable; emotional stability; persuasive **Job-specific skills:** Physical skills (standing long hours); Work on computers that run machines involved in manufacturing wiring harness, knowledge of industrial safety (important for a machine operator in wire harness industry); Operate the CNC machine which is numerically computerized; understand component drawings; tolerance; able to read instruments, vernier caliper, micrometer and air gauges etc. (important for CNC operator)	**Cognitive skills:** Reading; writing; speaking; communication skills; language (English); numeracy/ math (at advanced level); digital skills (using digital devices); active listening and learning; application of science; problem solving; critical thinking; creativity; independent research; judgement; systems analysis and evaluation; resource and time management; **Socio-emotional skills:** Gender and cultural diversity; open to experience; conscientiousness; agreeable; emotional stability; adaptable **Job-specific skills:** *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; knowledge of fundamental cybersecurity principles and cybersecurity frameworks; automotive protocols (like CAN); knowledge of security analysis tools, intrusion detection systems

Source: NCAER stakeholder interviews.

Box 2: Women Employment in Auto Sector

As found through secondary data and primary assessment, there are few women in the automotive industry and they too are concentrated in administrative and customer support positions. Several firms have expressed their willingness to have gender diversity in the core manufacturing job roles, but have difficulty due to:

- Lack of women trained in automotive manufacturing trades.
- Lack of women applicants for core automotive roles (hesitance 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, a stakeholder mentioned that the experience of Ola Electric is encouraging other electric vehicle (EV) manufacturers to also hire more women in 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. Another positive finding has been the emphasis placed by several firms on enacting POSH policies and committees, and providing crèche facilities on office/plant premises.

In near future, 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 stakeholder interviews.

Lessons and Way Forward

i) Updating NIC and NCO codes, and regular analysis of secondary data

The industry classification codes date back to 2008, and the occupation classification codes date back to 2015 (MoSPI 2008; MoLE 2015). Given the pace of change in technology, there is emergence of new domains within traditional industries. For instance, cybersecurity and battery technology now form a part of vehicle manufacturing, but the traditional NIC codes for motor vehicle manufacturing do not capture these. Corresponding with these technological changes, the job roles are expanding as well, but the occupation descriptions are a decade old. Regular updating of NIC and NCO codes would help improve the quality and precision of secondary data relating to industry and workers.

For workers in particular, the attempt should be to capture employment at a more detailed NCO 8-digit level. The current allocation of workers at NCO 3-digit level (in the PLFS data) is too broad and does not allow tracking of workers in specific occupations (see Box 1).

Regular analysis of secondary data available with ASI, ASUSE and PLFS – incorporating the updated and detailed NIC and NCO codes– would help us keep abreast of technological and occupational changes in the sector.

ii) Universe of firms needed to conduct survey of available vacancies

To achieve an ideal sample of firms for conducting a survey of available vacancies, a comprehensive list of all automotive firms in India is necessary, with details concerning size, location of plants/workshops, stage(s) of production (e.g. R&D, design, component manufacturing, vehicle assembly, sales, after-sales servicing), and type of vehicle produced (two/three/four wheelers, commercial vehicles, etc.).

While NCAER appreciates the help provided by industry associations and sector skill councils for sharing some firm-level contacts, ideally the universe of automotive firms should be provided by the Ministry of Corporate Affairs, Goods and Services Tax Network, or the Economic Census. Existing difficulties indicate the necessity of inter-governmental coordination and understanding for enabling industry studies in the country.

iii) Stakeholder sensitisation required to improve survey response rates

Response rates in business surveys are low, and despite persistent efforts NCAER achieved a response rate of 24 per cent. Therefore, prior to undertaking a large-scale survey, it is recommended that an awareness creation workshop/webinar is organised by the government for the senior leadership at automotive firms, in partnership with national/regional/state-level industry associations and state statistics departments. Senior personnel at firms can facilitate connecting with Human Resource (HR) heads, R&D divisions, plant/workshop managers, and learning and skill development personnel at the firms' offices and plant locations across India– who, in NCAER's experience, have been able to share detailed insights regarding skill shortages and gaps in establishments under their domain/region of responsibility.

While in-person interviews are recommended at the start, the government may consider moving to online direct submission of responses by the firms once the process of data collection, on the lines of the questionnaire developed by NCAER, has been regularised and popularised.

iv) Annual survey conducted using up-to-date database of firms, supplemented with big data analysis

It is important that the firms' database is up-to-date, and the survey is conducted at least annually with its results made public, to: i) track employment and skilling changes taking place in the industry across job roles, and ii) relay this demand-side information for the supply side (i.e. the candidates, and the training ecosystem) to keep up. It will be useful to supplement this exercise with big-data analysis of vacancies posted on online job portals. The subsequent informational clarity in the labour market will go a long way in helping align skill acquisition and candidate expectations to the needs of the automotive industry.

v) International precedence for LMIS: Occupation, wage, employment survey

Updated data regarding occupations, employment, skills, and salaries will bring India's *Labour Market Information System (LMIS)* in line with the occupation, wage, employment surveys conducted in countries such as Europe, United Kingdom, and USA.

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For detailed insights on the automotive sector, read the full chapter at:

https://ncaer.org/wp-content/uploads/2025/06/Chapter-7.pdf

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