



Ministry of
Skill Development
And Entrepreneurship



Skill India
कौशल भारत - कुशल भारत

A STUDY TO ASSESS
**EMPLOYMENT POTENTIAL
AND
SKILLING REQUIREMENT**

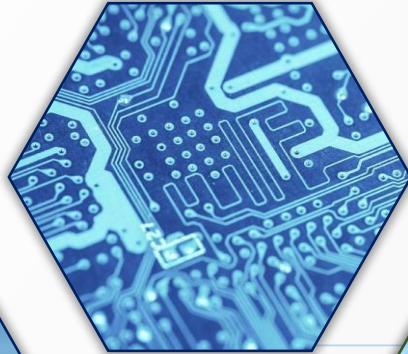
IN THE

ELECTRONICS SECTOR
ACROSS **SIX** SUB SECTORS

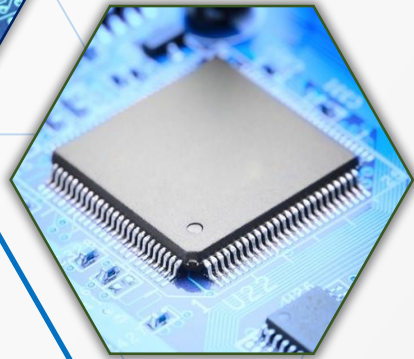
Feedback

SIX SUB SECTORS

**PCB
DESIGN &
MANUFACTURING**



**SEMICONDUCTORS
& COMPONENTS**



**INDUSTRIAL
AUTOMATION**



**E-MOBILITY &
BATTERY**

**SECURITY &
SURVEILLANCE**



**SOLAR
& LED**



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CONTENTS

CHAPTERS

- FOREWORD**
Page 5
- Executive Summary**
Page 6
- 01 Approach & Methodology**
Page 17
- SECTOR OVERVIEW AND FIELD FINDINGS**
- 02 PCB Design & Manufacturing**
Page 23
- 03 Semiconductors & Components**
Page 31
- 04 E-Mobility & Battery**
Page 40
- 05 Solar & LED**
Page 52
- 06 Security & Surveillance**
Page 65
- 07 Industrial Automation**
Page 73
- 08 In Summary**
Page 84

FOREWORD

The Indian Electronics industry is on track at full steam to achieve its full potential in manufacturing, service and designing capabilities. A significant milestone on the path towards becoming a manufacturing hub was achieved in 2016-17, when India's domestic electronics production exceeded imports of electronic goods into the country. The demand for electronics hardware in the country is projected to increase from USD 45 billion in 2009 to USD 400 billion by FY 2020.

However, to unlock the full potential of the Indian electronics industry, it is imperative to create a supportive ecosystem to facilitate manufacturing and service competitiveness. And a key ingredient in this is to fulfil the requirement of suitably skilled manpower. Thus, making the role of facilitators like the Electronics Sector Skills Council of India (ESSCI), strategic and extremely critical.

ESSCI is a Not-for-Profit Organization, registered under the Indian Companies Act, 1956. The Council has been promoted by Six Associations, viz., the CEAMA, ELCINA, IESA (formerly ISA), IPCA, LEDMA and MAIT, with financial support from the National Skill Development Corporation (NSDC).

ESSCI's vision is to facilitate an rich and dynamic ecosystem for industry-oriented skill development, with an eye to enhance the employability of the Indian human resource, thereby addressing the needs of the fast-growing electronics manufacturing and services industry in the country.

ESSCI is responsible for Standards, Assessment & Certification as per the NSQF (National Skill Qualification Framework) to augment the employability of the Indian workforce to globally acceptable standards.

As a part of its forward-looking agenda, ESSCI partnered with Feedback Consulting, a premier research and consulting firm to undertake an in-depth study into the employment potential and skilling requirement in the Electronics Industry.

The objective of the study was primarily two-fold, viz., to identify existing segments with large employment generation potential, and understand their skilling requirement with a view to identify areas of up-skilling. The report has also been crafted to look into areas of composite-skill requirements with an eye to address these skill gaps. Focus has also been on recommendations to generate low to mid-level employment opportunities in the 6 sub sectors - PCB design & manufacturing, semiconductors & components, E-Mobility & battery, solar & LED, security & surveillance, and industrial automation over the next 5 years.

The report aims to bring in the required clarity for the Industry and for ESSCI to develop a suitable action-plan that is far reaching, while also being implementable, thereby further empowering the Electronics Industry to grow to its full potential.

N K Mohapatra

CEO, Electronics Sector Skills Council of India (ESSCI)

Executive Summary

Background of the study

Electronics Sector Skills Council of India (ESSCI) commissioned Feedback Consulting, a premier market research company, to conduct a study to understand the current employment scenario and future employment potential in the Electronics sector value chain in India across the existing and emerging sectors. Additionally, ESSCI also expected to gain an understanding of emerging scenarios in the job market and skill requirements of the industry along with actionable recommendations, for the Ministry and the Industry to work towards.

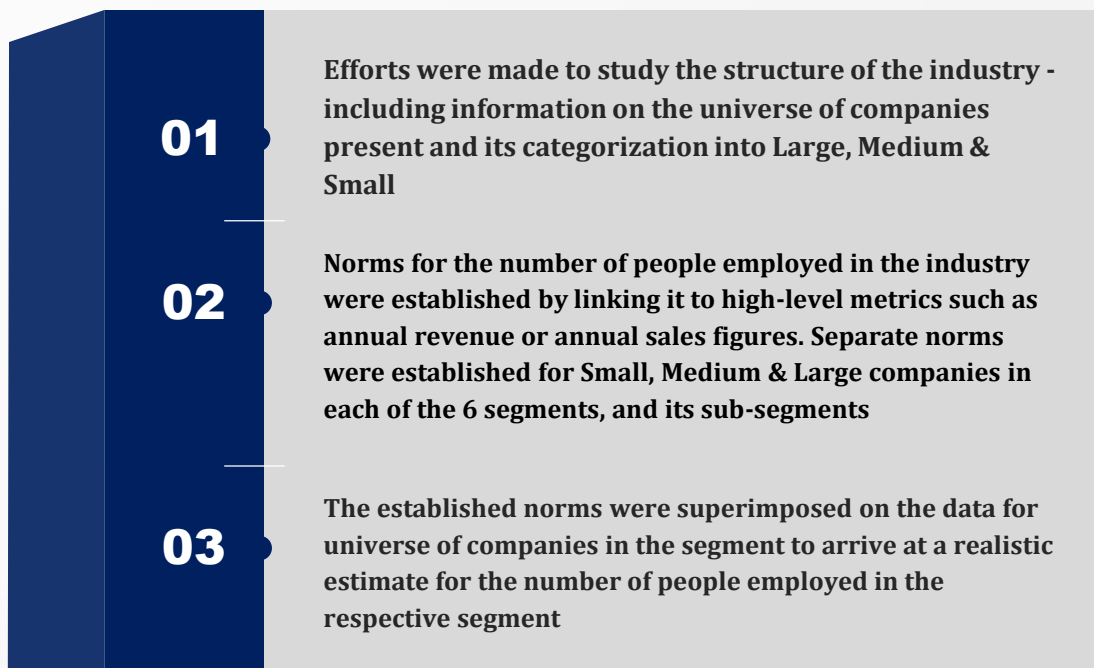
The scope of the study covers 6 identified sub-sectors viz., PCB design & manufacturing, Semiconductors & components, Solar & LED, E-Mobility & Batteries, Security & Surveillance, and Industrial Automation. For the sake of inclusion, a variety of additional products such as inverters &

UPS, HVAC systems and Machine Tools have also been included as part of the Industrial Automation segment for this research.

This report lays the groundwork for enhancement of training and skill-development measures in the targeted segments for the Electronics Industry in the next 5 years. For each of the segments, the report estimates the employment generation expected during the period and the skillsets expected by the industry from the new recruits.

Feedback had carried out a similar study for ESSCI in the past covering 4 sub-segments - Consumer Electronics, Communication & Broadcasting, IT Hardware and EMS. The study helped shine light on the existing market scenario and the job creation potential offered by these segments.

Approach to the engagement



Data on jobs in each of the segments was gathered through primary research from over 530 companies and close to 2,000 indirect responses, across the board, and from various Industry associations.

In-depth interviews were conducted with HR and department heads of companies in all the different product segments, and with large, medium and even a few identified smaller players.

Data from primary sources was collated with findings from secondary research and analysed. The findings of the analyses were further verified through in-depth interviews with industry experts and respective industry associations.

To present a clear picture, backed by data and qualitative analysis, Feedback adopted a 'Norms'-driven approach, in estimating current and future job requirements.

Norms for each of the product segments was arrived at by associating it with high-level parameters such as annual revenue or annual sales figures. A detailed approach was also undertaken to estimate the unorganised job market as well.

The refined norms were then superimposed on the universe of companies and extrapolated to arrive at the current and future employment estimates.

This research exercise involving company level information and qualitative data about the industry, threw-up several interesting trends. For instance, it was observed that in the LED segment, a large share of the service sector employment is being provided by the unorganised service centres. Similarly, the security & surveillance industry has a significant base of small scale system integrators and video analytics companies employing people in an unorganised service market.

Employment scenario in the six segments of interest

India's electronics demand is poised to grow exponentially to become one of the largest in the world. The penetration of electronic products in Indian households, and increased focus on automation & digitalisation of industries is expected to accelerate. This trend is also aided by the initiatives and drivers, such as Digital India, fast paced mobile & internet revolution, and an increased activity in e-commerce space.

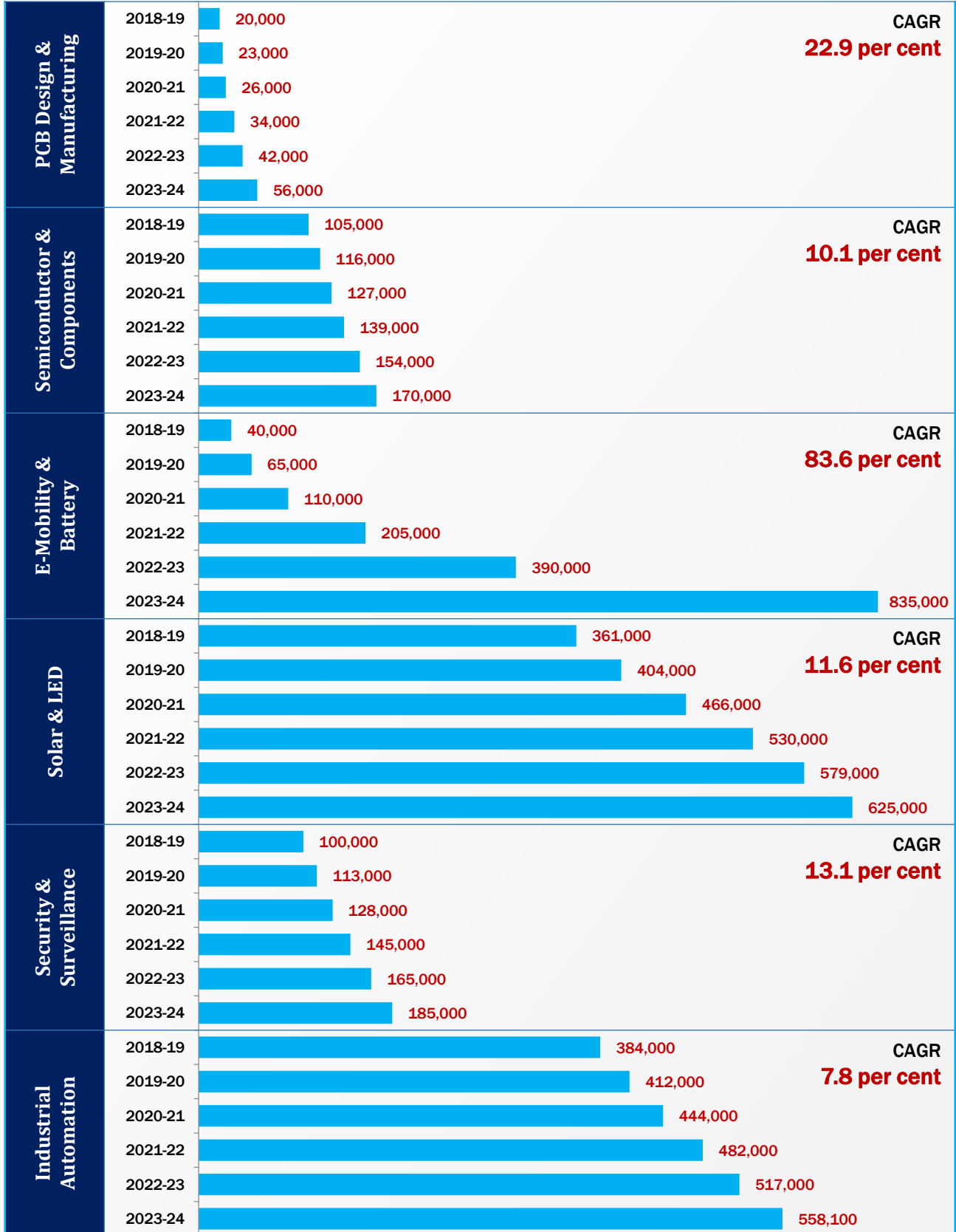
The Government plans to meet this growth in demand with creation of a stronger domestic industry. There is a greater emphasis on the Electronics sector in the 'Make in India' campaign, which is evident from the policies and regulations being framed for the sector. For instance, policies promoting mobile phone manufacturing & assembly have resulted in a marked increase in the number of such units over the last 3 years.

Currently, the six segments studied together employ more than 1 million people across the design, manufacturing and service functions of the business

Going forward, employment in these segments is expected to grow at a 19 per cent CAGR to reach about 2.4 million by the year 2023-24

Segments like E-Mobility & Batteries are expected to show tremendous growth over the period with employment generation taking place at a rate more than 80 per cent CAGR

Employment generation estimated in the six sub-sectors of interest



Future employment in Indian PCB Design & Manufacturing industry

Segment	Industry Structure	Industry Overview	Current jobs in the market	Future jobs likely to be created
PCB	<p>There are around 220 companies in the PCB manufacturing industry in India. Of this 10 are considered as large firms, with revenue more than INR 50 crore. There are also 50 medium sized firms with annual revenue between INR 15-50 crore, and close to 140 companies with revenue levels less than INR 15 crore per year. Of the 200 companies, roughly 150 are PCB manufacturers, while the remaining 50 are PCB assembly companies.</p>	<p>As of 2017-18, the industry is valued at about USD 2.63 billion in size, and is expected to grow and cross USD 8.5 billion by the year 2023-24</p> <p>A large part of this growth is expected to be driven by the mobile phone manufacturing infrastructure planned to be set up in India in the coming years</p>	<p>The industry currently employs close to 20,000 people in various functions & capacities.</p> <p>The manufacturing function employs the most number of employees.</p> <p>Of the total workforce employed in the industry, close to 50 per cent is employed on contract basis</p>	<p>The future estimate for employment in the sector is expected to be as follows:</p> <p>2018-19: 20,000 2019-20: 23,000 2020-21: 26,000 2021-22: 34,000 2022-23: 42,000 2023-24: 56,000</p>

Future employment in Indian Semiconductor & Components industry

Segment	Industry Structure	Industry Overview	Current jobs in the market	Future jobs likely to be created
Semiconductors	<p>The Indian semiconductor industry consists of 3 major types of companies. The largest segment is the embedded software design industry consisting of 180 companies.</p> <p>The other 2 smaller segments are VLSI design with 70 companies and 50-60 Board & hardware design companies.</p>	<p>As of 2018-19, the semiconductor industry is valued at about USD 16.7 billion in size.</p> <p>The industry has been growing at a CAGR of 10 per cent which is expected to continue, and to touch USD 27 billion mark by 2023-24.</p> <p>IoT and Digital India initiatives are expected to drive this growth in the coming years</p>	<p>The industry currently employs close to 105,000 people in various functions & capacities.</p> <p>Due to the large presence of fabless industry in India, the industry has a strong base of employees in the design function</p>	<p>The future estimate for employment in the sector is expected to be as follows:</p> <p>2018-19: 105,000 2019-20: 116,000 2020-21: 127,000 2021-22: 139,000 2022-23: 154,000 2023-24: 170,000</p>

Future employment in Indian E-Mobility & Battery industry

Segment	Industry Structure	Industry Overview	Employment scenario	
			Current	Future
EV – 2W & 3W	Around 30 players are present in the 2-wheeler sub-segment. The traditional manufacturers of 2-wheelers are active in low speed e-scooter business, while the high speed e-scooter & e-bike business are dominated by start-ups. In the 3-wheeler space, e-Autos is an emerging segment, while, the e-Rickshaw has an unorganised market with the presence of a number of small players.	During 2018-19, the industry sold a total of 126,000 electric 2-wheelers and close to 900,000 electric 3-wheelers This marks a growth of more than 100 per cent over the 2017-18 financial year	The industry currently employs close to 14,000 people in various functions & capacities. The manufacturing function employs the most number of employees. Of the total workforce employed in the segment, less than 25 per cent is employed on contract basis.	The future estimate for employment in the sector is expected to be as follows: 2018-19: 14,000 2019-20: 23,100 2020-21: 38,100 2021-22: 62,900 2022-23: 97,800 2023-24: 1,73,500
EV – 4W (Cars & Buses)	The 4-wheeler e-Car segment has only 2 OEMs in the market - Tata and Mahindra. The e-Bus segment currently has 6-7 players - Tata, Ashok Leyland, JBM, Volvo, Deccan Auto etc.	During 2018-19, the industry sold around 3,600 electric cars, which is about three times more than the previous year. Close to 550 electric buses were sold during the 2018-19 financial year.	The industry currently employs close to 9,000 people, with close to 60 per cent being employed in the manufacturing function. The segment employs less than 25 per cent of its workforce on contract basis.	The future estimate for employment in the sector is expected to be as follows: 2018-19: 9,200 2019-20: 15,500 2020-21: 25,500 2021-22: 48,300 2022-23: 88,700 2023-24: 172,800
EV Charging Infrastructure	The segment has about 15 firms supplying EV Chargers in India - Exicom, RRT Electro Power, Mass Tech Controls, etc. Firms like ABB, Delta, Schneider, Siemens, Raychem RPG, etc. are watching the market closely with intent to enter. In the charging infrastructure space, NTPC, EESL, state DISCOMs and few private players have initiated work.	The EV charger market has been driven by sales to EV owners that use it for captive purposes. For public charging infrastructure, NTPC has been mandated to set up 100,000 EV charging stations, with EESL assisting in procurement.	The industry currently employs close to 2,000 people, all of whom are employed in the service function. Of this, about 15 per cent of the people in the segment are employed on contract basis	The future estimate for employment in the sector is expected to be as follows: 2018-19: 2,000 2019-20: 4,200 2020-21: 9,500 2021-22: 27,500 2022-23: 81,000 2023-24: 243,000
Battery Manufacturing	Lithium-ion batteries are currently imported either in cell form or in packs. Most of the electronics industry directly uses the imported battery packs. The Indian industry also has assemblers manufacturing battery packs from imported Li-ion cells.	During 2017-18, India imported 7 million units of Li-ion batteries with a cumulative value of USD 372 million. Of this, the automobile sector is estimated to have consumed close to 30 per cent of the imported battery units.	The industry currently employs close to 3,600 people. Most of this workforce is employed in the manufacturing and service functions. The share of contractual employees in the segment's workforce is slightly more than 20 per cent.	The future estimate for employment in the sector is expected to be as follows: 2018-19: 3,600 2019-20: 7,100 2020-21: 14,100 2021-22: 28,000 2022-23: 55,500 2023-24: 1,10,000
EV Components, Drones & telematics	Majority of the EV component suppliers in India are conventional electrical & electronic component companies – suppliers of motors, inverters & convertors, battery chargers, etc. Drones & telematics is a nascent industry consisting of a few large companies, but also a number of start-ups.	The EV components industry is expected to grow in sync with the EV vehicle industry, due to the increased share of domestic manufacturing, specially in the 3-wheeler segment. However, drones & telematics would continue to be a niche segment in the near future.	The industry currently employs close to 11,200 people. A large part of this workforce is employed in the EV component manufacturing and service functions.	The future estimate for employment in the sector is expected to be as follows: 2018-19: 11,200 2019-20: 15,100 2020-21: 22,800 2021-22: 38,300 2022-23: 67,000 2023-24: 135,700

Future employment in Indian Solar & LED industry

Segment	Industry Structure	Industry Overview	Employment Scenario	
			Current	Future
Solar Power Developers	India has more than 80 solar power developers actively carrying out business. Of these, more than 50 companies are medium to small scale developers. The industry also has a few (around 6-8) foreign companies.	Currently, more than 18 GW of solar power capacity is under construction. Almost all	The industry currently employs close to 97,000. Being a service industry, a large part of this workforce is employed in under the design and service functions.	The future estimate for employment in the sector is expected to be as follows: 2018-19: 77,000 2019-20: 85,200 2020-21: 94,400 2021-22: 110,200 2022-23: 114,900 2023-24: 118,000
Solar EPC & System Integrators	India has more than 150 firms that provide EPC service for the solar power industry. The industry has a complex mix of companies from varying backgrounds –solar equipment suppliers, conventional EPC contractors, etc.	of these solar power projects are being carried out through EPC companies.	The industry currently employs close to 80,000. Being a service industry, a large part of this workforce is employed in under the design and service functions.	The future estimate for employment in the sector is expected to be as follows: 2018-19: 100,500 2019-20: 107,800 2020-21: 115,500 2021-22: 122,800 2022-23: 130,300 2023-24: 136,000
Solar O&M	The solar O&M segment has more than 450 companies. Of this, more than 50 companies are primarily solar EPC companies. About 400 dedicated solar O&M companies are present in India, which mostly cater to small rooftop systems up to 50 kW in capacity.	It is estimated that, as of 2019, close to 17 GW of Indian solar power capacity is under outsources O&M activities. The estimated size of the industry in 2019 is around INR 2,200 crore.	The industry currently employs close to 72,200 people in various functions & capacities. The entire workforce in this industry is employed under the service function.	The future estimate for employment in the sector is expected to be as follows: 2018-19: 72,200 2019-20: 90,300 2020-21: 123,300 2021-22: 147,700 2022-23: 170,500 2023-24: 197,500
Panel & Module Manufacturers	India has about 60 companies manufacturing solar panels & modules in the country. These companies are capable of manufacturing both mono-crystalline and poly-crystalline panels of capacities up to 320 kWp.	The local manufacturing industry is under threat from lower-priced imported modules from China and USA. Close to 80% of solar cell and 50% of the solar panel manufacturing capacities in India are lying idle, as of 2019.	The industry currently employs close to 22,450 people in various functions & capacities.	The future estimate for employment in the sector is expected to be as follows: 2018-19: 22,500 2019-20: 24,000 2020-21: 26,500 2021-22: 32,500 2022-23: 38,500 2023-24: 42,500

Future employment in Indian Solar & LED industry

Segment	Industry Structure	Industry Overview	Employment Scenario	
			Current	Future
Solar Inverter & Solar BOM System Manufacturers	The solar inverter industry consists of two types of companies – Domestic inverter manufacturers (such as ABB, Schneider, Hitachi, etc.) and Foreign inverter suppliers (such as SMA, Growatt, Fronius, TBEA, Sungrow, etc.)	The inverter market for the year 2018-19 has been estimated at 6.9 GW, which translates to close to INR 1,100 crore in value terms.	The industry currently employs close to 27,800 people in various functions & capacities. The manufacturing function employs more than 50 per cent of this workforce.	The future estimate for employment in the sector is expected to be as follows: 2018-19: 27,800 2019-20: 30,700 2020-21: 34,300 2021-22: 37,800 2022-23: 39,800 2023-24: 41,000
LED	The Indian LED industry consists of about 330 companies. These companies can be categorised into 3 segments – 8 major companies, 50 emerging companies and more than 250 small scale companies. The industry also has around 7,000–8,000 LED repair shops in the unorganised sector in India.	The lighting industry is expected to grow from INR 24,500 crore in 2018-19 to reach about INR 36,500 crore by the year 2023-24. During this period, market share of conventional lighting will diminish to give way to LED lighting.	The industry currently employs close to 68,000 people in various functions & capacities. Manufacturing and service functions have a strong representation, when compared to the design function.	The future estimate for employment in the sector is expected to be as follows: 2018-19: 61,000 2019-20: 66,000 2020-21: 72,000 2021-22: 79,000 2022-23: 85,000 2023-24: 90,000

Future employment in Indian Security & Surveillance industry

Segment	Industry Structure	Industry Overview	Employment Scenario	
			Current	Future
Security & Surveillance Products	The Indian security & surveillance industry is a complex mix of multiple products with Building Management System being the core product. Some of the prominent sub-segments include CCTV cameras, fire safety system, HVAC & lighting control, alarm systems, etc.	As of 2018-19, the security & surveillance industry is valued at about INR 24,500 crore in size. The industry is expected to grow at a steady CAGR of 12 per cent to reach INR 44,000 crore by the year 2023-24.	The industry currently employs close to 100,000 people in various functions & capacities. Of this, about 16,000 employees are involved in the system integration & video analytics business alone.	The future estimate for employment in the sector is expected to be as follows: 2018-19: 100,000 2019-20: 113,000 2020-21: 128,000 2021-22: 145,000 2022-23: 165,000 2023-24: 185,000

Future employment in Indian Industrial Automation industry

Segment	Industry Structure	Industry Overview	Employment Scenario	
			Current	Future
Home Inverter & UPS	The Indian Home inverter and UPS industry consists of about 150 companies. These companies can be classified into 3 categories – 5 national players, 50 regional players and more than 100 local players.	Home inverter and UPS market is expected to grow from INR 11,450 crore in 2018-19 to reach about INR 16,000 crore by the year 2023-24.	The industry currently employs close to 1,27,000. The industry has a significant service infrastructure, which employs a large number of people.	The future estimate for employment in the sector is expected to be as follows: 2018-19: 1,27,000 2019-20: 1,35,000 2020-21: 1,45,000 2021-22: 1,55,000 2022-23: 1,63,000 2023-24: 1,76,000
HVAC Industry	The Indian HVAC industry has more than 100 companies. These companies can be classified into 3 categories – 6 large MNC players, 7-8 domestic players and more than 80 importers,	Indian HVAC market for the year 2018-19 is estimated at INR 27,900 Crore, which is expected to grow and pass INR 42,000 crore by 2023-24. The expected growth rate for the industry is pegged at 8.6 per cent.	The industry currently employs close to 70,000. A large part of this workforce is employed under the service function.	The future estimate for employment in the sector is expected to be as follows: 2018-19: 70,000 2019-20: 75,000 2020-21: 82,000 2021-22: 90,000 2022-23: 97,000 2023-24: 1,05,000
Machine OEMs	The Indian Machine tools industry has more than 400 companies. Nearly 200 manufacturers can be categorized as part of the organised sector, while the remaining are operating in the small ancillary sector.	It is estimated that, as of 2019, close to INR 16,250 crore of Indian machine tools industry. India stands 12th in production and 8th in the consumption of machine tools in the world.	The industry currently employs close to 89,000. Being a manufacturing industry, a large part of this workforce is employed in under the design and manufacturing functions.	The future estimate for employment in the sector is expected to be as follows: 2018-19: 89,000 2019-20: 95,000 2020-21: 1,00,000 2021-22: 1,10,000 2022-23: 1,10,000 2023-24: 1,20,000
Industrial Automation	The Indian industrial automation industry has about 250 companies. These companies can be categorised into three – 10 International players, 40 National players and more than 100 local players.	Automation market for the year 2018-19 has been estimated at INR 42,000 crore, which is expected to grow at about 12 per cent CAGR to reach INR 73,000 crore by 2023-34.	The industry currently employs close to 98,000 people in various functions & capacities.	The future estimate for employment in the sector is expected to be as follows: 2018-19: 98,000 2019-20: 1,07,000 2020-21: 1,17,000 2021-22: 1,27,000 2022-23: 1,37,000 2023-24: 1,47,000

Key skills required in the six sub-sectors of Electronics industry

PCB Design & Manufacturing		Design - Library accuracy, signal behavior, power integration, thermal analysis, and experience of various tools.
		Manufacturing - Practical knowledge of machine operations like mechatronics, electroplaters, fitters, circuit routing, schematics
		Service - Mechanical drafting, electronic structuring, electronic fabrication, laboratory courses.
Semiconductor & Components		Design - Library development, component location on PCB, component identification, specification.
		Manufacturing - Knowledge of circuit boards, processors, chips, electronic equipment, and computer hardware & software.
		Service - Technical knowledge of components, repair services like soldering, component handling etc.
E-Mobility & Battery		Design - Battery management, battery safety. battery & charging system design, drive-train (motor, transmission, inverter).
		Manufacturing - Li-ion batteries expertise, EV power train, performance analysis of battery, testing and debugging, validation.
		Service - Electric vehicle charging, packaging & transportation of Li-ion batteries, troubleshooting, electrical power cabling.
Solar & LED		Design - Knowledge of RE screen software, , HeliScope, site analysis, 2D/3D design, LED efficiency (Lumens).
		Manufacturing - Testing of PV modules, solar packaging, electrical measurement, soldering techniques.
		Service - Solar panel repairs, wiring & installation, basic knowledge on installation of floating solar, LED repairs.
Security & Surveillance		Design - Circuit design, logic gates, MATLAB design, advanced mathematics. tools like C++, LabVIEW.
		Manufacturing - Knowledge of safety aspects in manufacturing, digital control systems, Bio-medical instrumentation etc.
		Service - Troubleshooting, assembling & disassembling, repair & monitoring of alarm systems, CCTV systems.
Industrial Automation		Design - General assembly drawings (GAD), PLC & HMI Programming, Control Systems Design, Process Automation.
		Manufacturing - Product validation & verification, reliability testing, ability to use various machines and hand tools.
		Service - Preparation of budget, EHS management, Industry 4.0, IoT and smart factory, Lean Manufacturing.

Challenges faced by the industry in recruitment

01

A key requirement for this mega industry is the presence of a ready pool of multitalented manpower to rely-on on a regular basis. Lack of this ready talent-pool has resulted in low employability of new entrants into the workforce. Companies are currently investing capital and time to train their employees to make them job-ready.

02

Another key challenge is of lack of technical competency. Many of the latest manufacturing plants require niche skills, in addition to computer knowledge, and this combination-skill is currently not readily available in the job-market.

03

The ability of employees to quickly adapt to new technologies has also been observed to be low, across almost all segments.

04

With the industry becoming more and more global, lack of soft skills among prospective-hires affects the hiring process. Poor verbal and written communication skill are increasingly being viewed as a drawback, given the growing number of customer-touch-points the industry is witnessing today.

05

Most employees face financial constraints when it comes to self-learning, especially in the Services segment. Migrant workers, having come from rural areas, often lack financial muscle to self-train and upgrade their existing skills.

06

The industry has a serious lack of adequate number of training institutions & finishing schools focusing on quality training for installation, service and repairs. There is also a significant mismatch between academic courses and the actual skillset required.

Industry initiatives to address skill challenges:

01

Conventional Training & Induction

Under this program trainers travel to different locations where Group or Team Leaders are asked to come together, and training is imparted at the zonal location.

02

Specialized training

This form of training is targeted mainly at Mid-level employees, wherein Engineers and Senior Technicians are provided training at the company training centres.

03

Ad-hoc training

This is mainly for the Senior Management and consists primarily of online courses and on-site global visits on a need-basis.

Overview of some skilling initiatives being run in India

PCB D&M	<ul style="list-style-type: none"> Companies like Sienna Ecad and Weruth Electroniks are training Diploma holders and Graduate Engineers on tools like CAM, CAD, Design Library, PCB layout etc. by visiting their institutes. ITI Limited, Bangalore has signed an MoU with Telecom Sector Skill Council (TSSC) to promote and develop telecom skills across students, technicians and ITI/Diploma holders.
Semiconductor & Components	<ul style="list-style-type: none"> Institutes like NTTF, which train diploma holders is working with NSDC for skill development, even on latest technologies like IoT, Deep Learning, Artificial Intelligence, etc. Sasken Technologies have an in-house training center where they provide training on skills including ICDS, EDA, IoT, FPGA, and embedded programming. Intel has trained more than 100,000 students & developers on Artificial Intelligence. Infineon has tie-ups with NSDC to provide training on semiconductors & chip technology.
E-Mobility & Battery	<ul style="list-style-type: none"> Diyaguru Education And Research Private Limited is a skill partner for NITI Aayog Electric Vehicle Mobility Vision 2030. Advance Electrical Design & Engineering Institute has been authorized under the National Institute for Entrepreneurship and Small Business Development (NIESBUD). MakerMax is a Canadian Online resource start-up that has started India-specific programme on Electric Vehicle Battery and BMS Masterclasses.
Solar	<ul style="list-style-type: none"> Tata Power Solar Systems Limited is imparting skill training through the Tata Power Skill Development Institute. Aveon Technologies had tied-up with NISE (National Institute of Solar Energy) to train ITI/Diploma holders and attain the Suryamitra certification. Mahindra Susten is providing training at the Solar Skill Training Centre, Karjat, and have trained around 775 students so far in various programmes. Vikram Solar has adopted the Industrial Training Institute (ITI) at Bahal under Public-Private Partnership to upgrade it into a Centre of Excellence (BRCM Skill Development Training Centre)
LED	<ul style="list-style-type: none"> Philips is operating a university offering a range of educational resources like webinars and online courses to expand knowledge on lighting, along with an LED certification program. Havells has come forward to provide vocational training to enhance employability. Their state-of-the-art electrical skill center at Pusa ITI provides industrial training to youth.
Security & Surveillance	<ul style="list-style-type: none"> HAIL (Honeywell Automation India Ltd.) has a separate wing that trains people on various technologies to meet the global standards. Hikvision has launched an Integration Partner Program that train participants in skills including technical support, SKD training, integration support, co-marketing etc. Johnson Controls runs Johnson Controls Institute for HVAC which partners with colleges, institutes, and experts from building industry to provide a high quality practical training. CPPlus conducts a Government-approved training initiative on surveillance technologies & offers hands-on experience of all types of security solutions & equipment.
Industrial Automation	<ul style="list-style-type: none"> Sofcon India Pvt Ltd. is an NSDC affiliated Company that runs courses in Industrial Automation, Building Automation, MATLAB, Embedded Systems and LabVIEW. Cetpa Infotech provides training on topics such as PLCs, SCADA, VFD, HMI, Wiring of PLC, Panel designing, Relays, Contactor, PID, Sensors, Electrical CAD etc. Dynamic Institute of Automation & Controls (DIAC) imparts training on cutting-edge Industrial Automation technologies to fresh Engineering Graduates and Diploma holders.

Approach & Methodology

Feedback Consulting is a 34-year-old Industrial Research and B2B Research-based Consulting firm. The Bangalore head-quartered company brings to the table extensive experience gathered across industry segments and has been in the forefront of new technology and business evolution in India.

Feedback was commissioned by Electronics Sector Skills Council of India (ESSCI) to conduct an in-depth research on the identified subject.

ESSCI, envisions to enable a world-class Electronics Manufacturing industry in India. The organization aspires to create an ecosystem for skill development with an eye to enhancing the employability of the large number of Indian human resource spread across the country.

As part of its forward-looking agenda, ESSCI undertakes regular market research to identify industry trends which in turn lead to emergence of new jobs and connected Job Roles in the Electronic Design, Manufacturing and Services segments.

We, at Feedback Consulting, through our research have endeavoured to equip ESSCI in understanding the current and changing scenario and the potential for jobs in the Electronics value chain in India, across the existing and new emerging sectors.

The objective was to develop a detailed study of the market, complete with recommendations for the Ministry and the Industry, to work towards not just more job creation but also to create a pool of suitably skilled professionals who would meet the requirements.

This engagement was carried out along the lines of an earlier study conducted by Feedback for ESSCI covering four sub-segments of the Electronics industry. This study had helped shine light on the existing market scenario and the job creation potential offered by these segments.



Primarily, the objective of the study was to identify the current volume of employment in each of the six segments, and its sub-segments, and how the employment numbers are expected to change over the next 5 years.

The study also aimed to understand the areas of employment in each of the segments, and the associated qualifications and skill requirements expected from an employee staffing that area.

The conducted survey was comprehensive, encompassing not just the organised design, service and manufacturing operations, but also any

unorganised sub-segments that may be present in the industry.

Impact of changing technology trends on the skilling requirement of the industries was also investigated. Special attention was paid to segments have the potential to be disrupted by Industry 4.0 (IoT, Robotics), AI-ML and advanced levels of automation.

Additionally, representative of companies from the different segments were consulted to understand their view of the future recruitment trend in their segment. This metric was used as a validation for estimates arrived at through extrapolation.

Principle used for estimation

Feedback Consulting adopted a strategic “Norms”-driven approach for the estimation of the employment figures in each of the segments.

Norms helped link the required data point i.e. the number of employees with high-level statistics (such as annual revenue, annual production, etc.)

which could be used extrapolate and generate estimate for the entire segment or sub-segment.

The norms were based on analysis carried out on the data collected from a wide variety of sources – representatives of companies active in the segment, industry experts and targeted research reports.

Data sources used for this study

The study deployed several key initiatives in identification of stakeholders and in the study of existing literature. Following this a qualitative as

well as quantitative analysis was undertaken; post which trends and projections were derived, which were interpreted to arrive at the conclusions.

To get a clear picture at the shop-floor level, extensive data collection from various sources was undertaken by Feedback Consulting. These included:

Centralized Desk-based Research to identify existing literature (for the timespan 2019-2024). Thus, review of several identified surveys and reports generated by Industry Associations, Government Organizations, Labour Bureau, and Market Research organizations was carried out. The data collated also included published research reports from large job aggregators such as Naukri, Monster, Timesjobs & Indeed, to name a few.

Interviews were carried out with HR, Leaders, CEO's and Policymakers deemed relevant to the study. This was conducted over phone, in-person, over video & teleconference, and emails using a structured questionnaire containing wide-ranging and in-depth queries.

Engagement framework

The focus of the survey was restricted to 6 key sectors. This included segments such as PCB design and manufacturing, semiconductors & components, solar & LED, E-Mobility and battery, security & surveillance, and industrial automation

The engagement framework for this study covers the existing electronics sector jobs from design, manufacturing and services functions. It explores the current and potential jobs, and the skills required for these jobs.

Analysis of new investments in the sector, the traditional industry growth, and emerging technology trends in the industry, an attempt was made to predict the potential for employment generation during the next 5 years across the six segments.

Each of the segments were further segregated into its key sub-segments to add greater detail and granularity to the estimation exercise being carried out.

Classification of Sub-sectors

PCB Design & Manufacturing

- PCB Assembly
- PCB Manufacturing

Semiconductor & Components

- Semiconductors
- Semiconductor components

E-Mobility & Battery

- EV 2W / 3W
- EV - 4W (Cars) and E-Buses
- EV Components - Motors and Electronics
- EV Charging Infrastructure Services
- Battery Manufacturing Business
- Drones and Telematics

Security & Surveillance

- Security & Surveillance Systems
- Fire Safety System
- HVAC Controls
- Lighting Controls
- BMS Solutions

Solar & LED

- Manufacturers & suppliers of Solar Module, Solar Cell, Solar Wafers
- Manufacturers & suppliers of Solar Inverters
- Solar BOM Systems
- EPC firms - Installation & Commissioning
- Solar System Integrators
- Solar Operations & Maintenance Services
- Solar Developers
- LED Lighting

Industrial Automation

- HVAC OEM & Service Providers
- Energy Service Companies – Energy meter / UPS & Inverter
- Machine OEM's - CNC / NC / Machine Manufactures
- Solution Providers
- Product Automation Suppliers
- System Integrators
- IIoT / Industry 4.0 / M2M / SCADA / Super SCADA
- Mechatronics / PLC / HMI / ATM / KIOSK / AFD
- Robotics / 3D Printing / Electric pneumatic

Approach to current job estimation

Feedback approach to evaluate 'current' and 'projected Job requirements going forward' involved a systematic 'Norms-driven' approach.

The various steps undertaken included:

1. Collection of primary data: on the number of jobs required at different levels across the board (including low, mid, and high-levels; Design, Manufacturing and Services functions). The data so collated was then linked to the total production or sale of product (or unit) to arrive at a norm, for example - 0.039 jobs for every Electric Vehicle manufactured.
2. These norms were then validated across different companies in various sub-sectors, to arrive at an industry or segment-specific Norm.
3. Projected growth of the industry was then evaluated and 'taken into account' to arrive at the estimated job requirements using these Norms.

An estimate of the number of jobs per Sector was then validated through different sources. These included:

1. Validation through published news reports and industry as well as ministry reports
2. Validation post interviews and verifications by Industry leaders, Industry Association and major players. Data points were collated regarding their views on the likely trends and employment possibilities going forward.

Sample size used for the purpose of the study

Segment	Sub-Segment	Large	Medium	Small	Total
PCB Design & Manufacturing	PCB -A	2	2	6	10
	PCB-M	7	8	15	30
Semiconductors & Components	Semiconductor	8	16	37	61
E-Mobility & Battery	EV 2W / 3W	4	4	7	15
	EV - 4W (Cars) and E-Buses	3	3	8	14
	EV Components	3	4	4	11
	EV Charging Infrastructure	2	4	2	8
	Battery Manufacturing	3	3	4	10
	Drones and Telematics	6	4	3	13
Solar & LED	Solar Module + Solar Cell	4	5	6	15
	Solar Inverters	2	3	3	8
	Solar BOM Systems	3	4	9	16
	EPC firms	5	6	9	20
	Solar System Integrators	4	5	12	21
	Solar O&M	5	5	5	15
	Solar Developer	2	1	1	4
LED	8	16	31	55	
Security and Surveillance	Security and Surveillance	9	9	77	95
Industrial Automation	HVAC Industry	6	3	5	14
	Home Inverter and UPS	4	6	8	18
	Machine OEMs	6	8	16	30
	Solution Providers	2	2	1	5
	Product Automation Suppliers	3	1	2	6
	System Integrators	3	2	6	11
	IIoT / Industry 4.0	3	2	1	6
	Mechatronics / PLC	4	5	3	12
Robotics / 3D Printing	1	2	3	6	
Grand Total		112	133	285	530

To arrive at the Job Estimation figures, a comprehensive methodology was adopted to get the best possible estimates.

As the first step, information across all product segments, encompassing all, the Large, Medium and even the few Small players was collated. This ensured a greater understanding of the industry scenario, in terms of their current employee strength in the Design, Manufacturing and Service functions.

Next, an extrapolation exercise with the Norms-estimation methodology was undertaken for each of the product segments to arrive at an estimate for the universe of that segment.

It needs to be kept in mind at this juncture, that in the Security & Surveillance and Solar & LED sectors, there is a significant section comprising of the unorganised service personnel (and standalone repair shops). The final estimation, for these industries was arrived at keeping this in view.



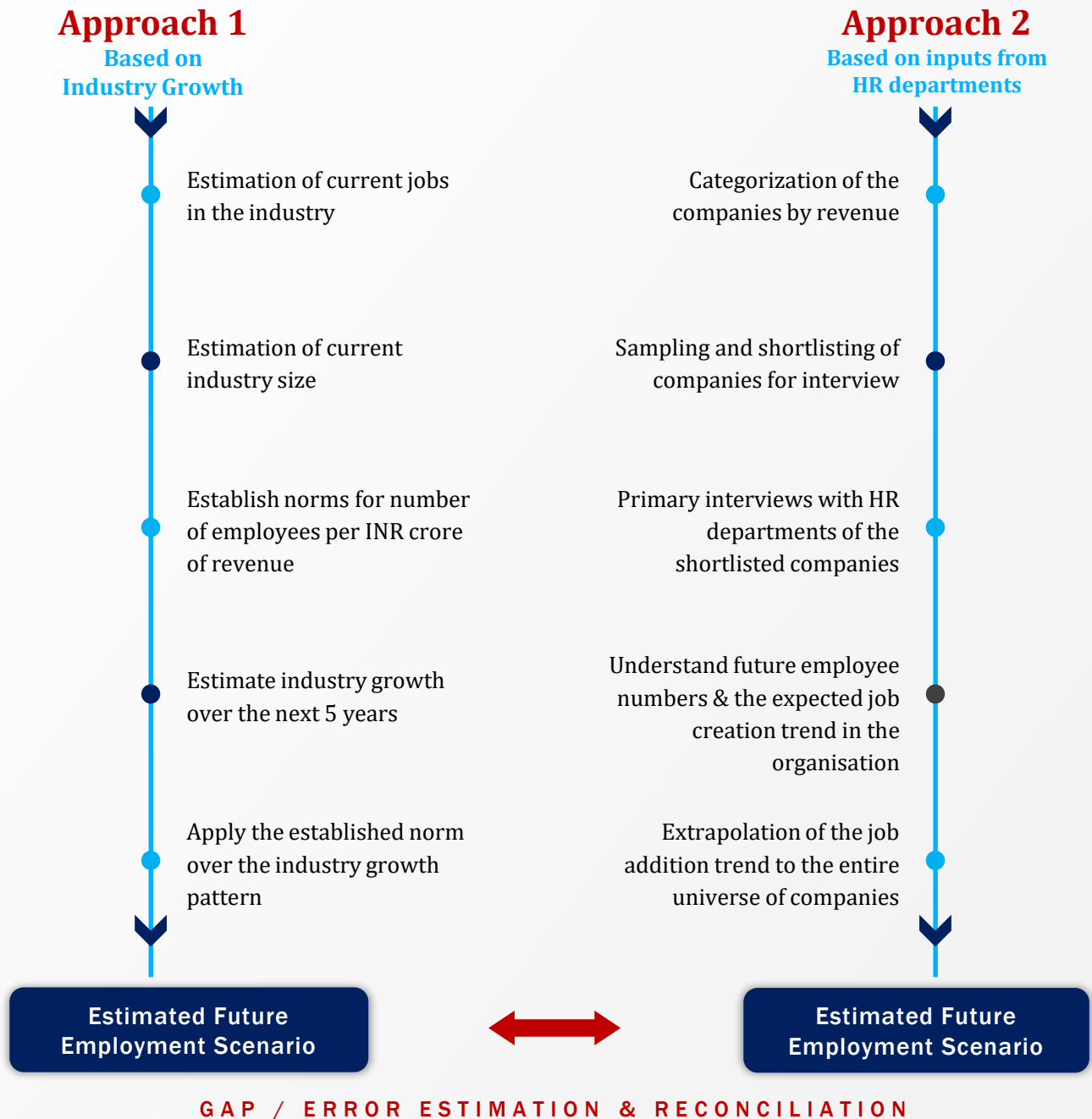
Approach to estimate future employment generation

Potential employment generation estimates were arrived at through 2 parallel approaches:

The first approach used an industry norm was built using the employment data collected from a sample of industries. The norms were then superimposed onto the growth trend projected for the segment to arrive at a future estimate.

The second approach was based on primary interviews conducted with the HR department of sampled companies. The respondents were asked to comment on the future employment generation trend in their company under the various functions.

The estimates arrived at through both the approaches were compared & reconciled to finalize the future employment estimates for the industry.



PCB Design & Manufacturing



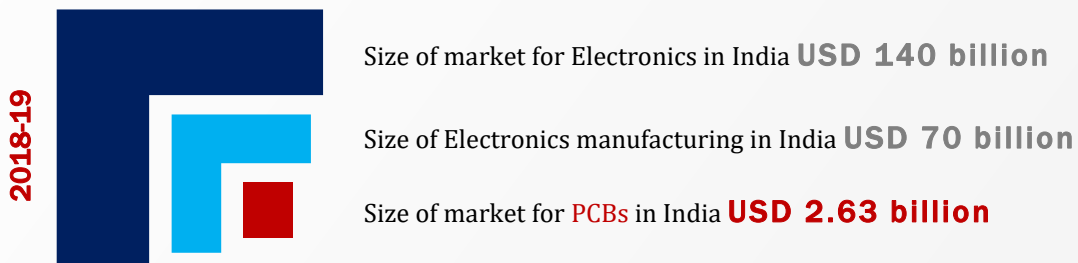
Sector overview

Printed Circuit Boards are the backbone of all electronic devices powering the global economy. PCBs have been instrumental in reducing the size of such devices across segments like Consumer Electronics & Mobile Phones to Industrial Electronics, Defense Electronics and Computer Hardware.

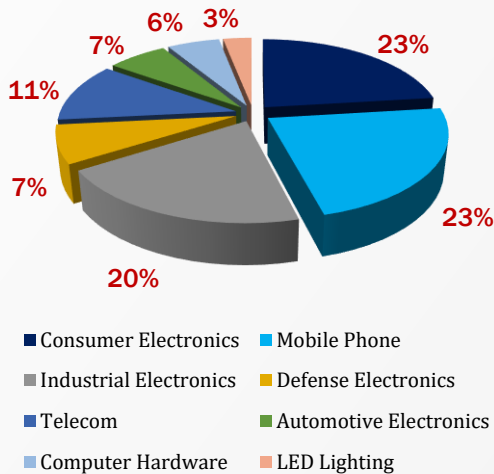
Currently, only 50% of this demand for electronics is being met through local manufacturing, while the remaining is being imported. For the electronics being manufactured in India, the current demand for PCBs is estimated to be around USD 2.64 billion – of which, bare PCBs account for USD 1.52 billion.

By 2024, size of electronics market in India is expected to reach USD 400 billion – registering a CAGR of 27 per cent. In 2018-19, the market size stood at USD 140 billion.

However, only one-third (about 34 per cent) of the domestic demand for bare PCBs is currently being met by local PCB manufacturers. Rest of the bare PCBs demand (about 66 per cent) in India is being met through imports.

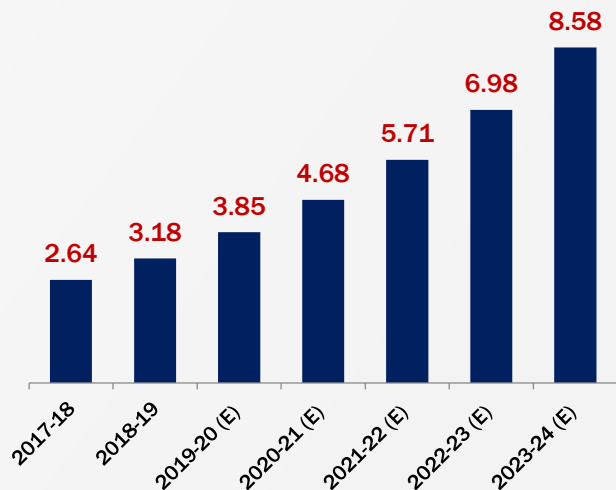


2017-18 PCB Demand by Industry



Source: ELCINA

Indian PCB Demand Outlook (USD billion)



Source: ELCINA

Capabilities of Indian PCB Industry

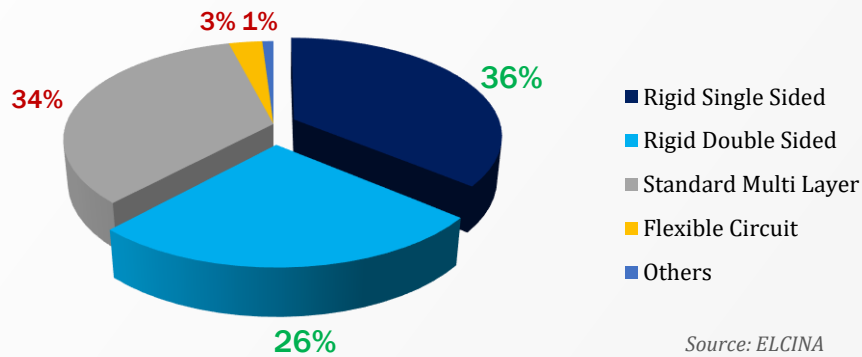
Indian industry has about 200 PCB manufacturers - more than 60% of which are very small and unorganised. Additionally, there are about 20 raw materials suppliers present in the industry.

The Indian PCB manufacturers have a strong capability in manufacturing of single-sided, double-sided PCBs, and multi-layer PCBs having 4-6 layers.

These manufacturers have adopted high mix-medium volume strategy when a large number of PCBs are manufactured in low-to-medium volume.

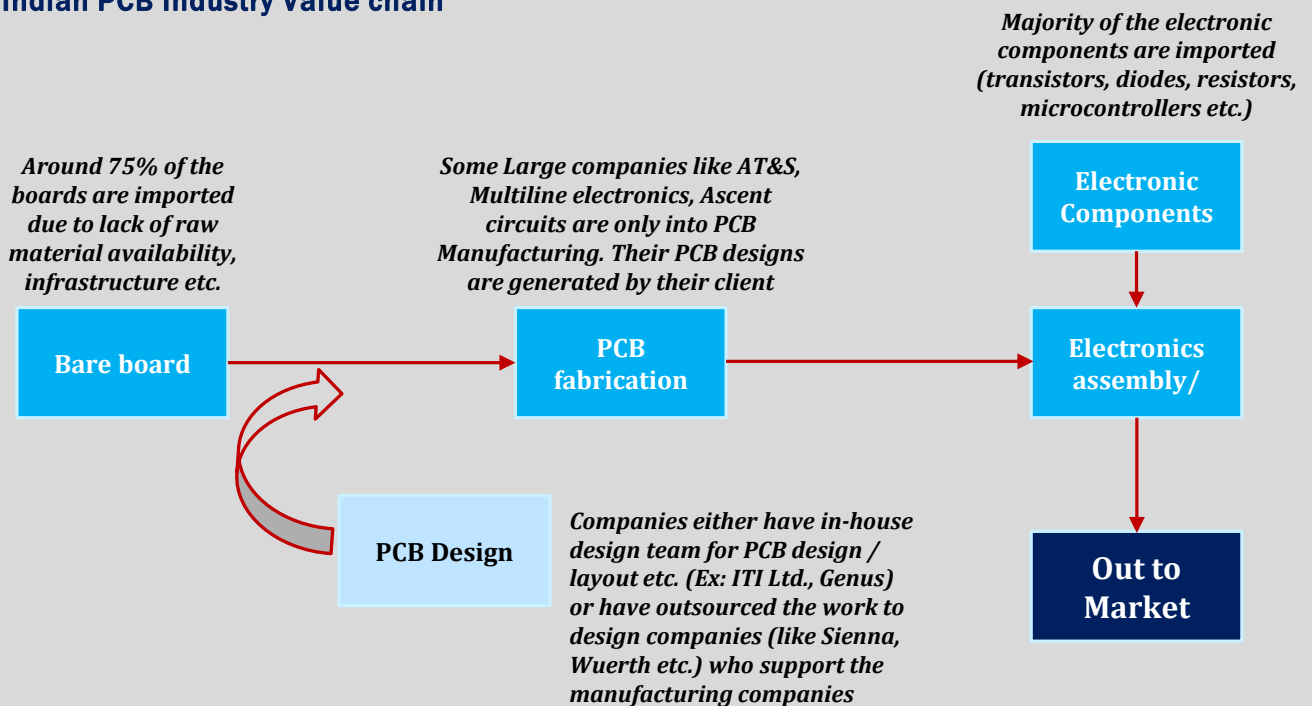
Globally, the demand for flexible circuits is expected to grow much faster than that for rigid PCB, primarily due to its advantages such as form factor reduction and elimination of connectors.

Production Capabilities of Indian PCB Manufacturers



Source: ELCINA

Indian PCB Industry Value chain

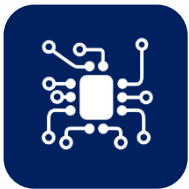


Hurdles for growth of PCB industry in India



Technical Capability

Majority of the Indian PCB manufacturers do not have the capability to manufacture PCBs for mobiles, telecom, defence or computer hardware applications. The industry is limited to manufacturing of automotive PCBs and LED PCBs that have very low operating margins. The Indian Government's M-SIPS initiative will help the Industry improve its technical capability, but it may still be difficult to compete with China in terms of price of finished product.



Raw Material Availability

None of the key raw materials required for manufacturing of PCBs are produced in India. Laminates, dry films, solder masks, copper balls, tin balls, plating chemicals, copper foil, Pre-preg etc. are all imported, mainly from China and other Far East countries



High Capital Costs

As in the case of raw materials, very few suppliers of PCB manufacturing equipment are manufactured in India. On the other hand, practically every global manufacturer of PCB manufacturing equipment has large manufacturing facilities in China



Manpower Productivity & Work Quality

With low manpower productivity, dedication, and work quality issues being faced in India, it is difficult to hold workers accountable due to restrictive labour laws applicable in the country



Infrastructure & Taxation

Although there has been a steady increase in the quality of infrastructure available in the country, demand still exists for better power supply, water supply, roads & highways, telecom, connectivity and logistics

Import of raw materials by PCB manufacturers resulting in escalation of manufacturing costs



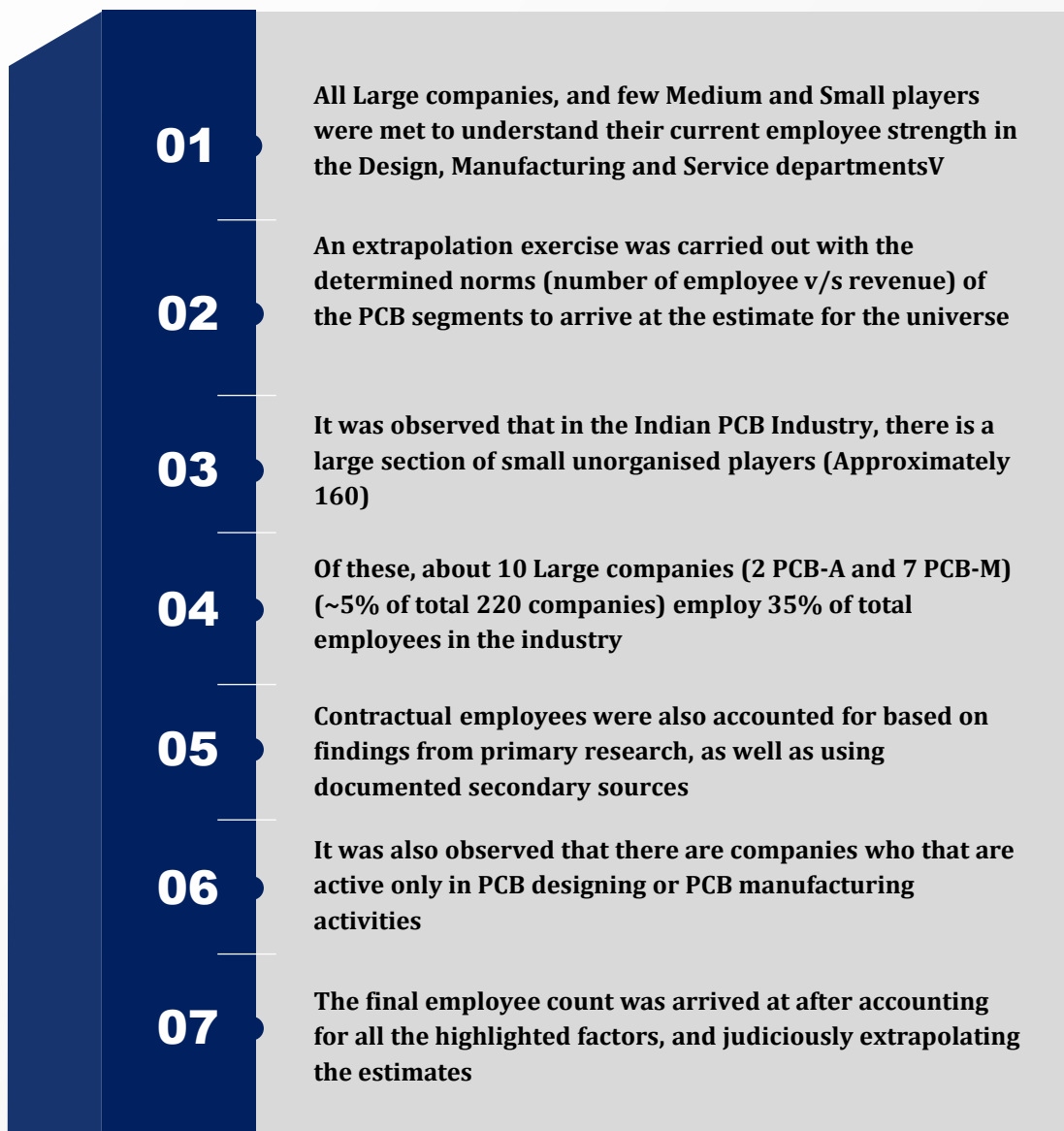
Approach to estimate current employment in Indian PCB Design & Manufacturing industry

The Indian PCB industry has about 200 entities, of which 150 are PCB manufacturers, while the remaining 50 are assemblers of PCB. A sample of 40 companies was identified – containing a mix of all the large companies, and a few medium & small scale companies. The sample contained 30 PCB manufacturers, along with 10 PCB assemblers.

The companies in the sample were interviewed to understand their current employee strength, and its

categorization on various parameters such as – type of employees (on-role v/s contractual), function (design v/s manufacturing v/s service) and their level of seniority.

Norms for number of employees were established separately for both the PCB manufacturing and PCB assembly segments of the industry. Estimates were arrived at for both of these segments through judicious extrapolation of the gathered data.



Current employment scenario in Indian PCB Design & Manufacturing industry

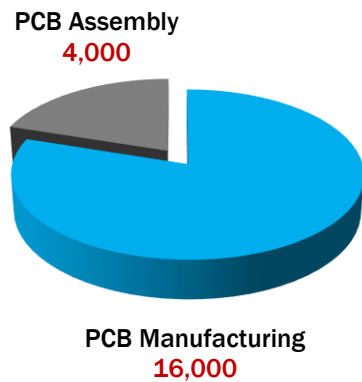
It is estimated that the Indian PCB industry employs around 20,000 people across departments, and across the organisational hierarchy. More than 41 per cent of the entire workforce employed in the industry is on contractual basis, while the remaining are on the payroll of the companies.

Large companies such as AT&S, Ascent Circuits Ltd. have outsourced the designing function, while only

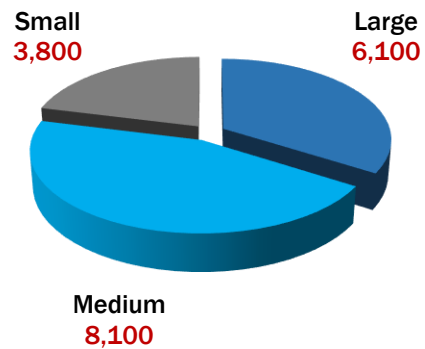
carrying out manufacturing operations, which reduces the count of design staff in such companies. On the other hand, companies like Sienna ECAD Pvt. Ltd, Wuerth Elektronik India are majorly into designing PCBs for the various manufacturers.

The average number of employees in a company from the PCB industry range from 35 to about 500 depending on the category of the company.

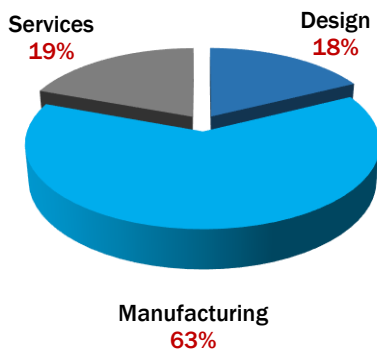
PCB Manufacturing is far more popular than PCB Assembly – This reflects in the number of employees for these segments



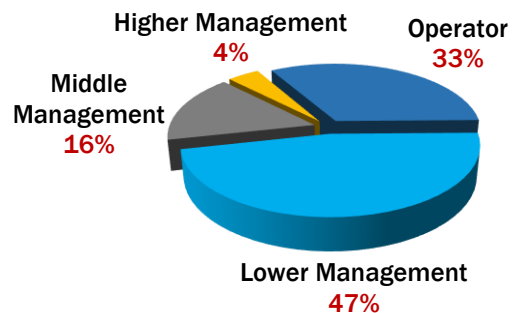
Large & medium scale companies together employ more than 80% of the entire workforce in in the industry



Manufacturing functions employ close to two-thirds of the entire employee base of the Indian PCB industry



20 per cent of the employee base manages the work carried out by the operators & supervisory staff (remaining 80 per cent)



Approach to estimate future employment in Indian PCB Design & Manufacturing industry

Potential employment generation estimates were arrived at primarily by using the revenue per employee norms. These norms are established based on the primary interviews conducted with the HR and department heads from a number of

companies in the PCB industry. The norms are then superimposed on to the industry growth projections to arrive at a realistic estimate for the job growth expected over the forecast period.

01. PCB Manufacturing Segment

Estimate the current and expected demand for PCB in India till 2023-24

Established revenue per employee norms are considered to estimate the likely future employee strength using forecasted PCB demand

Calculated growth trend was estimated to be 24 per cent till 2022, and 27 per cent between 2022 and 2024

Overall Growth in Employment in the PCB Industry was arrived at by combining these **TWO** sub-segments

02. PCB Assembly Segment

Demand-side estimation was not feasible for the PCB assembly segment due to its dynamic nature

The normalised growth rate of 15 per cent CAGR was considered to estimate the number of people employed in the PCB assembly segment

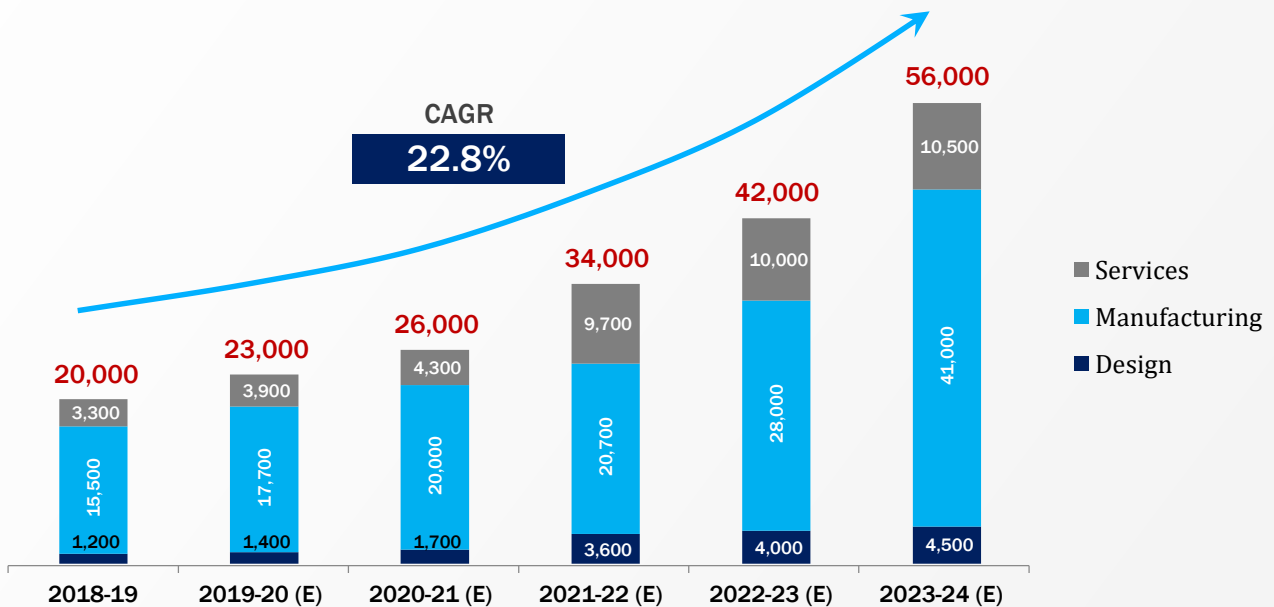
Future employment scenario in Indian PCB Design & Manufacturing industry

Employment in the PCB industry is expected to grow by 36,000, and reach 56,000 employees during the 5 year period between 2019 and 2024. This growth in employment is expected to be dominated by the PCB manufacturing segment which would accommodate around 90% of the employment generation.

This growth in employment is expected to be driven largely by the massive growth in demand for electronic products in India. This growth in demand will facilitate demand for PCB manufacturing companies, which in turn will create opportunity for

employment. The growth in employment is expected to accelerate post 2021, mainly driven by the introduction of large scale mobile manufacturing facilities in India.

The PCB assembly segment, although growing slower than the PCB manufacturing segment, is expected to create around 4,000 jobs during the 5 year period from 2019 to 2024. The segment's growth would continue due to the lack of raw material availability, and the country's continued dependence on imported PCB boards.



Emerging areas where skilling would be required in future

High Power Boards

These PCB's support voltage levels of 48 V or higher, which enables the designer to build compact power circuits, and mount larger components like battery packs while dealing with interference issues effectively.

HDI & Microvia

High Density Interconnection (HDI) circuit boards and Microvia Technology is a laser drilling process that helps create electrical connection in between layers on a multilayer circuit board design.

Internet of Things

Multi-tiered design strategy employed in IoT devices requires fast communication (mostly wireless) between layers & element of the IoT network.

Flex PCBs

Flex and rigid-flex PCBs are rapidly gaining market share in PCB development across the world. It is predicted that 75-80% board would be printed on flex PCB boards by the year 2021.

Skilling requirement for Indian PCB Design & Manufacturing industry

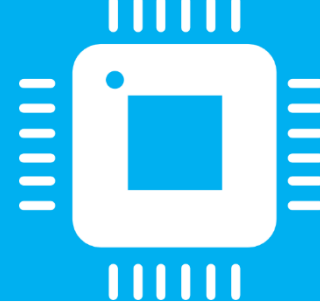
Qualification requirement

Employee level	Design	Manufacturing	Services
Operator	Library Accuracy	Practical knowledge of machine operations like mechatronics, electroplaters, fitters	Any Degree (preferably technical Degree)
Lower Management	CAD, CAM EAD, PCB design, PCB layout, DFM, component planning	Understanding of workflow, technical knowledge of PCB, process and maintenance, PCB engineer, CAM engineer	Sales Experience, Selling, Technical knowledge (not mandatory)
Middle Management	Signal behavior, power integration analysis, thermal analysis, and experience of various tools, management	Team management, supervision, production management, supply chain management	Marketing and sales experience, ability to crack deals and convenience, key account management
Higher Management	Experience in handling project and ability to drive business and lead organization	Bachelors degree in Engineering with minimum 15 years of experience (Generally promoted from same organization). Masters degree / Doctorate is considered if recruiting from outside.	Sales strategy, planning, business lead, strategy

Skill requirement

Employee Level	Design	Manufacturing	Services
Operator	ITI / Diploma	ITI / Diploma	Any Degree (preferably technical degree)
Lower Management	Diploma / Engineer	Diploma (with Experience) / Engineer	Any Degree
Middle Management	Engineer with 5-10 years of experience	Bachelors degree in Engineering with experience (Masters degree is not mandatory, but will be considered)	Any degree with 5-8 experience in sales function. MBA with 3-5 years of experience preferable.
Higher Management	Engineer with minimum 10 years of experience. Masters degree / Doctorate is not mandatory, but preferable	Bachelors degree in Engineering with minimum 15 years of experience (Generally promoted from same organization). Masters degree / Doctorate is considered if recruiting from outside.	Technical Degree with minimum 10 years of experience. MBA in Marketing & Sales is preferable.

Semiconductor & Components



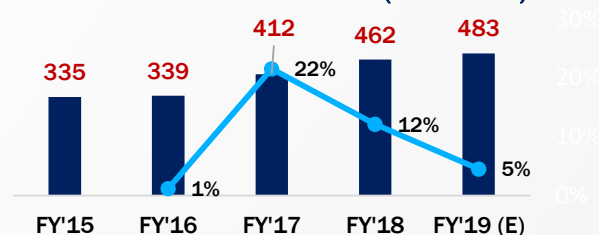
Sector overview

The global Semiconductor industry has been valued at about USD 483 billion in 2018-19. The industry has been growing at a CAGR of 9.5 per cent for the past 5 years. Nearly half of the industry's revenue is generated by US companies like Intel, Qualcomm, Micron, Texas Instruments, Broadcom etc., while other countries like Taiwan, China, Singapore are the other major share holders.

Size of the Indian Semiconductor market has been estimated at USD 16.7 billion in 2018-19. The market is likely to grow at 10 per cent CAGR to reach USD 27 billion by 2023-24. A large part of this revenue – close to 80 per cent is generated from the embedded systems segment.

India is a major hub for Fabless Semiconductor Designing, with the presence of more than 250 companies. Communications, IT and Consumer Electronics segments are the major end-user segments that are driving the growth in semiconductor demand in India. These segments are in turn being driven by the trend towards building smarter cities, IoT architecture for industries and

Global Semiconductor Market (USD billion)



Source: WSTS 2018-19

the Digital India initiative.

The country also has a latent need for semiconductor applications in segments such as agriculture, healthcare and telecom, primarily in rural areas which provides a tremendous untapped potential for the industry.

India hosts offices and development centres of some of the global semiconductor industry majors, like Qualcomm, Nvidia, Global Foundries, Microsemi, Intel, AMD, Broadcom and MediaTek. However, the country still lacks as there are no semiconductor foundries or IDM companies, and hence there is no wafer fabrication capacity available in the country.

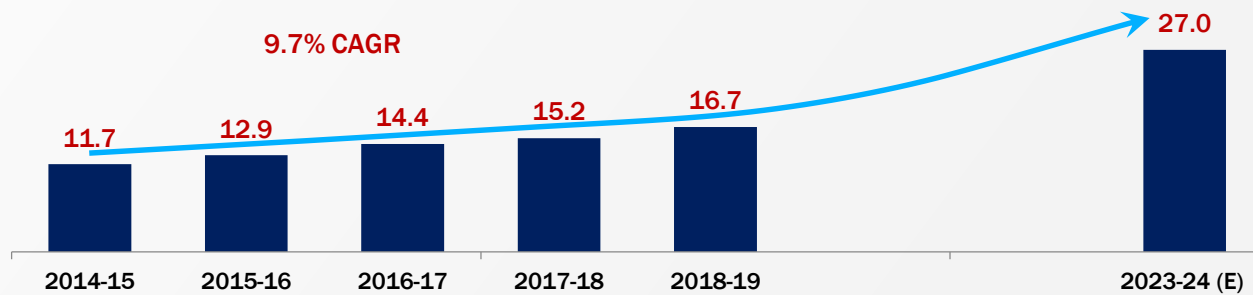
Split of Indian Semiconductor Industry for 2018-19

Total: USD 16.7 billion



Growth of Indian Semiconductor Industry (USD billion)

Source: IESA



Dynamics playing in Indian Semiconductor industry

The Indian semiconductor industry has a fabless ecosystem hosting the R&D and design capabilities of major global players. Over the past decades India has become a hotspot for fabless IP or SoC design primarily due to the availability of vast domain knowledge at lower cost as compared to Europe and USA. However, the Indian Fabless semiconductor industry, as a whole contributes very little to the global semiconductor industry.

India Advantage

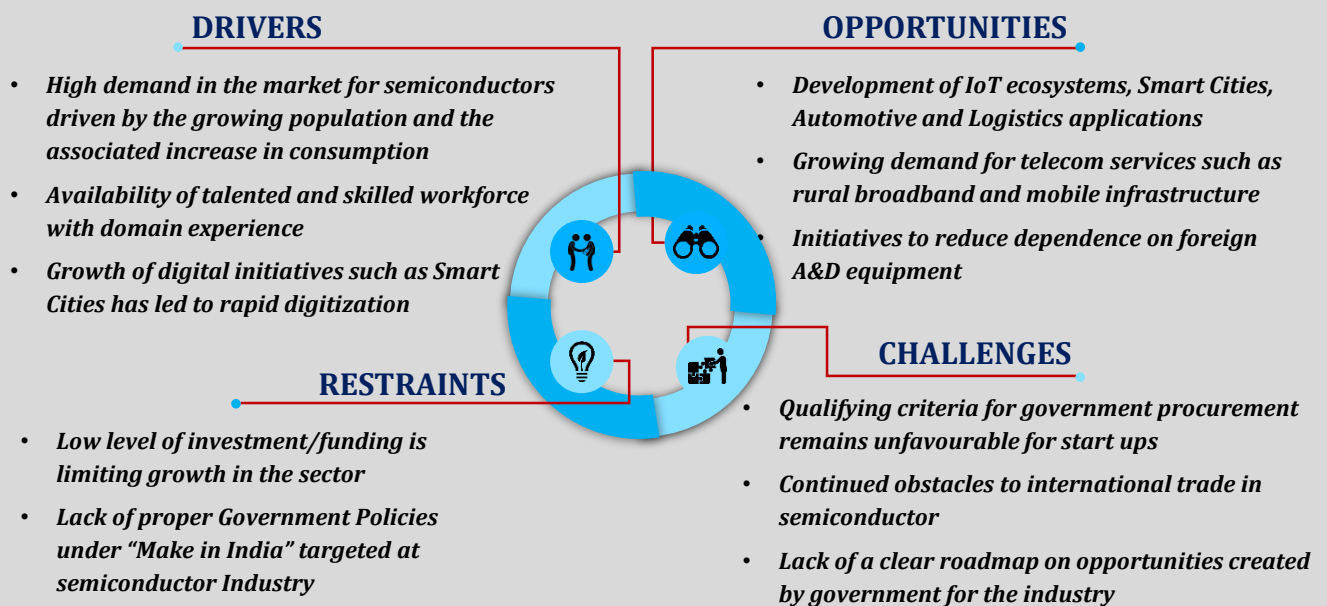
India is one of the hubs for design and R&D activities for many major semiconductor companies. Companies such as Intel, AMD, Broadcom, MediaTek etc. have their design and R&D bases located in India. Indian industry offers a significant domain experience, along with a number of training centres working towards skill development. On the other hand, the Indian electronics industry also provides a hot market for semiconductors, with its tremendous growth drivers.

More needs to be done

Even though the country provides some strong drivers to the semiconductor industry, government procurement activities are not in coordination with local OEMs. Government methods for most of the products are still skewed towards traditional procurement routes. Additionally, there is a lack of proactive policy push in favour of the fabless Industry under the “Make in India” banner.

Key growth hurdles

India does not have any semiconductor foundries or IDM companies in India, and hence there are no wafer fabrication facilities in the country. All the development carried out by the Indian fabless industry is taken to foreign countries for fabrication. The investment & funding environment for the industry is also dull, which acts as a serious deterrent to the industry.



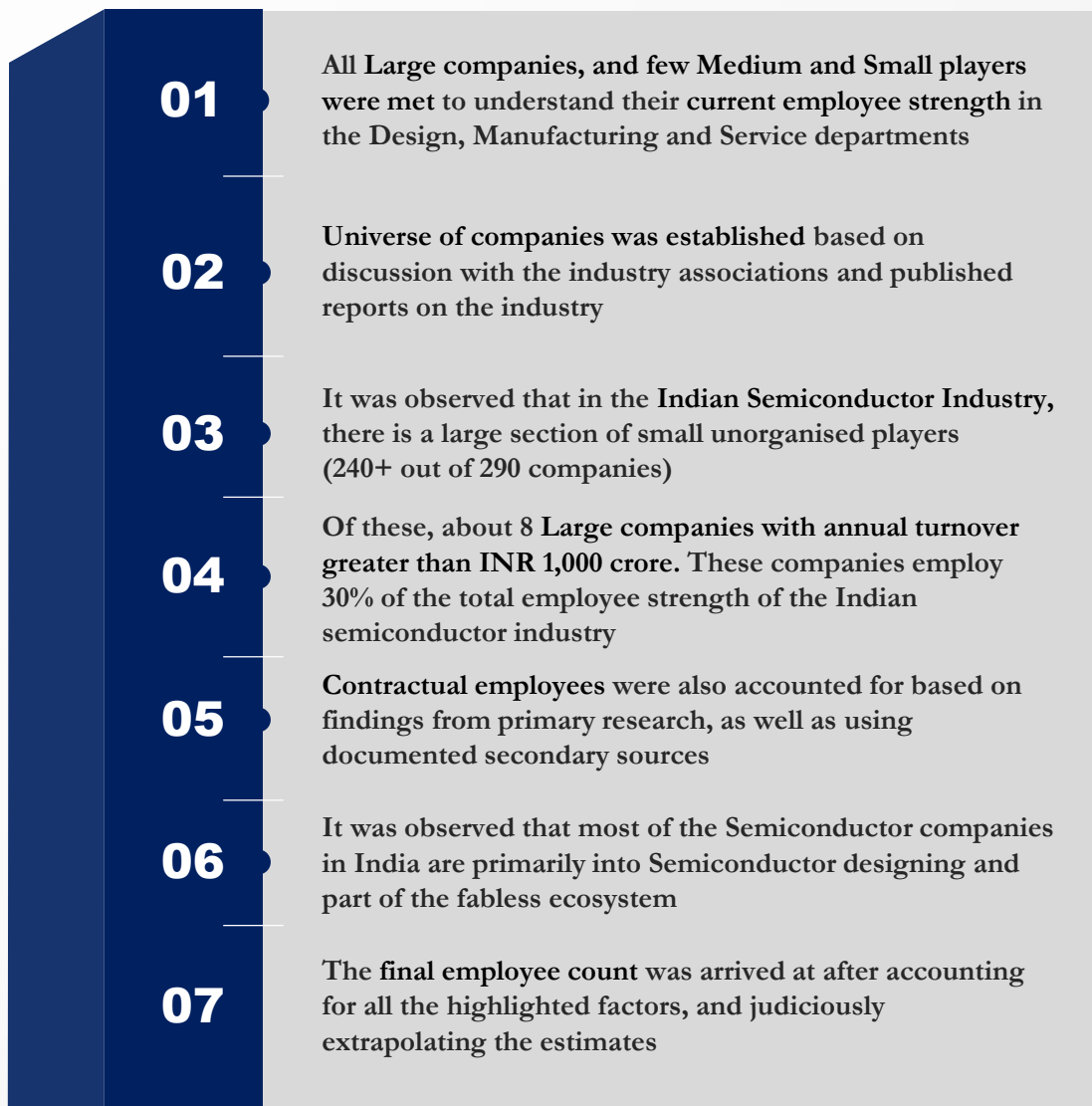
Approach to estimate current employment in Indian Semiconductor & Components industry

The Indian semiconductor industry has about 290 companies which can be categorised based on their revenue levels. Of these, 8 companies have annual revenue greater than INR 1,000 crore, and about 40 companies have revenue in the range of INR 100-1,000 crore. The remaining 240 companies have revenue less than INR 100 crore per annum.

A sample of 56 companies was identified – containing a mix of all the companies from the first category, and a few companies from the remaining categories. The companies in the sample were

interviewed to understand their current employee strength, and its categorization on various parameters such as – type of employees (on-roll v/s contractual), function (design v/s manufacturing v/s service) and their level of seniority.

Norms for employee numbers were established for companies falling in all the 3 revenue categories. Estimates were arrived at for all the three segments through judicious extrapolation of the gathered data.



Current employment scenario in Indian Semiconductor & Components industry

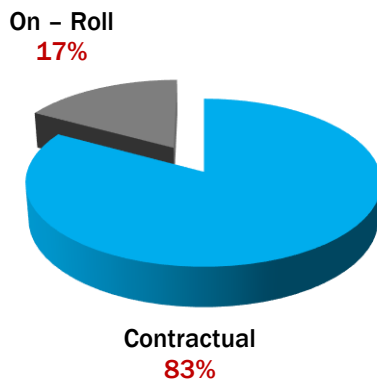
It is estimated that the industry employs around 105,000 people across departments, and across the organisational hierarchy. Due to the lack of a significant manufacturing activity in the industry, the share of contractual employees in the total workforce is relatively less at about 17 per cent.

The Indian industry's fabless ecosystem has a strong base of employees (about 50 per cent of the industry's workforce) in the design function. Meanwhile, the manufacturing category with 32 per cent of employees includes the HR, Accounts &

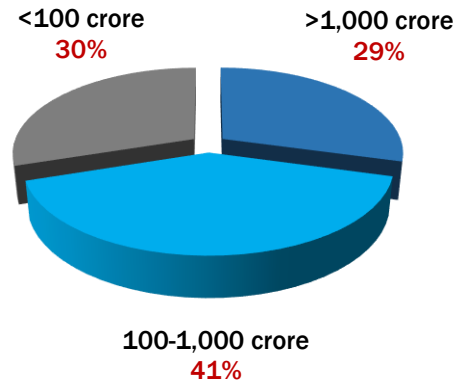
finance, maintenance and administrative functions. Of the entire employee base, the 18 per cent of the employees categorised under the operator level consist of lab assistants, attenders, cleaning staff, security persons etc.

The total number of people employed in a company varies largely. Larger companies employ close to 4,000 employees each on an average, while the smallest companies employ only about 100-150 employees each.

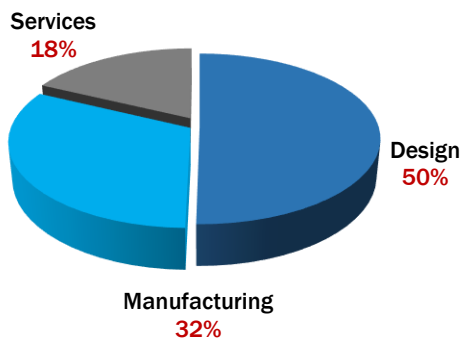
A large share of the employees in the Indian semiconductor industry are employed by the company on their payroll



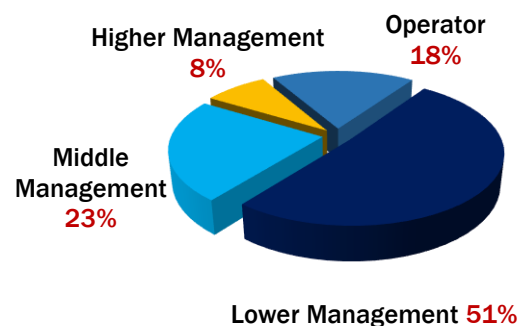
The top 50 semiconductor companies alone employ more than 70 per cent of the industry's workforce



Half of the people employed in the Indian semiconductor industry are involved in R&D and design activities



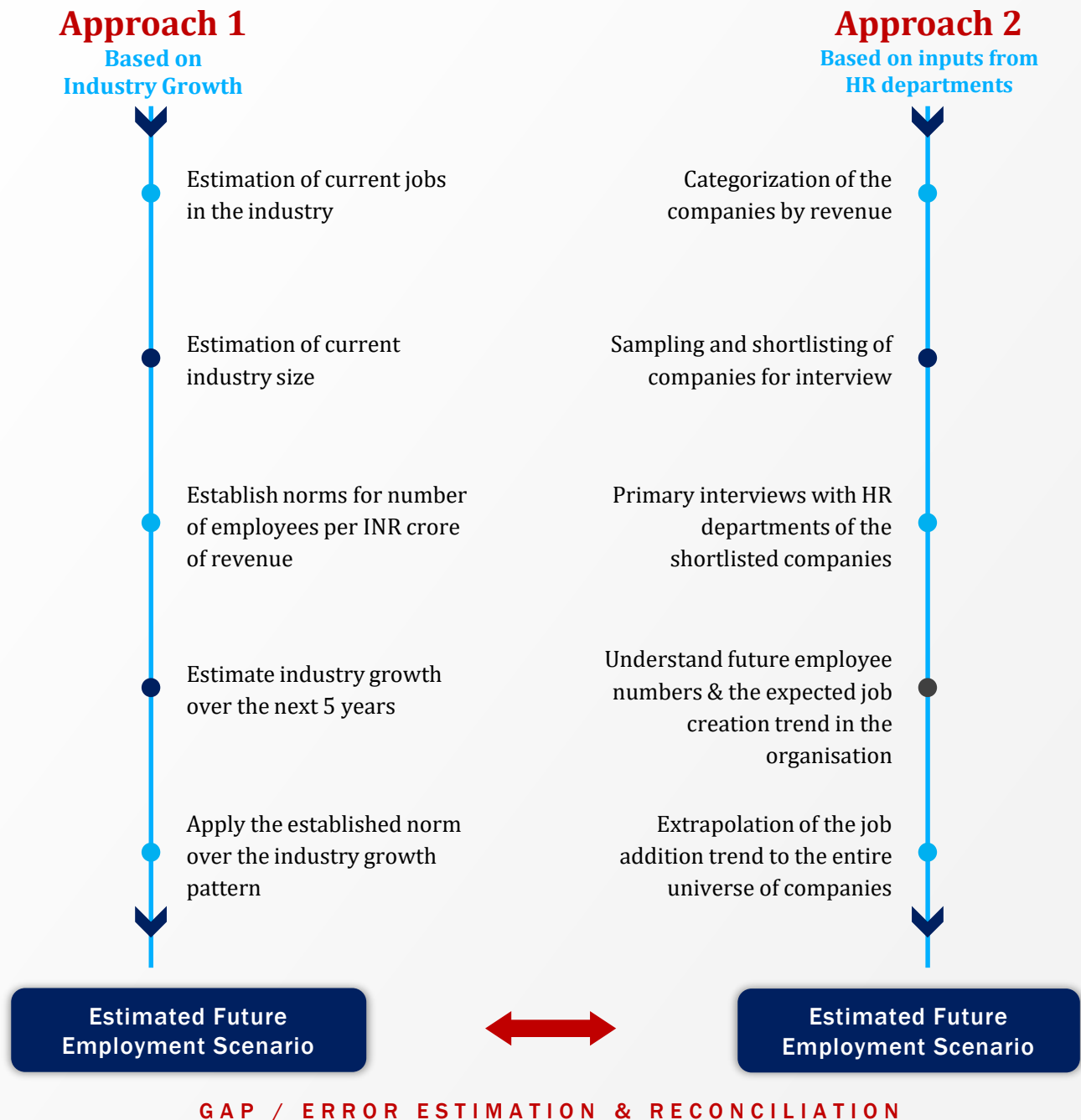
30 per cent of the employee base manages the activities carried out by the operators & supervisory staff



Approach to estimate future employment in Indian Semiconductor & Components Industry

Potential employment generation estimates were arrived at through 2 parallel approaches. The first approach used an industry norm (employee per INR crore of revenue), and superimposed it onto the growth trend of the industry to arrive at a future estimate.

The second approach was based on primary interviews conducted with the HR department of sampled companies. The estimates arrived at through both the approaches were compared and reconciled to finalize the future employment estimates for the industry

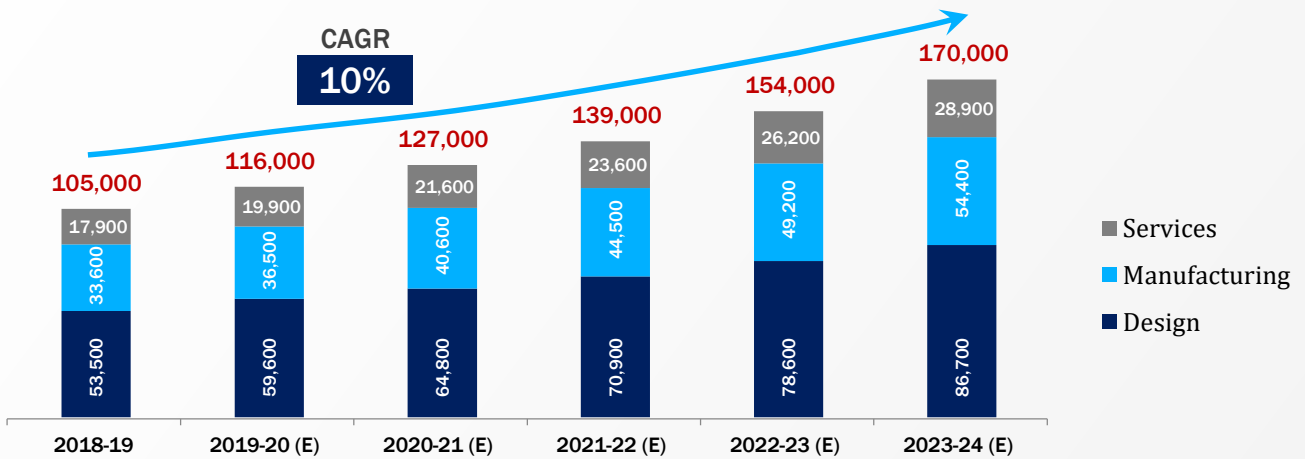


Future employment scenario in Indian Semiconductor & Components industry

It is estimated that the industry would employ about 65,000 more employees by the financial year 2023-24. This job creation over the next 5 years is expected to take place at a CAGR of 10 per cent.

During this period, the Indian semiconductor industry would continue to be dominated by the existing fabless ecosystem. Thus, the industry will continue to create employment in the design function to meet their requirement for design engineers.

It is expected that silicon fab technology would be developed in India by the year 2021. The industry has seen multiple attempts at the development of such technologies, but without any major breakthrough. The major hurdle to quick deployment of such technologies is the prohibitive levels of investment required (about INR 30,000 crore). With the development of a wafer fabrication unit in India, it is expected that there would be a notable growth in employment under the manufacturing function in the industry.



Emerging areas where skilling would be required in future

Mass fabrication of AI chips would increase the demand for expertise in functionalities such as data processing, linguistic analytics, speech recognition, and image recognition. These technologies are already being utilized in a wide array of industries, however a deeper penetration has the potential to cause a boom in demand for people trained on and conversant with such technologies.

Level 3 autonomous vehicles will make use of such AI technologies, along with neural network processing chips that allow the vehicle to safely navigate by processing the visual and sensory data available to it.

AR (Augmented Reality) and VR (Virtual Reality) are also expected to drive the IC evolution as the demand for stereoscopic video processing &

streaming increases. Currently, 70 per cent of the broadband data usage is being used for video streaming, which is expected to increase further.

Promulgation of the Internet of Things architecture would significantly boost demand for semiconductors in the form of microcontrollers, sensors, connectivity devices, and memory chips.

The 5G network infrastructure implementation will unlock the demand for 5G chipsets with advanced technology supporting high bandwidth networks.

Extended ultraviolet lithography (EUVL) is one of the next-generation technologies that is expected to transform the manufacturing of the high-end computing chips.

Skilling requirement for Indian Semiconductor & Components industry

Design Function

Level	Qualification	Skillset
Operator	<ul style="list-style-type: none"> Diploma in Computer Science, IT or Electrical & Electronics Engineering. 	<ul style="list-style-type: none"> Library Development, component location identification on PCB, component identification, component specification, safety of equipment
Lower Management	<ul style="list-style-type: none"> Diploma or Bachelors degree in Electronics & Communication, Computer Science, IT and Electrical & Electronics Engineering. 	<ul style="list-style-type: none"> VLSI design skills & library development. Circuit design & simulation, PCB design, EDA tools, RTL design, RTL verification, ASCII verification. Digital design, analog design, IC design layout, physical design, design for test & mass design. Embedded software, C++ programming Digital Signal Processing
Middle Management	<ul style="list-style-type: none"> Bachelors or Masters degree in Engineering with at least 5 years of experience. 	<ul style="list-style-type: none"> Research on technology and image processing. Knowledge of Machine Learning, algorithms, IoT. Logical reasoning, critical thinking and analysis.
Higher Management	<ul style="list-style-type: none"> Engineer with 10-15 years of experience. Doctorate degree preferred especially for R&D role. 	<ul style="list-style-type: none"> Understanding of semiconductor business. Domain/Subject expertise. Long-term R&D strategy, innovation roadmaps / strategy. Capital execution, annual operational control Leadership, analytical and critical thinking

Skilling requirement for Indian Semiconductor & Components industry

Manufacturing Function

Level	Qualification	Skillset
Operator	<ul style="list-style-type: none"> Secondary or Higher Secondary schooling required for housekeeping and security. For manufacturing, minimum qualification is a Diploma in Electronics & Communications Engineering or Electrical & Electronics Engineering for their ability to be trained on semiconductor modules / components, their working etc. 	<ul style="list-style-type: none"> Mechanical - Knowledge on machines and tools. Operation monitoring – Monitoring gauges, dials, or other indicators to make sure a machine is working properly. Knowledge on production process of semiconductors. Technical - Knowledge of semiconductor components, their working principal and identification.
Lower Management	<ul style="list-style-type: none"> Any degree for Accounts & Administrative functions. For HR function, MBA with HR specialization and 1-2 years of experience in HR function. For Manufacturing, minimum qualification is a technical degree like Bachelors in Mechanical, Electronics & Communication, Chemical or Computer Science engineering. 3 years of added experience is required for production planning functions. 	<ul style="list-style-type: none"> Engineering and Technology - Knowledge of the practical applications of engineering, science and technology. This includes applying principles, techniques, procedures, and equipment to the design & production of various goods. Computers and Electronics - Knowledge of circuit boards, processors, chips, electronic equipment, and computer hardware & software, including applications and programming. Production and Processing - Knowledge of raw materials, production processes, quality control, costs, and other techniques for maximizing the effective manufacturing and distribution of goods.
Middle Management	<ul style="list-style-type: none"> Any degree with MBA, or 5+ years of experience in a relevant field. Certifications like Six Sigma, Production Planning, SAP, ERP systems etc. 	<ul style="list-style-type: none"> Knowledge of production process, and its control based on demand. Assigning monthly, quarterly and annually production targets. Supply chain management. Operations Analysis - Analyzing needs and product requirements to create a design. Administrative - Need to have experience in all fields (like HR, Accounts etc.)
Higher Management	<ul style="list-style-type: none"> Doctorate or MBA with more than 8-10 years of experience in relevant field. Certification in project management, supply chain management, Six Sigma 	<ul style="list-style-type: none"> Responsible for managing the company, and all its aspects like production planning (department-wise). Budget planning, quality report analysis, future growth strategy & its implementation.

Skilling requirement for Indian Semiconductor & Components industry

Service Function

Level	Qualification	Skillset
Operator	Any Degree (preferably technical degree) / diploma in Electronics & Communication or IT engineering / Secondary & Higher secondary school pass with experience in repairing	Technical knowledge of components, repair services like soldering, component handling etc.
Lower Management	Any degree with sales experience. Technical knowledge is an added advantage. Experience of at least 1-2 years in with exposure to electronics field	Knowledge of different prices and designing the quotation. Negotiation skills, ability to handle sales team and work on operational targets. Distributor handling and management.
Middle Management	Degree with MBA (preferable). At least 5 years of experience in sales and marketing.	Marketing and sales experience, Ability to crack deals, key account management. Planning sales targets at quarterly, half yearly and annual levels
Higher Management	Technical degree with MBA and at least 8-10 years of experience in sales	Sales strategy, planning, business lead, strategy implementation. Monitor business functions and key decision markets. Knowledge of semiconductor industry and its market dynamics.

E-Mobility & Battery



Segments included in this industry:

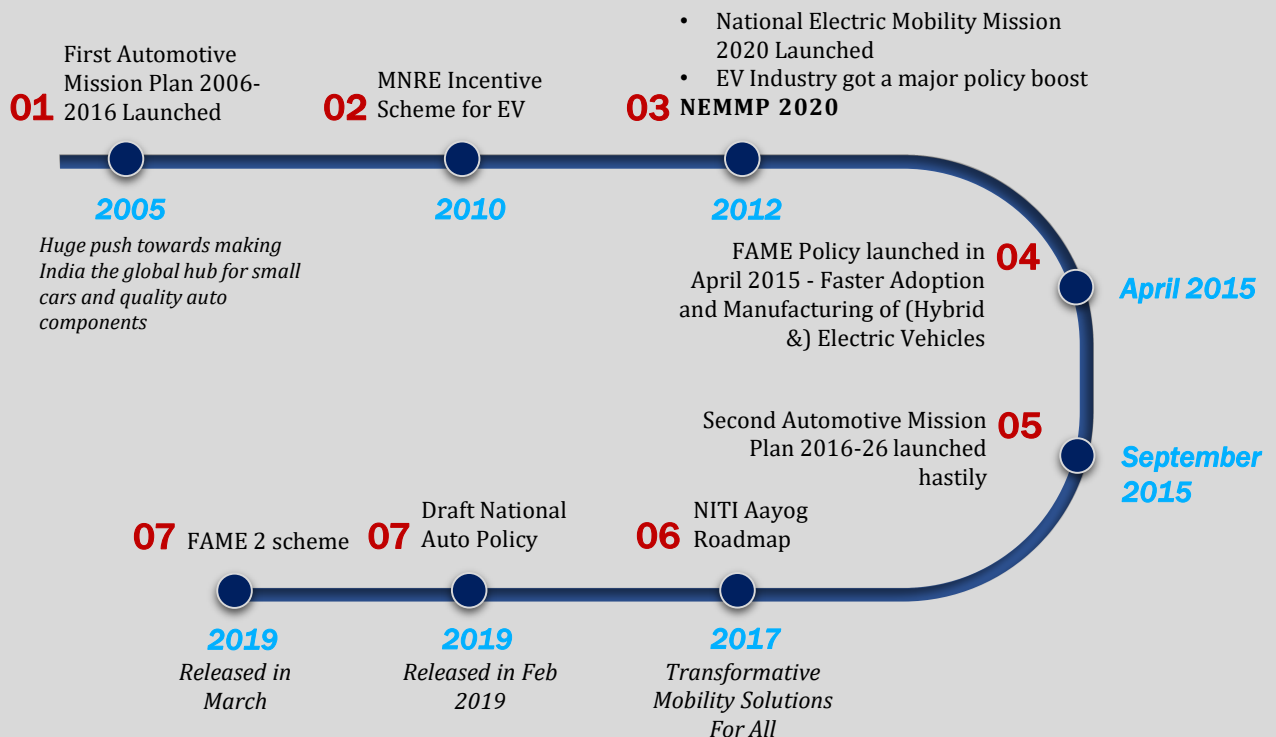
EV - 2 wheelers & 3 wheelers	EV Charging - Chargers, Charging Infrastructure & Battery Swapping Services
EV - 4 wheelers and E-Buses	Battery Manufacturing - Li-ion Batteries
EV Components - Motors & Electronics	Drones & Telematics

Sector overview – Electric Vehicles

Despite being small in terms of absolute size of the industry, the e-Mobility and battery space in India has been in a constant state of flux for the past few years. The industry has been attracting interest from

both established conglomerates and start-ups trying to solve problems and create value. The Government policy in these matters has also been supportive of the developments taking place in the industry.

Key milestones in EV policies in India so far



Indian EV industry can largely be categorized under three categories – 2-Wheelers, 3-Wheelers and 4-Wheelers.

2-Wheeler segment can further be categorized as E-Scooters and E-Bikes. E-Scooter is an established segment with presence of 20 – 22 companies, and many companies trying to enter into this market. Some renowned companies in this space include, Hero Electric, Ampere Electric, Lohia Auto, Ather etc. E-Bikes is a relatively new segment with presence of 7-8 new-age firms – mainly start ups such as Revolt Motors. International firms like Yamaha, Honda etc. are also eyeing an entry in this space.

3 Wheeler segment can further be categorized as E-Auto and E-Rickshaw. Players like Mahindra (Treo), Greaves Cotton, Bajaj and Kinetic are looking at launching new range of E-Autos in Indian market. E-Rickshaw segment is mostly unorganized & catered by local small players and import. However, organized OEMs (like M&M, Lohia Auto, Kinetic group etc.) are now entering this fast-growing segment

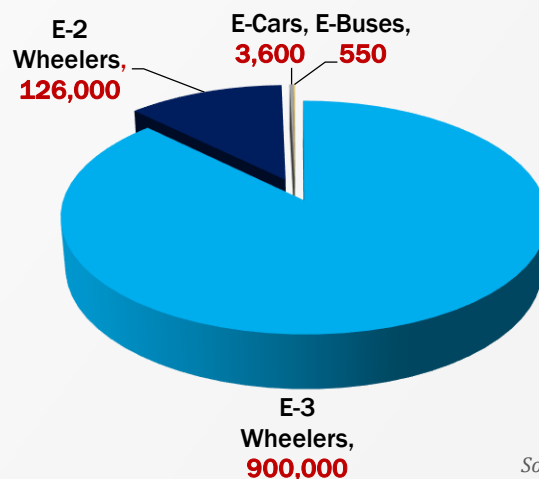
4 Wheeler segment can further be categorized as E-Cars and E-Buses. At present, three companies have launched their products in E-Car segment – Mahinda, Tata and Hyundai. India’s largest car

maker Maruti is evaluating commercial launch of a small electric car in 2020. In the E-Bus segment, 6 – 7 companies have launched their products - TATA, Ashok Leyland, JBM, Volvo, Deccan Auto etc. These companies have electric or hybrid models in their portfolio.

The electric vehicle industry registered sales of more than 1 million units during the financial year 2018-19. More than 90 per cent of the electric vehicles sold during this period fall in the 2-wheeler and 3-wheeler categories which has seen more than 100 per cent growth year-over-year. Government’s FAME scheme has been a strong growth driver for this industry. The contribution of electric cars and buses to the electric vehicle market has been less than 0.5 per cent.

Growth of electric car segment would largely be driven by the fleet companies like Ola which has plans to adopt EVs on large scale across India. For passenger vehicles, there are issues related to price of the vehicle, charging infrastructure and range. Once these issues are sorted out and because of tightening of Corporate Average Fuel Efficiency (CAFÉ) norms, there would be higher penetration of EVs in the passenger vehicle segment in the coming years. Market for E-Buses would be driven by State Govt. schemes in order to reduce vehicular pollution within the city.

2018 – 19 Electric Vehicle Market in India



Source: Feedback Primary Research

It is perceived that, for wider adoption of EVs, there is a need for strong charging infrastructure across the country. Charging infrastructure can be classified under three categories – Level 1 charging, Level 2 charging and DC fast charging. While level 1 provides charging of 3 – 8 km / hour, level 2 provides charging of 15 – 35 km / hour and DC fast charger can provide charging of 90 – 130 km in 20 minutes. Three types of entities are setting up charging infrastructure in the country. Central Govt. PSUs like NTPC has plans to set up 1,00,000 charging stations in India. State Governments like Maharashtra, Andhra Pradesh, Telangana and Karnataka have mandated their electric utilities to set up EV charging infrastructure in the state.

Besides, a host of private sector companies are also eyeing the business space and have strong plans for India. Some of these companies are Panasonic, Tata Power, Fortum India, Engie India, Mahindra, Sun Mobility etc.

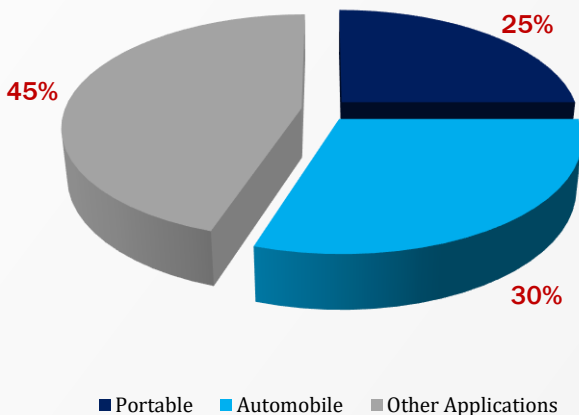
Another service that can be extremely beneficial in order to reduce charging time is Battery Swapping. At present, Battery Swapping is not part of FAME 2 policy. Many companies – large corporate (Sun Mobility, Essel Infraprojects, Fortum India), Central Govt. PSUs (NTPC, PGCIL etc.), Start-ups (Lithion Power, Gayam Motor Works etc.) and Educational Institutions (IIT Madras) have plans to offer swapping services in their charging stations.

Sector overview – Lithium Ion Battery

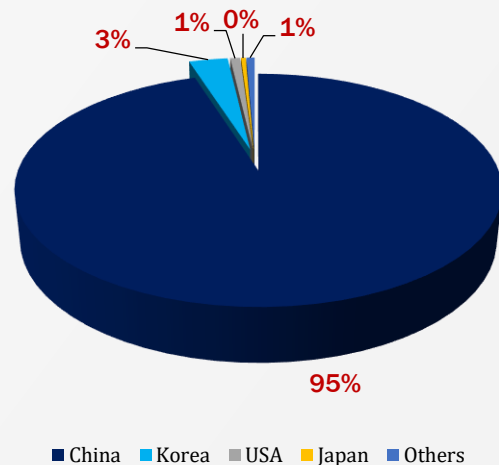
Batteries are an integral part of the EV ecosystem and the falling cost of batteries is expected to drive this growth throughout the next decade. The Indian Lithium-ion battery market for the financial year 2017-18 was more than 7 million units. Only 30 per cent of these batteries were consumed by the automobile industry, while the rest were used up by other segments such as electronics, energy, telecom and defence. Indian lithium-ion battery market is expected to grow at a robust CAGR of 33-35%

during the forecast period, 2019-2024, depending on how the EV business in India takes off. Manufacturing of Li-ion batteries has already been started in India with proactive push from the Govt. through FAME 2 policy. At present, companies largely imports batteries from other Asian countries – China, Taiwan, Japan and Korea. Sony, Panasonic, Samsung SDI and Heter Electronics are the leading suppliers of Li-ion batteries in India in the Consumer Electronics Segment.

2017 – 18 Li-Ion Battery Market by Application



2017 – 18 Li-Ion Battery Market by Country of Import



Source: Import Data Analysis by Feedback & Primary Research

Future outlook for the E-Mobility and Battery market in India

SIAM (Society of Indian Automobile Manufacturers) predicts that the automobile market in India would grow to reach about 63 million to 75 million vehicles by the year 2025-2026. The market size estimations have been based on GDP growth projections - 5.8 per cent per annum for the median case scenario, and 7.5 per cent per annum for the optimistic case scenario for this period.

NITI Ayog, in its EV Roadmap document, had set out vision for 100% electric vehicle on Indian roads by 2030 which has now been toned down to 30%. NITI Ayog had also announced plans for full electric transition for three-wheelers by 2023 and two-wheelers with an engine capacity less than 150 CC by 2025.

Feedback Consulting has made a conservative estimate of Electric Vehicle market in India by 2023-24 keeping in mind SIAM's projection, NITI Ayog's vision and current market reality of the Automobile segment in India.

In the passenger vehicle segment, Feedback has estimated that EVs should have approx. 13% penetration by 2023-24, translating to annual market size of One million units by 2023-24.

In the 2 Wheeler segment, EV currently has less than 1% penetration. Feedback estimates that by 2023-24, EV penetration in the segment should be around 10% considering the market is doubling itself since last 2 years. This will translate to annual market of Four million units by 2023-24.

In the 3 Wheeler segment, Feedback estimates that market will reach to 1.35 million units by 2023-24 and this segment will have 100% EV penetration by that time.

In the E-Bus segment, the outlook is very positive with many State Govt. are contemplating to launch E-Bus in the key cities in their respective states in order to tackle the pollution. Feedback estimates that E-Bus segment likely to grow to 1,65,000 units by 2023-24.

Based on the battery requirement for each of these category of vehicles - ranging from average 4 kWh for 2-wheelers to about 200 kWh for e-Buses, it is estimated that approx. 95 GWh of battery would be required in 2023 -24. It goes without saying that innovations in battery technology and R&D in the field of energy efficiency will determine the exact demand for batteries in the Indian EV space.

Indian Electric Vehicle and Li-Ion Battery Demand Projection till 2023-24

Demand Element	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24
2 Wheelers	126,000	250,000	500,000	1,000,000	2,000,000	4,000,000
3 Wheelers	900,000	1,000,000	1,100,000	1,175,000	1,250,000	1,350,000
4 Wheelers	3,600	30,000	100,000	300,000	500,000	1,000,000
E-Buses	550	2,000	6,000	18,000	55,000	165,000
TOTAL EV	1,030,150	1,282,000	1,706,000	2,493,000	3,805,000	6,515,000
Battery Rqmt. (GWh)	5.3	7.6	12.7	25.5	45.3	95.8

Source: SIAM Projection, NITI Ayog's Vision & Feedback Analysis

Approach to estimate current employment in the E-Mobility & Battery industry

The Indian e-Mobility & Battery industry has about 250 companies across the 6 product segments. A sample of 71 companies was identified – containing a mix of all the large companies, and a few medium & small scale companies from each of the 6 product segments.

Companies in the sample were interviewed to understand their current employee strength, and its categorization on various parameters such as – type

of employees (on-roll v/s contractual), function (design v/s manufacturing v/s service) and their level of seniority.

Norms for number of employees were established separately for each of the product segments falling under the industry. Estimates were arrived at for all the product segments through judicious extrapolation of the gathered data.

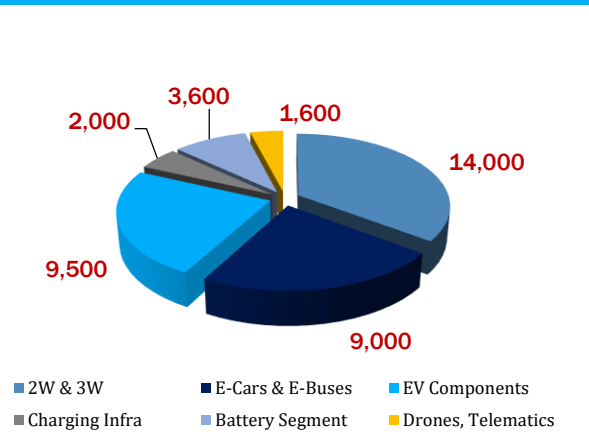


Employment scenario in the E-Mobility and Battery industry

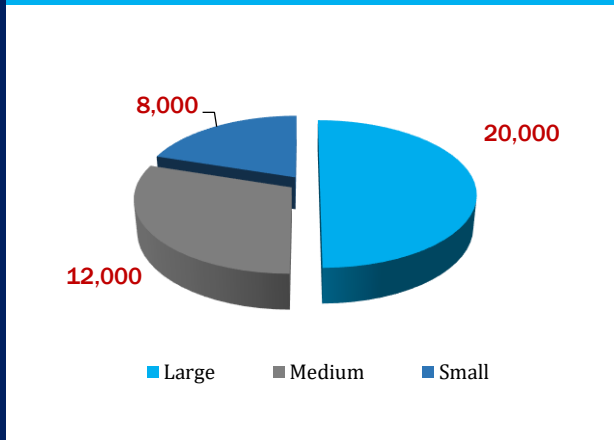
It is estimated that the industry currently employs around 40,000 people across departments, and across the organisational hierarchy in all the 6 product segments. Close to 28 per cent of the entire workforce employed in the industry is on contractual basis, while the remaining are on the payroll of the companies.

The employment patterns in the industry vary across the various product segments. For example, employment in the EV segment & EV component segments are skewed towards the manufacturing function. On the other hand, the charging infrastructure segment is entirely focused on service function, with a team of operators and supervisor level employees.

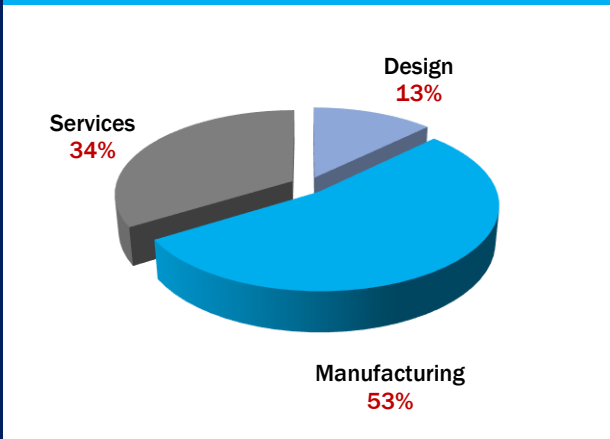
The EV and EV component segments of the industry employ the most number of people due to presence of manufacturing activities



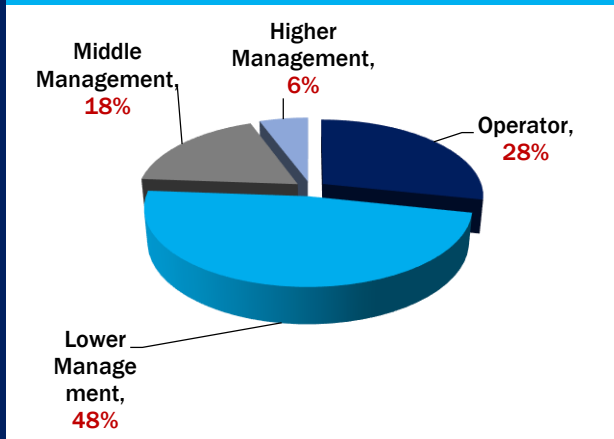
Large & medium scale companies together employ close to 80 per cent of the workforce employed in the industry



More than 85 per cent of the industry workforce is employed in the manufacturing and service functions



Close to 25 per cent of the employee base manages the work carried out by the operators & supervisory staff



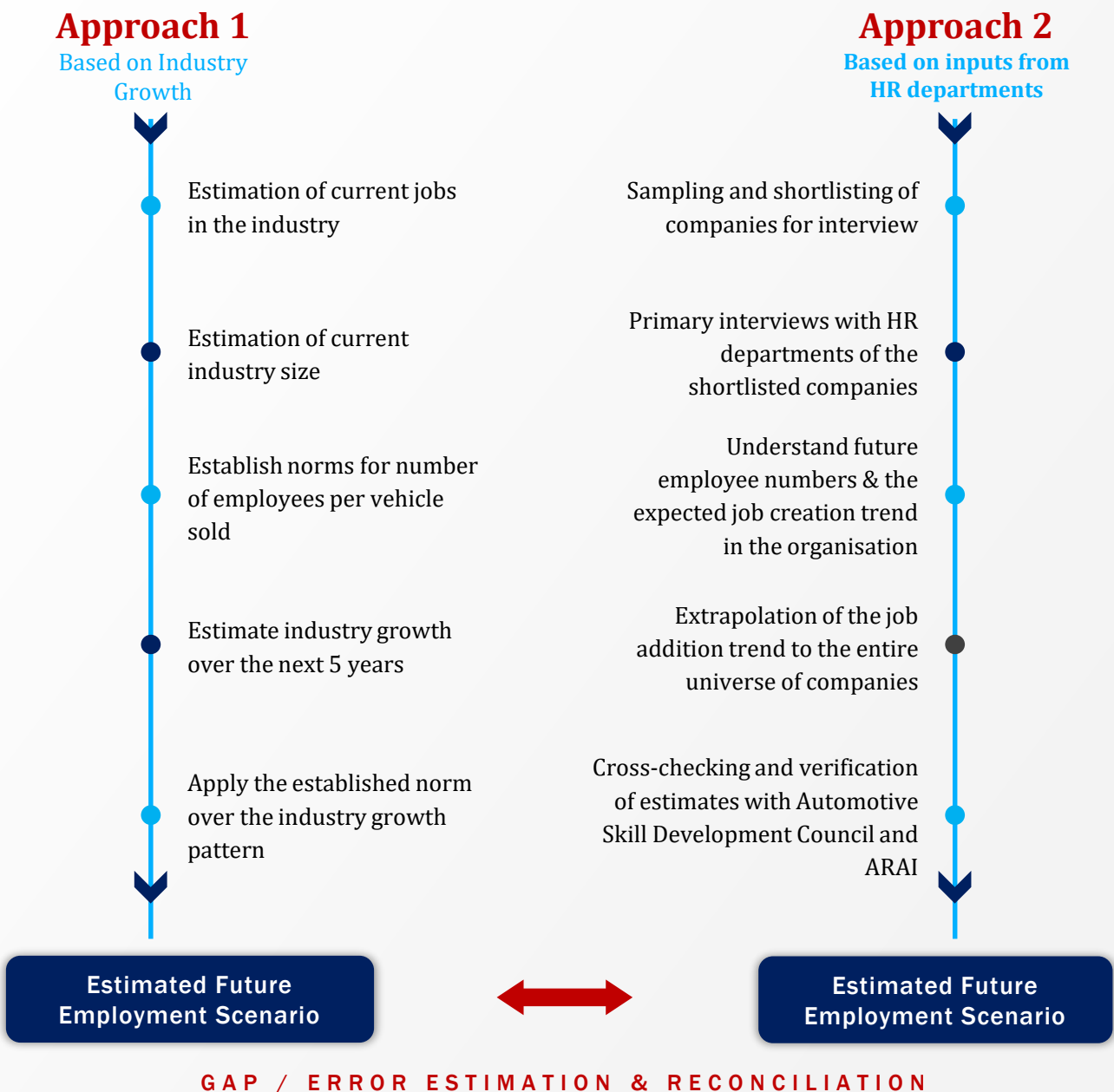
Approach to estimate future employment in Indian E-Mobility & Battery industry

Potential employment generation estimates were arrived at through 2 parallel approaches:

The first approach used an industry norm (number of employees per vehicle sold) which was built using the employment data collected from a sample of industries. The norms were then superimposed onto the growth trend projected for the segment to arrive at a future estimate.

The second approach was based on primary interviews conducted with the HR department of sampled companies. The respondents were asked to comment on the future employment generation trend in their company under the various functions.

The estimates arrived at through both the approaches were compared & reconciled to finalize the future employment estimates for the industry.



Future employment scenario in Indian E-Mobility & Battery industry

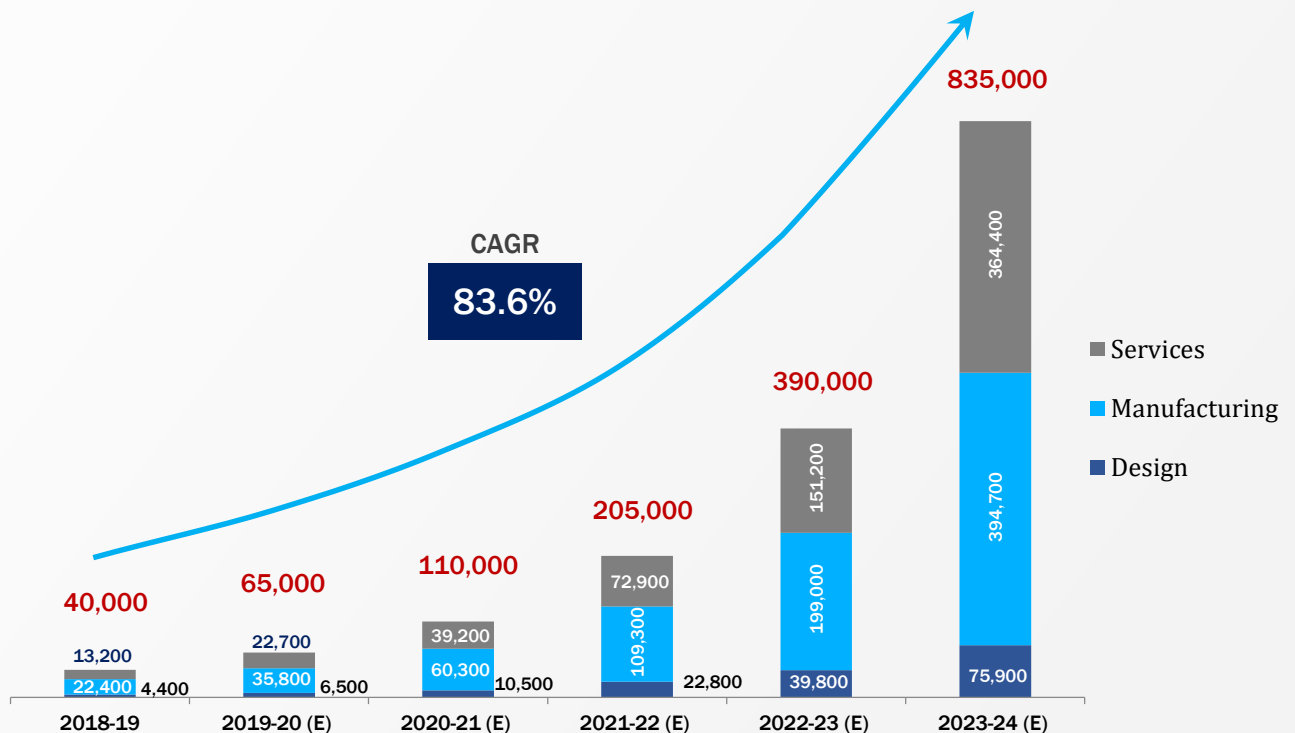
It is estimated that approximately 800,000 additional jobs will be created in the e-Mobility and Battery industry during the period between 2018-19 and 2023-24. The compounded annual growth rate of employment in the industry is estimated to be more than 80 per cent over this period.

The service function of the industry is expected to show the strongest growth in the industry with a CAGR close to 95 per cent, while the other two functions are estimated to grow at slightly more than 75 per cent CAGR.

Close to 46 per cent of the employment generation estimated (about 384,000 jobs) in the industry is expected to be at the operator level. This vacancy in the workforce would require trained and skilled people with an ITI diploma in Electrical, Electronics or Mechanical engineering specialization.

The employment generation in the Indian e-Mobility & Battery industry would not only be driven by the increasing penetration of EVs in the automobile market, but also through the implementation of innovative business models around the ownership and usage of EVs. The design and service functions of the industry are expected to help carry out these changes in the industry.

Currently, Indian companies are investing heavily to explore the potential offered by the industry through launch of new products and expanding their reach in the market. The Government too is working to create a competent workforce specializing in the various sub-segments to bolster the EV ecosystem - manufacturing, design & testing, battery manufacturing & management, sales, service and infrastructure support.



Future employment in sub-segments of E-Mobility & Battery industry

Sub-segment	Industry Structure	Industry Overview	Employment scenario	
			Current	Future
EV – 2W & 3W	<p>Around 30 players are present in the 2-wheeler sub-segment. The traditional manufacturers of 2-wheelers are active in low speed e-scooter business, while the high speed e-scooter & e-bike business are dominated by start-ups. In the 3-wheeler space, e-Autos is an emerging segment, while, the e-Rickshaw has an unorganised market with the presence of a number of small players.</p>	<p>During 2018-19, the industry sold a total of 126,000 electric 2-wheelers and close to 900,000 electric 3-wheelers This marks a growth of more than 100 per cent over the 2017-18 financial year</p>	<p>The industry currently employs close to 14,000 people in various functions & capacities. The manufacturing function employs the most number of employees. Of the total workforce employed in the segment, less than 25 per cent is employed on contract basis.</p>	<p>The future estimate for employment in the sector is expected to be as follows: 2018-19: 14,000 2019-20: 23,100 2020-21: 38,100 2021-22: 62,900 2022-23: 97,800 2023-24: 1,73,500</p>
EV – 4W (Cars & Buses)	<p>The 4-wheeler e-Car segment has only 2 OEMs in the market - Tata and Mahindra.</p> <p>The e-Bus segment currently has 6-7 players - Tata, Ashok Leyland, JBM, Volvo, Deccan Auto etc.</p>	<p>During 2018-19, the industry sold around 3,600 electric cars, which is about three times more than the previous year. Close to 550 electric buses were sold during the 2018-19 financial year.</p>	<p>The industry currently employs close to 9,000 people, with close to 60 per cent being employed in the manufacturing function. The segment employs less than 25 per cent of its workforce on contract basis.</p>	<p>The future estimate for employment in the sector is expected to be as follows: 2018-19: 9,200 2019-20: 15,500 2020-21: 25,500 2021-22: 48,300 2022-23: 88,700 2023-24: 172,800</p>
EV Charging Infrastructure	<p>The segment has about 15 firms supplying EV Chargers in India - Exicom, RRT Electro Power, Mass Tech Controls, etc. Firms like ABB, Delta, Schneider, Siemens, Raychem RPG,, etc. are watching the market closely with intent to enter. In the charging infrastructure space, NTPC, EESL, state DISCOMs and few private players have initiated work.</p>	<p>The EV charger market has been driven by sales to EV owners that use it for captive purposes. For public charging infrastructure, NTPC has been mandated to set up 100,000 EV charging stations, with EESL assisting in procurement.</p>	<p>The industry currently employs close to 2,000 people, all of whom are employed in the service function. Of this, about 15 per cent of the people in the segment are employed on contract basis</p>	<p>The future estimate for employment in the sector is expected to be as follows: 2018-19: 2,000 2019-20: 4,200 2020-21: 9,500 2021-22: 27,500 2022-23: 81,000 2023-24: 243,000</p>
Battery Manufacturing	<p>Lithium-ion batteries are currently imported either in cell form or in packs. Most of the electronics industry directly uses the imported battery packs. The Indian industry also has assemblers manufacturing battery packs from imported Li-ion cells.</p>	<p>During 2017-18, India imported 7 million units of Li-ion batteries with a cumulative value of USD 372 million. Of this, the automobile sector is estimated to have consumed close to 30 per cent of the imported battery units.</p>	<p>The industry currently employs close to 3,600 people. Most of this workforce is employed in the manufacturing and service functions. The share of contractual employees in the segment's workforce is slightly more than 20 per cent.</p>	<p>The future estimate for employment in the sector is expected to be as follows: 2018-19: 3,600 2019-20: 7,100 2020-21: 14,100 2021-22: 28,000 2022-23: 55,500 2023-24: 1,10,000</p>
EV Components, Drones & telematics	<p>Majority of the EV component suppliers in India are conventional electrical & electronic component companies – suppliers of motors, inverters & converters, battery chargers, etc. Drones & telematics is a nascent industry consisting of a few large companies, but also a number of start-ups.</p>	<p>The EV components industry is expected to grow in sync with the EV vehicle industry, due to the increased share of domestic manufacturing, specially in the 3-wheeler segment. However, drones & telematics would continue to be a niche segment in the near future.</p>	<p>The industry currently employs close to 11,200 people. A large part of this workforce is employed in the EV component manufacturing and service functions.</p>	<p>The future estimate for employment in the sector is expected to be as follows: 2018-19: 11,200 2019-20: 15,100 2020-21: 22,800 2021-22: 38,300 2022-23: 67,000 2023-24: 135,700</p>

Skilling requirement for Indian E-Mobility & Battery industry

Design Function

Level	Qualification	Skillset
Operator	<ul style="list-style-type: none"> ITI / Diploma / Higher Secondary school education 	<ul style="list-style-type: none"> Draughtsman, Test Technician, Test Driver, Tool room operator or technician. Electronics principles & Circuit Design. Prototype assembly, R&D testing (Indoor / Outdoor products)
Lower Management	<ul style="list-style-type: none"> Bachelors or Masters in Electrical, Electronics, Mechanical or Production Engineering with up to 5 years of experience in design. Knowledge of various tools. 	<ul style="list-style-type: none"> Ability to choose right product/design based on cost, performance, delivery, safety and regulations. Validation testing of Electric Vehicle. Benchmarking analysis of competitor vehicles. Knowledge of CATIA, FMEA, DFMEA, APQP, PPAP, Manufacturing Engineering (ME), Design Documentation, software expertise in AUTOSAR and 1D/3D simulation. Expertise in Root Cause Analysis, Embedded Software, control system design, power electronics, electric machine hardware, electric machine drive. Knowledge of Electronics principles & circuit design, telematics, Human Machine Interface, national & international standards, plastic & sheet metal part design, tooling, jogs & fixtures.
Middle Management	<ul style="list-style-type: none"> Any technical degree (Bachelors, Masters or Doctorate in Engineering) with at least 10 years of experience in automotive Industry. Exposure to various design aspect of EVs. 	<ul style="list-style-type: none"> Ability to choose right product/design based on cost, performance, delivery, safety and regulations. Adaptation & integration. Lead the engineering delivery of entire EV program. Program management, project anchoring, and knowledge of various tools with at least 10 years of experience. Battery management, battery algorithms, battery safety, battery & charging system design specification, signal distribution design strategy. Circuit design / insulation coordination. Development of digital & analog interfaces. EV power electronics circuit design & development. Good knowledge of Drivetrain (motor, transmission, inverter), computational thinking, Artificial Intelligence, virtual collaboration, automotive design. Understanding of communication & ECU, product & technology development and the concept of product lifecycle.
Higher Management	<ul style="list-style-type: none"> Bachelors or Masters or Doctorate in any engineering stream with experience in end-to-end delivery of EVs or automobiles 	<ul style="list-style-type: none"> Cross-functional leadership skills End-to-end delivery of EV program Managing R&D with a fine amalgam of technical skills & business management

Skilling requirement for Indian E-Mobility & Battery industry

Manufacturing Function

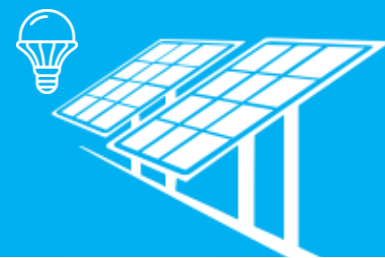
Level	Qualification	Skillset
Operator	<ul style="list-style-type: none"> Secondary or Higher Secondary schooling required for housekeeping and security. For manufacturing, minimum qualification is a Diploma in Electronics & Communications or Electrical & Electronics Engineering for their ability to be trained on EV modules / components, their working etc. 	<ul style="list-style-type: none"> SPC/SQC techniques, product validation & verification, reliability testing, EMI/EMC testing. Assembly of battery packs, motor, powertrain assembly, ability to use various machines and hand tools. Exposure to welding, casting, forging, heat treatment. Manual dexterity. Vehicle assembly fitter / technician, auto component assembly fitter. Workmanship standards, ESD, process capability, occupational safety.
Lower Management	<ul style="list-style-type: none"> Any degree for Accounts & Administrative functions. For HR function, MBA with HR specialization and 1-2 years of experience. For Manufacturing, minimum qualification is a technical degree like Bachelors in Mechanical, Electronics & Communication engineering. 3 years of added experience is required for production & planning functions. 	<ul style="list-style-type: none"> Expertise in TPM, Six Sigma, Kaizen, Lean Manufacturing, Global or Strategic Sourcing of electrical and electronics commodities. Expertise in Li-ion batteries, EV powertrains. Performance analysis of battery, inverters and motors of EVs. Testing & debugging validation - EV electrical system. Maintenance - Mechanical & Electrical, quality controller, service advisor, warranty in-charge. Installation, modification of electrical & electronic circuits, components, systems and equipment, plants, machines, components, tools & fixtures. ESD and occupational safety. CNC programming, SMT programming and knowledge of industrial automation
Middle Management	<ul style="list-style-type: none"> Bachelors or Masters in Engineering with at least 2-3 years of experience in project handling, supply chain management, operations control & coordination. Certifications like Six Sigma, Production Planning, SAP, PLM, ERP Systems etc. 	<ul style="list-style-type: none"> Team management, supervision, production management, supply chain management, resource management, vendor development, Cost optimisation. Mechanical & electrical skills along with computer programming skills. Familiarity with pneumatic, hydraulic & electrical symbology, relay logic, ladder diagram wiring and programming techniques, mechatronics, ESD and occupational safety.
Higher Management	<ul style="list-style-type: none"> Bachelors in Electrical or Mechanical Engineering, with a Masters degree in Management. More than 10 years of experience in a leadership role at plant level operations 	<ul style="list-style-type: none"> Fostering a culture of excellence and best practices. Continuous improvement strategies. Expertise in enhancing operations of technically advanced, state of the art production systems.

Skilling requirement for Indian E-Mobility & Battery industry

Service Function

Level	Qualification	Skillset
Operator	<ul style="list-style-type: none"> Any Degree (preferably technical degree) / diploma in Electronics & Communication or IT engineering / Secondary & Higher secondary school pass with experience in repairing 	<ul style="list-style-type: none"> Mechanics, technicians, electricians with exposure to traction motors, traction inverters, vehicle control units, traction battery packs, battery pack management, on-board & off-board charging, EV wiring harness. Electrical / Mechanical / Auto Body Repair Technician / Denter / Engine Repair Technician / Maintenance Assistant / AC Specialist / Brake Specialist etc. Electric Vehicle charging, high voltage technician. Replacement of BMS & controls, packaging & transportation of Li-ion batteries.
Lower Management	<ul style="list-style-type: none"> Bachelors degree in Engineering and Masters in Management. At least 3-5 years of experience in automotive industry or EV sales and marketing, branding, analytics, chanel sales. Technical knowledge is added advantage 	<ul style="list-style-type: none"> Brand building, hands-on sales experience with fleet owners, managing creative agencies, dealers development, media strategy. Service Marketing / Regional Service Process / Territory Service Process. Product Specific knowledge / Vendor Development / Product Branding. Mechanical and troubleshooting skills. Handling high voltage battery packs.
Middle Management	<ul style="list-style-type: none"> Bachelors in Engineering and Masters in Management, with at least 10-15 years of experience in a reputed automotive company 	<ul style="list-style-type: none"> Create diverse electrification kit solutions for customers, Create business models to converge fleet on the ground mobility solutions. Develop maintenance and operating standards for all technicians, technologists, programmers, and analysts. Prepare contract documents and evaluate tenders for EV chargers or maintenance. Ability to crack deals.
Higher Management	<ul style="list-style-type: none"> Graduate Engineers with Masters in Management from top management institutes. Proven credentials in a leadership role for over 5 years 	<ul style="list-style-type: none"> Business creation and growth, leading teams in strategy and business development. Managing Government policy & liaising with agencies such as EESL, relevant ministries, etc.

Solar & LED



Segments included in this industry

Solar Cell & Module	Solar O&M providers
Solar Inverters	Solar Developers
Solar BoP	LED & Smart Lighting
Solar EPC & System Integrators	

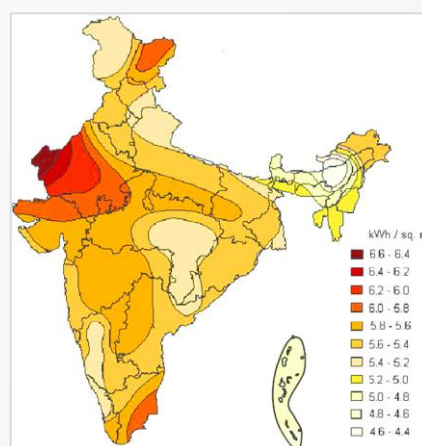
Sector overview - Solar

India's geographic location within the tropical belt bestows it with an abundance of solar radiation, which has been a major resource for the solar energy market in the country. India enjoys 300-320 sunny days and 3,000 hours of sunshine each year which is equivalent to over 5,000 trillion kWh. In India, almost all the regions receive 4-7 kWh of solar radiation per sq. meter with about 2,300-3,200 sunshine hours per year, depending upon the location. Key regions getting very high sunshine are the states of Rajasthan, Gujarat, parts of Tamil Nadu, Madhya Pradesh, Maharashtra, Telangana and Karnataka.

Four tier regulatory structure is present in Indian Renewable Energy sector. Ministry of New & Renewable Energy (MNRE) is the nodal ministry framing all the policy and programmes / schemes for renewable energy sector for the country. It also oversees the implementation of renewable energy projects at a macro level.

Electricity Regulation Commissions – both at the state and central levels, help in forming and amending regulations for the sector. They also set cost & performance benchmarks, and resolve hurdles that arise in the regulatory space.

State Nodal Agencies (SNAs) directly oversee the facilitation and implementation of renewable energy projects at the state level. SNAs are also delegated to monitor the progress of schemes and



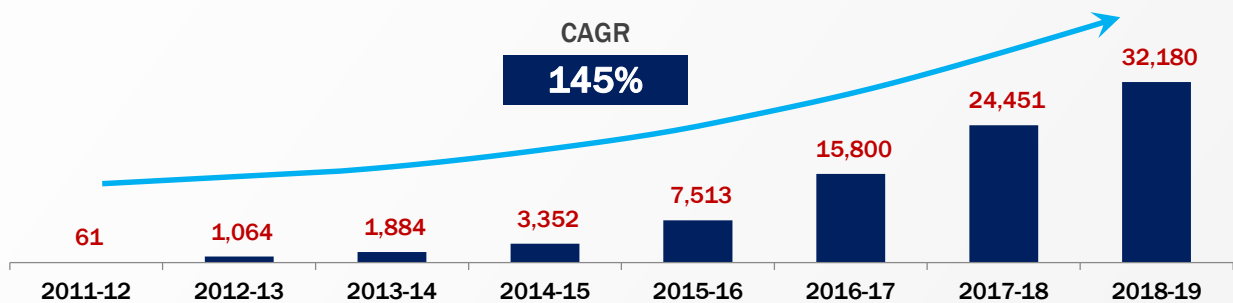
projects floated by the ministry. Some SNAs also bring out state specific RE Policies e.g., CREDA, TNEDA, MEDA, ANERT (Kerala) etc.

Other than that, there are agencies which provide financing and institutional support to solar sector. Indian Renewable Energy Development Agency (IREDA) has been mandated to provide financial support to specific projects and schemes for generating electricity and / or energy through new and renewable sources and conserving energy through energy efficiency. Organizations such as Solar Energy Corporation of India (SECI) is responsible for implementation of a number of schemes of MNRE. In addition, SECI has ventured into solar project development on turnkey basis for several PSUs. The company also has a power trading license.

Indian solar industry can broadly be classified under two categories – Solar Thermal and Solar PV. Solar PV is the dominant category and can further be classified under three categories – distributed off-grid, distributed grid connected and utility scale grid connected. The last two categories have fairly established market and ecosystem in India with presence of large no. of domestic and international companies. Off grid solar PV market is highly price sensitive and is dominated by medium and small social entrepreneurs / micro grid companies. Most of the Solar thermal applications are still in nascent stage and yet to find scalable business models and technologies.

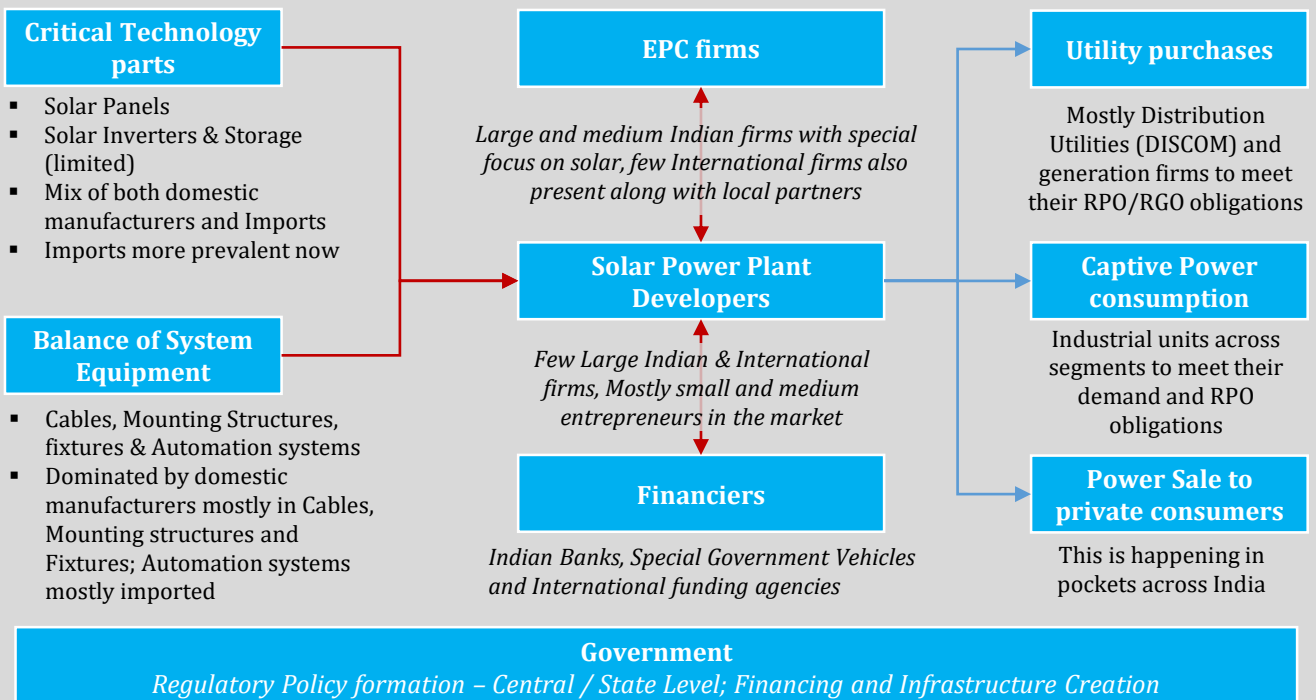
Because of continued focus and progressive policies from the Government, solar power installed generation capacity in the country has crossed the 32 GW mark, growing at a staggering 145 per cent CAGR between 2012 and 2019. Utility scale solar project account for approx. 88% of this installed capacity. Government’s target of achieving 100 GW of installed solar power generation capacity by 2022 has been a tremendous enabler for the industry. This has not only given fillip to the EPC industry, but has also acted as a confidence boosting measure for the associated manufacturing (panels, inverters and BoP equipment) & service (EPC and O&M services) industry.

Installed capacity of Solar-based power generation capacity in India (In MW)



Source: Ministry of New & Renewable Energy

Value chain of grid connected solar power business in India



Key stakeholders in the Solar industry are Panel & Module suppliers, BoP suppliers, developers, EPC companies and O&M companies.

There are approx. 70+ solar developers present in India – there is a good mix of Indian and international companies in this segment. Some of the notable solar power developers in India are Adani Group, Tata Power, Mahindra Susten, Hero Future, Azure Power, Acme Solar, Waree Energies, Fortum, First Solar etc.

There are approx. 150 Solar EPC firms present in India. These companies can be categorized in four categories – conventional EPC companies diversifying into solar EPC, pure play Solar EPC firms, equipment companies forward integrating into Solar EPC & companies from other segments diversifying into Solar EPC. There are various routes through EPC work is carried out in India – the most prominent route being developer takes care of land, PPA and procurement and EPC takes care of rest of the activities.

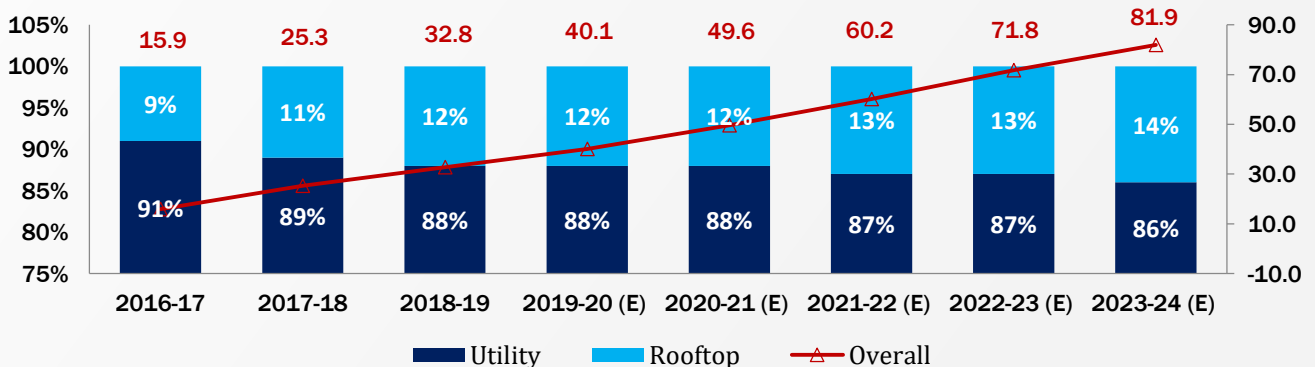
When it comes to Operations & Maintenance (O&M) of Solar plants, it is done either by the EPC firms or by the local companies or by the in-house team of the Solar power developers. There are 50+ EPC companies offering O&M services in India. Some of the prominent companies in this segment are Sterling & Wilson, Mahindra Susten, Tata Power, L&T EPC etc. When it comes to local O&M service providers, these are mostly promoter driven firms

with a small team. There are 400+ local companies offering Solar O&M services in India.

As on December 2018, India has 2,960 MW of Solar cell manufacturing capacity and 9,000 MW of Solar panel manufacturing capacity. Prominent technology being Crystalline Silicon. Indian Government has taken multiple initiatives to incentivize Solar Cells and Modules manufacturing in India:

- JNNSM mandates the use of locally manufactured solar cells and modules by engaging the government’s Domestic Content Requirement (DCR), which mandates as high as 25% of the targets to be kept for bidding under DCR
- ‘National Manufacturing Policy’, which was later merged with the ‘Make in India’ initiative offers a host of incentives specifically for PV module and BOM manufacturers, including custom and excise duty exemptions
- The Modified Special Incentive Package Scheme (M-SIPS) of the Department of Electronics and Information Technology (DeitY) offers 20% and 25% subsidy on capital expenditure for cell & module lines in Special Economic Zones (SEZ) and Non-SEZs, respectively
- Reimbursement of excise duty and countervailing duty is also applicable for capital equipment purchased for Non-SEZ units
- Further, high technology units, such as fabrication units (wafer manufacturing facility), get a reimbursement of central taxes and duties

Likely installed capacity of Solar power in India by 2023-24 (GW)



Source: Feedback Analysis

Sector overview - LED

The lighting industry has been seeing a similar push from the Government for the replacement of basic and inefficient incandescent, halogen and fluorescent lamps with modern LED lights in order to reduce electricity consumption. It is expected that LED lighting would reduce energy consumption for lighting across the country from the present 18 per cent level to 13 per cent of the total power consumed in the country.

The government's initiatives have resulted in the demand for CFLs and incandescent lamps being gradually being replaced by the demand for LED bulbs. Sales of CFLs have fallen by a third since their peak in 2013 primarily due to schemes like the Bachat Lamp Yojana (BLY) and Domestic Efficient Lighting Programme (DELP). During the same period, the sales for incandescent bulbs have also dropped at an annual rate of about 5 per cent.

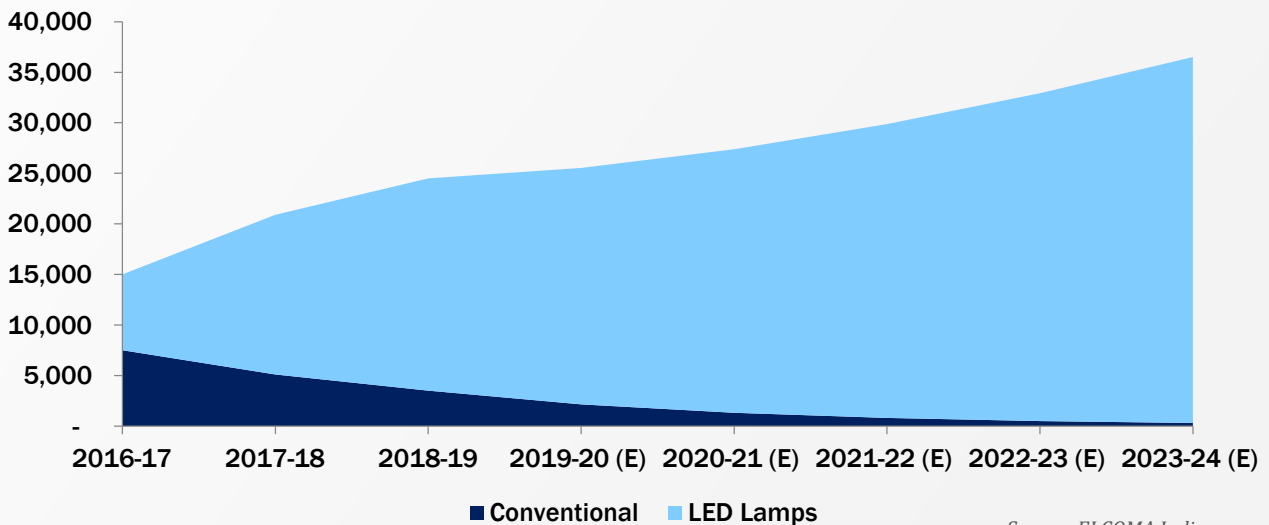
Going ahead, the lighting industry in India is expected to grow from INR 24,500 crore in 2018-19 to reach INR 36,500 crore by 2023-24. During this period, conventional lighting (incandescent lamps & CFLs) is expected to diminished, giving way to LED lighting.

The growth in the market for LED between 2017 and 2019 alone has been recorded at greater than 65 per cent. EESL has been at the forefront of this growth. EESL's UJALA scheme has sold more than 75 crore LED lamps in last 3 years through the network of state power distribution companies and its own distributors. Its SLNP program has installed more than 90 lakh LED streetlights in different cities in partnership with the local municipal bodies.

There are more than 300 suppliers present in Indian LED market. There are 8 companies which account for approx. 65 – 70% market share in LED lighting business in India. These companies are Bajaj Electricals, Crompton Greaves, Havells, Osram, Signify (Earlier Philips Lighting), Surya Roshni, Syska LED and Wipro. Other than there are approx. 20 mid sized companies and 300+ small suppliers are present in the market.

LED Market has grown by more than 65 per cent CAGR between 2017 and 2019 and likely to capture more than 99 per cent market share by 2023-24

Indian lighting market size – past trends & future projections (in INR Crore)



Source: ELCOMA India

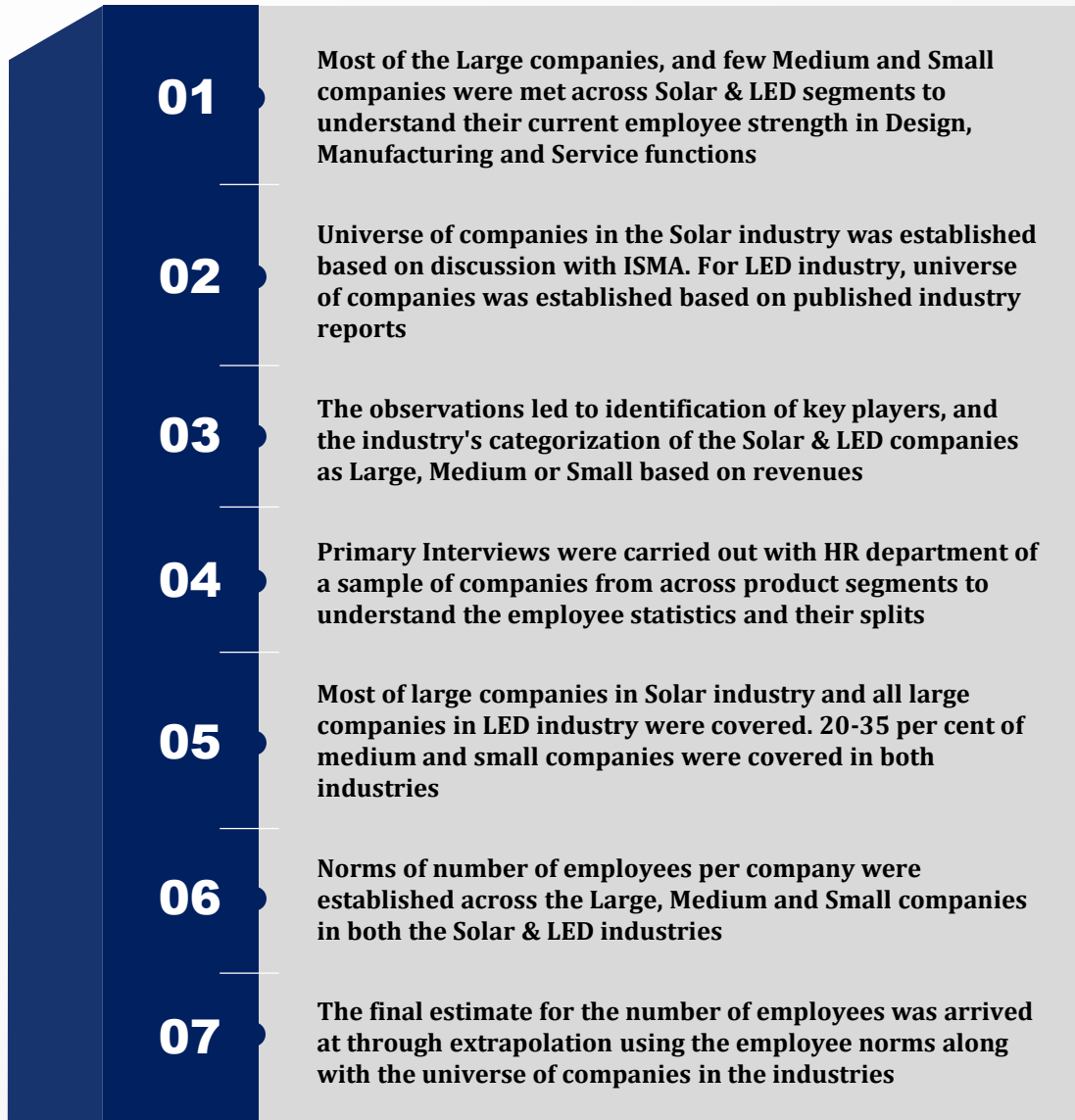
Approach to estimate current employment in Indian Solar & LED industry

The Indian solar industry has about 900 companies and the LED lighting industry has more than 300 companies which can be categorised based on their revenue levels. These companies from the various sub-segments were categorised into Large, Medium & Small based on their annual revenue levels.

A sample of 100 companies from the solar industry and 59 companies from the LED industry were identified – containing a mix of a large number of companies from the Large category, and a few companies from the Medium & Small categories.

The companies in the sample were interviewed to understand their current employee strength, and its categorization on various parameters such as – type of employees (on-role v/s contractual), function (design v/s manufacturing v/s service) and their level of seniority.

Norms for number of employees were established for companies falling in all the 3 revenue categories. Estimates for the total employee numbers were arrived at for all the three segments through judicious extrapolation of the gathered data.



Employment scenario in the Solar & LED industry

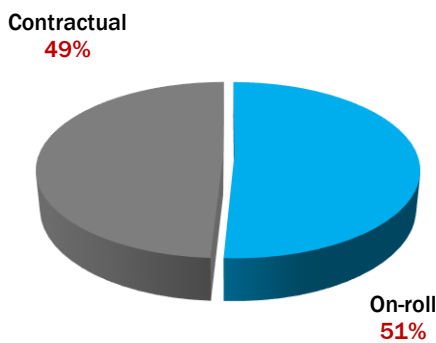
It is estimated that the solar & LED industries together currently employ around 360,000 people across departments, and across the organisational hierarchy. A large share of these employees – close to 300,000, is employed in the solar industry.

Due to the large presence of solar companies providing EPC and O&M services across the country, and strong solar developer base, there is a significant share of employees in the

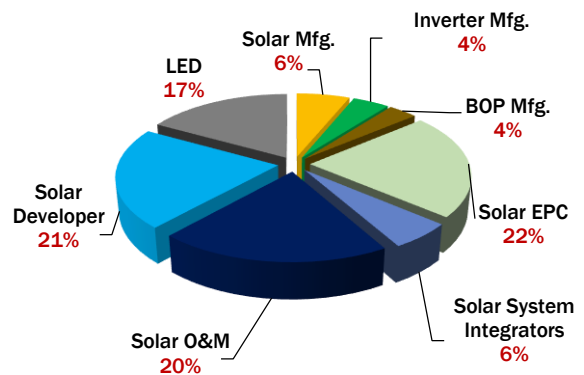
service function of the industry. On the other hand, the manufacturing function lacks the employee strength due to the nascent state of the LED & solar manufacturing in the country.

The existence of large base of employees in the solar service companies also translates into a higher share of employees at the operator level, and a higher share of people employed on contract basis.

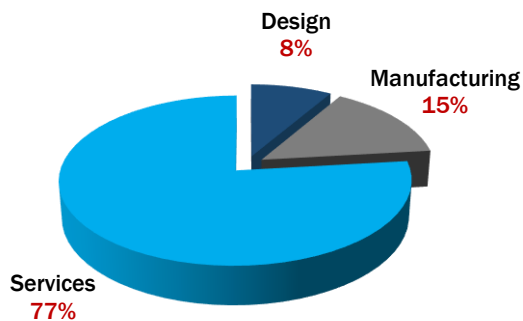
The solar & LED industry have roughly equal number of employees on their payroll and on contract basis



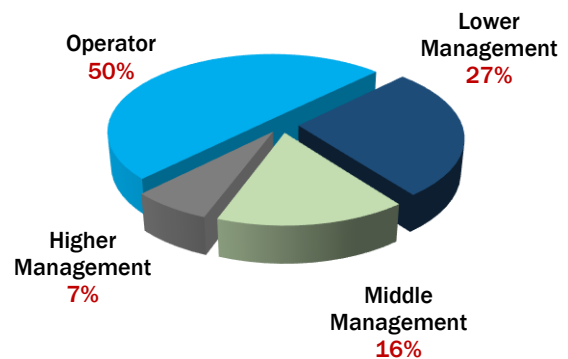
The solar service companies – EPC, O&M and developers employ close to two-thirds of the entire workforce in the industry



Both the solar & LED industries have a strong service oriented business, which is more so in the case of the Solar industry



Less than 25 per cent of the employee base manages the activities carried out by the operators & supervisory staff (more than 75 per cent of the workforce)



Approach to estimate future employment in Indian Solar & LED industry

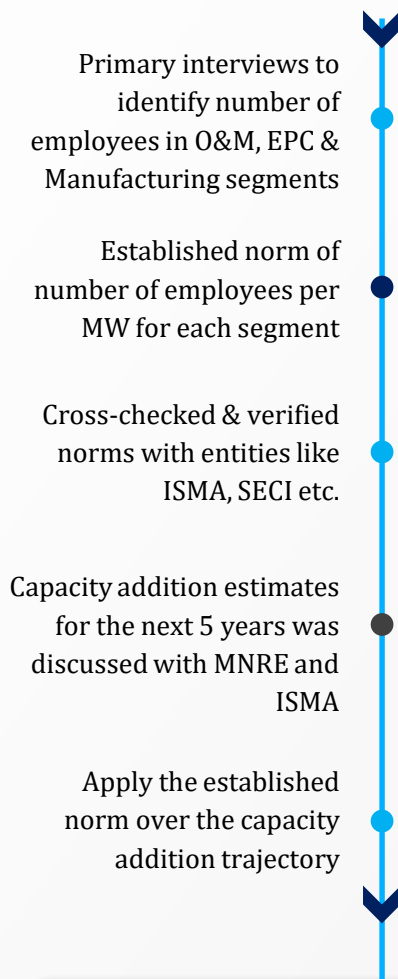
Potential employment generation estimates were arrived at through 2 parallel approaches.

The first approach used an industry norm (number of employees per vehicle sold) which was built using the employment data collected from a sample of industries. The norms are then superimposed onto the growth trend projected for the segment to arrive at a future estimate.

The second approach was based on primary interviews conducted with the HR department of sampled companies. The respondents were asked to comment on the future employment generation trend in their company under the various functions.

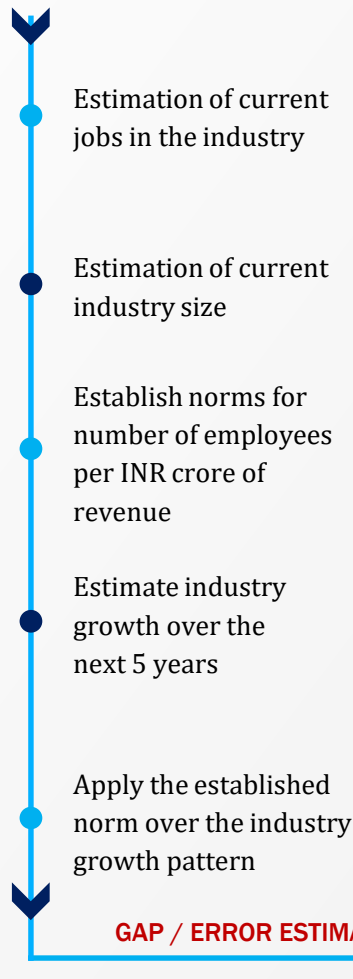
The estimates arrived at through both the approaches were compared and reconciled to finalize the future employment estimates for the industry.

Approach - Solar Based on Industry Growth



ESTIMATED FUTURE EMPLOYMENT SCENARIO IN THE SOLAR INDUSTRY

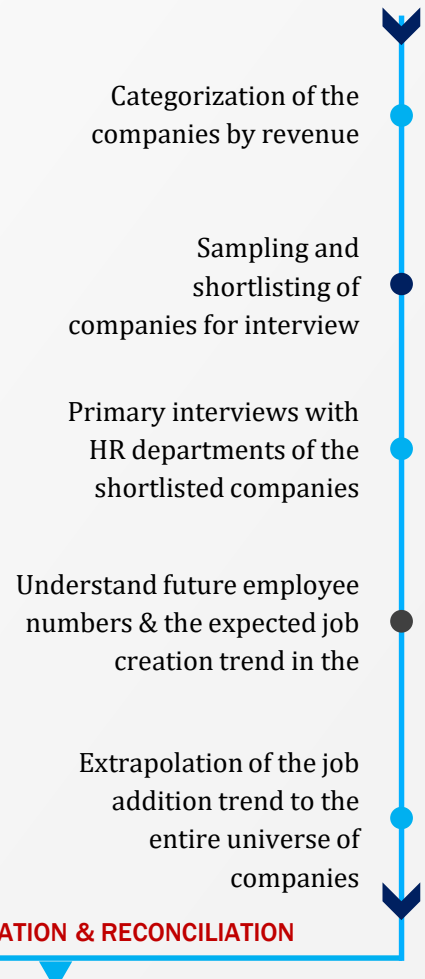
Approach 1 Based on Industry Growth



GAP / ERROR ESTIMATION & RECONCILIATION



Approach 2 Based on inputs from HR departments



ESTIMATED FUTURE EMPLOYMENT SCENARIO IN THE LED INDUSTRY

Future employment scenario in Indian Solar & LED industry

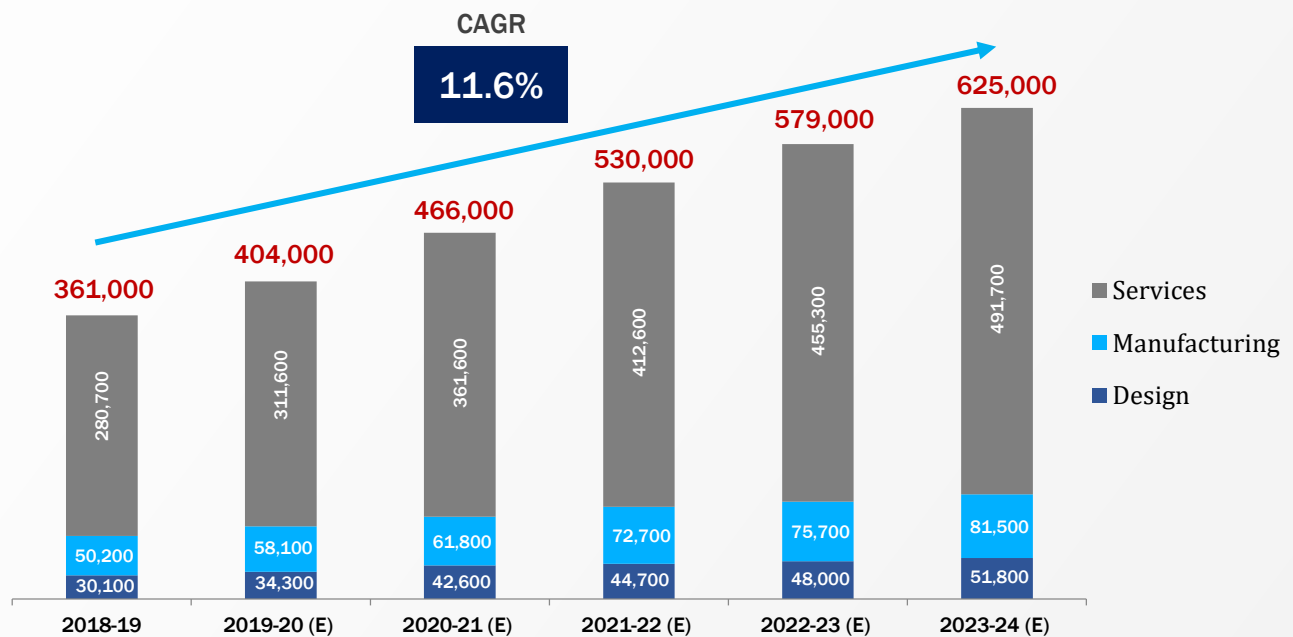
It is estimated that about 235,000 additional jobs in the solar industry and about 29,000 additional jobs in the LED industry would be created during the period between 2018-19 and 2023-24. The employment growth in these industries would grow at a CAGR of about 12 per cent and 8 per cent respectively, to register an overall growth rate of about 11.6 per cent CAGR during this period.

In the solar segment, the demand for solar power would be driven by the Government’s target of 100 GW of solar power by 2022. During the same period, the LED segment is expected to add employees under manufacturing function as India taps its potential of manufacturing complete LED lighting

solutions within the country.

During the same period, the growth in jobs in solar O&M function is expected to slow as the solar panel cleaning tasks, which are carried out by unskilled labour, would get mechanised with the help of robotic cleaning equipment.

Meanwhile, the LED lighting sector is facing challenges in the growth of its manufacturing function due to shortage of raw material, such as LED chips, packaging, driver components, optics & diffusers, etc. Currently, close to 50 per cent of these raw material is being imported & assembled in India.



Emerging areas where skilling would be required in future

Both the solar & LED industries are extremely fast paced industries, not just in terms of market growth, but also in terms of innovation and technology development. These emerging technologies require the workforce to be trained and re-skilled to cater to the changes expected to be seen in the market.

Floating solar power plants are a new and exciting application of solar PV technology. The concept was

born in the industry to overcome issues faced with the availability and acquisition of land. Over the years, the technology has started gaining traction worldwide, and is expected to grow strongly over the coming years.

Solar powered micro grids are distributed energy generation systems that feed into the local grid, but that can also be disconnected from the grid to

independently operate in an “island” mode. In the island mode, the system is able to supply power to the local community using the solar power plant, making it self-sustainable for its energy needs.

Installation of Battery Energy Storage Systems (BESS) is increasing dramatically across India to augment the renewable energy generation portfolio of the country. The BESS provides flexibility and agility to better integrate the solar & wind energy resources – which are intermittent in nature, into India’s electricity grid.

Robot technology is being emerging in the market that helps ensure water-less or water-efficient cleaning of the PV panels in solar power plants.

Another recent innovation in the solar industry are bifacial solar PV modules which are able to

produce solar power from light falling on both sides of the panel. These bifacial PV panels also offer more durability as both sides are made UV resistant.

In the lighting industry, lighting control systems are emerging that allow users to control the colour, temperature and illumination levels of lighting. Added wireless function for such systems also allow the lights to be controlled from mobile devices and remote locations through technologies like Power-over-Ethernet (PoE), IoT, Visible Lighting Control (VLC) and WiFi.

Another innovation termed as Human Centric Lighting (HCL) modulates the lighting parameters to support the human circadian rhythm, enhance concentration, prevent sleeping disorders and improve our overall well-being of the users.

Future employment in sub-segments of Solar & LED industry

Segment	Industry Structure	Industry Overview	Employment Scenario	
			Current	Future
Solar Power Developers	India has more than 80 solar power developers actively carrying out business. Of these, more than 50 companies are medium to small scale developers. The industry also has a few (around 6-8) foreign companies.	Currently, more than 18 GW of solar power capacity is under construction. Almost all	The industry currently employs close to 97,000. Being a service industry, a large part of this workforce is employed in under the design and service functions.	The future estimate for employment in the sector is expected to be as follows: 2018-19: 77,000 2019-20: 85,200 2020-21: 94,400 2021-22: 110,200 2022-23: 114,900 2023-24: 118,000
Solar EPC & System Integrators	India has more than 150 firms that provide EPC service for the solar power industry. The industry has a complex mix of companies from varying backgrounds –solar equipment suppliers, conventional EPC contractors, etc.	of these solar power projects are being carried out through EPC companies.	The industry currently employs close to 80,000. Being a service industry, a large part of this workforce is employed in under the design and service functions.	The future estimate for employment in the sector is expected to be as follows: 2018-19: 100,500 2019-20: 107,800 2020-21: 115,500 2021-22: 122,800 2022-23: 130,300 2023-24: 136,000

Segment	Industry Structure	Industry Overview	Employment Scenario	
			Current	Future
Solar O&M	The solar O&M segment has more than 450 companies. Of this, more than 50 companies are primarily solar EPC companies. About 400 dedicated solar O&M companies are present in India, which mostly cater to small rooftop systems up to 50 kW in capacity.	It is estimated that, as of 2019, close to 17 GW of Indian solar power capacity is under outsources O&M activities. The estimated size of the industry in 2019 is around INR 2,200 crore.	The industry currently employs close to 72,200 people in various functions & capacities. The entire workforce in this industry is employed under the service function.	The future estimate for employment in the sector is expected to be as follows: 2018-19: 72,200 2019-20: 90,300 2020-21: 123,300 2021-22: 147,700 2022-23: 170,500 2023-24: 197,500
Panel & Module Manufacturers	India has about 60 companies manufacturing solar panels & modules in the country. These companies are capable of manufacturing both mono-crystalline and poly-crystalline panels of capacities up to 320 kWp.	Local manufacturing industry is under threat from lower-priced imported modules from China and USA. Close to 80% of solar cell and 50% of the solar panel manufacturing capacities in India are lying idle, as of 2019.	The industry currently employs close to 22,450 people in various functions & capacities.	The future estimate for employment in the sector is expected to be as follows: 2018-19: 22,500 2019-20: 24,000 2020-21: 26,500 2021-22: 32,500 2022-23: 38,500 2023-24: 42,500
Solar Inverter & Solar BOP System Manufacturers	The solar inverter industry consists of two types of companies – Domestic inverter manufacturers (such as ABB, Schneider, Hitachi, etc.) and Foreign inverter suppliers (such as SMA, Growatt, Fronius, TBEA, Sungrow, etc.)	The inverter market for the year 2018-19 has been estimated at 6.9 GW, which translates to close to INR 1,100 crore in value terms.	The industry currently employs close to 27,800 people in various functions & capacities. The manufacturing function employs more than 50 per cent of this workforce.	The future estimate for employment in the sector is expected to be as follows: 2018-19: 27,800 2019-20: 30,700 2020-21: 34,300 2021-22: 37,800 2022-23: 39,800 2023-24: 41,000
LED	Indian LED industry consists of about 330 companies, which can be broadly categorised into 3 segments – 8 major companies, 50 emerging companies and more than 250 small scale companies. The industry also has around 7,000–8,000 LED repair shops as part of the unorganised sector.	The lighting industry is expected to grow from INR 24,500 crore in 2018-19 to reach about INR 36,500 crore by the year 2023-24. During this period, market share of conventional lighting will diminish to give way to LED lighting.	The industry currently employs close to 68,000 people in various functions & capacities. Manufacturing and service functions have a strong representation, when compared to the design function.	The future estimate for employment in the sector is expected to be as follows: 2018-19: 61,000 2019-20: 66,000 2020-21: 72,000 2021-22: 79,000 2022-23: 85,000 2023-24: 90,000

Skilling requirement for Indian Solar & LED industry

Design Function

Level	Qualification	Skillset
Operator	<ul style="list-style-type: none"> ITI / Diploma in Electrical, Electronics or Mechanical engineering 	<ul style="list-style-type: none"> Understanding of concepts & components, and other fundamental details about the product & process.
Lower Management	<ul style="list-style-type: none"> Bachelors degree in Engineering with 5 years of design experience & knowledge of various tools Masters degree in Electrical, Mechanical or Energy Engineering (for solar industry) 	<ul style="list-style-type: none"> Solar - Certification in or knowledge of software packages such as PVSyst, AutoCAD, PVDS, Sketchup, RE Screen, Helioscope. Site Analysis, 2D/3D design for solar rooftop, utilities etc. LED – Knowledge of tools like CATIA, CAD, embedded software, microprocessor design (analog & digital). LED behavior, lighting design, LED colour temperatures, wavelengths, LED efficiency (Lumens), visibility, viewing angle, etc.
Middle Management	<ul style="list-style-type: none"> Any technical degree (Bachelors or Masters in Engineering) with at least 10 years of experience in relevant industry. Doctorate degree is an added advantage. 	<ul style="list-style-type: none"> Team management, project anchoring, quality inspection, analytical & critical thinking. Knowledge of various tools with at least 5-7 years of working experience. Knowledge on power electronics, LED characteristics, LED standards
Higher Management	<ul style="list-style-type: none"> Bachelors or Masters Degree in Electrical, Electronics or Energy Engineering. Doctorate degree in Energy or Electrical subjects is preferable. 	<ul style="list-style-type: none"> Knowledge of solar & LED industry, project planning, driving design and R&D activities. Enhance product design efficiency. Goal-oriented, critical & logical mindset. Out-of-box thinking.

Skilling requirement for Indian Solar & LED industry

Manufacturing Function

Level	Qualification	Skillset
Operator	<ul style="list-style-type: none"> Higher secondary schooling or diploma in Electrical, Mechanical, Energy or Electronics & Communication Engineering. 	<ul style="list-style-type: none"> Solar - Knowledge of basic solar power concepts - loss calculation, voltage, current, power, energy etc. Familiarity with inverter, junction box, multimeters and maintenance. Testing of PV modules, solar packaging, electrical measurement equipment/tools handling, soldering techniques, and solar handling procedures. LED - Knowledge of LED product parts, soldering, electronic assembler, material / component handling, work flow. LED repairs, wiring, installations, sales.
Lower Management	<ul style="list-style-type: none"> Bachelors or Masters degree in Engineering with at least 2-3 years of experience in project handling, SCM, sales support management, operations control & coordination 	<ul style="list-style-type: none"> Solar - Procurement, feasibility analysis, inventory management, warranty management, SCADA, documentation. Knowledge of Helioscope. Suryamitra Certification. Knowledge of solar plant construction civil structure, thermographic testing, visual testing (PV), flash test, EL test, IR imaging, energy analyzer test. LED - Ensure compliance and norms of LED, quality checking, production engineering - planning & scheduling of production as per target. Maintain stock of material, inventory management.
Middle Management	<ul style="list-style-type: none"> Technical degree with more than 6-8 years of experience and exposure to Solar / LED production process. Masters degree in Management is an added advantage. Almost all the top management employees have MBA degrees. 	<ul style="list-style-type: none"> Supervision, team management, production management, supply chain management, resource management, long-term production planning, production optimization. Solar - Solar monitoring, maintenance and asset management.
Higher Management	<ul style="list-style-type: none"> Bachelors degree in Electrical, Mechanical, Electronics & Communication or Energy Engineering. More than 10 years of experience, with at least 3-5 years in solar / LED industry. 	<ul style="list-style-type: none"> Heading production - Production control, optimization, production planning, strategy & strategic initiatives, decision making. Understand functioning of all business units. Understand entire business value chain.

Skilling requirement for Indian Solar & LED industry

Service Function

Level	Qualification	Skillset
Operator	<ul style="list-style-type: none"> Solar - Higher secondary school education / diploma / bachelors degree in Electrical, Electronics or Energy Engineering LED - Any graduation and experience of LED sales. For repair & service - ITI / diploma or higher secondary school education 	<ul style="list-style-type: none"> Solar - Basic knowledge of solar power & solar components / parts. Repair of solar panels, wiring, basic installation. Knowledge of floating solar systems. LED - LED repairs, wiring, installations and sales. Knowledge of LED parts.
Lower Management	<ul style="list-style-type: none"> Bachelors or Masters degree in Electrical, Electronics & Communication or Energy Engineering. At least 2-4 years of experience in Solar / LED industry, or associated sectors such as electrical, power conditioning, etc. Masters degree in marketing, with experience in relevant field 	<ul style="list-style-type: none"> Solar - Solution selling, project / product sales, tender management, cost estimation, economic analysis of PV and maintenance analysis. Knowledge of solar rooftop systems - performance of solar PV, energy & monetary savings. LED - Retail sales, ATL & BTL marketing activities. Evaluation of sales performance, market trend analysis & sales planning. Distributor stock management.
Middle Management	<ul style="list-style-type: none"> Bachelors or Masters degree in Engineering, or Masters degree in Management, with at least 5-7 years of experience. 	<ul style="list-style-type: none"> Business development, marketing and sales experience, ability to crack deals, key account management. Market analysis and go-to-market plans. LED - Knowledge of channel sales, ability to handle large geographies, Heading regional sales functions.
Higher Management	<ul style="list-style-type: none"> Any graduation with sales experience in Solar / LED industry Masters in Management is preferable. 	<ul style="list-style-type: none"> Sales strategy, business planning, business lead, business growth strategy, business expansion, go-to-market strategies.

Security & Surveillance

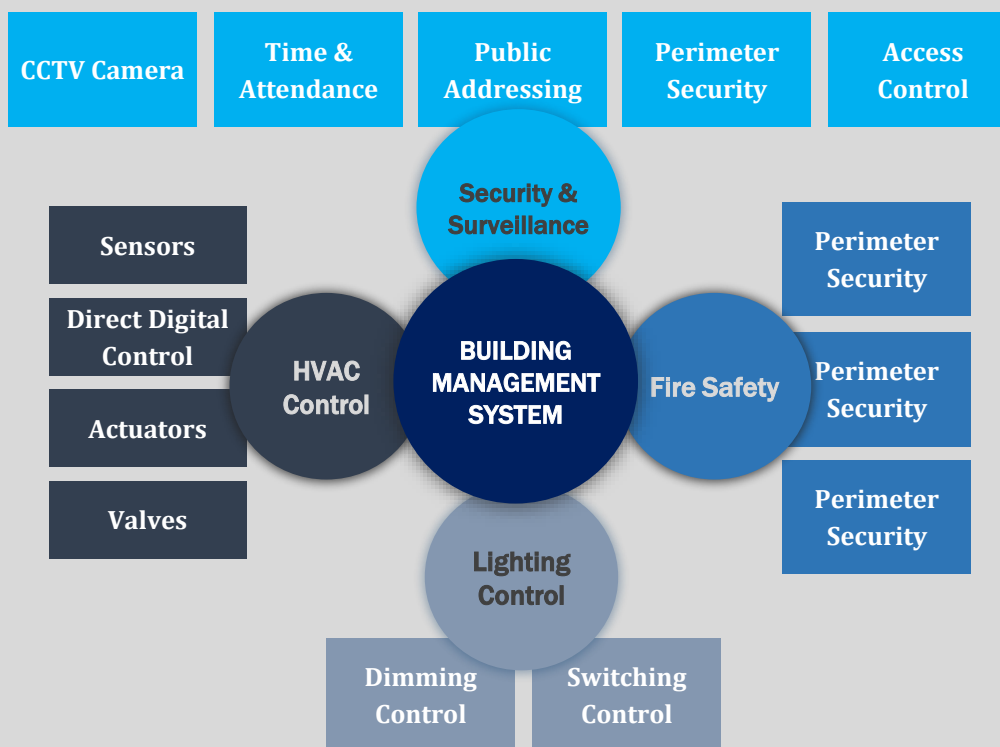


Sector overview

Feedback has considered five sub-segments under Security & Surveillance sub-sector of the Electronics Sector. These sub-segments are Security & Surveillance Systems, Fire & Safety Systems, HVAC Controls, Lighting Controls and BMS Solutions. All these systems fall under the larger umbrella of Building Management Systems (BMS) market. Building Management Systems are deployed in buildings for efficient energy

performance. It controls and manages building facilities such as lighting, electricity, fire precautions, safety, security, and HVAC. Shift towards Green and Smart buildings is rising the demand for BMS in India. Demand is arising from segments such as large offices, Information Technology and Technology Parks, commercial complexes, multiplexes, malls, and airports.

Composition of Security & Surveillance sub-sector from the study perspective



Building Management Systems (BMS) industry has been estimated at INR 24,500 crore in 2018-19 across residential, commercial & industrial sectors in India. It consists of installation of sensors, controllers and any other hardware that is then integrated using a software program for

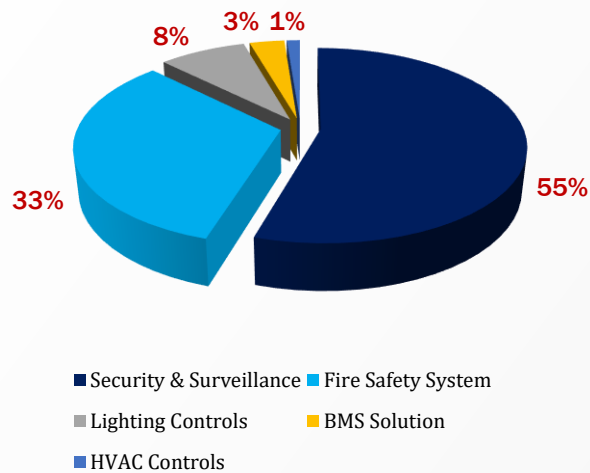
centralized monitoring and controlling purposes. Leading players in this industry are Honeywell, Legrand, Advantech, Lutron, Crestron, Siemens Building Technologies, Schneider Electric, Johnson Control, ECIL, Tyco, Ingersoll Rand, etc.

Electronic Security & Surveillance and Fire Safety Systems account for 88% share of the Indian BMS market. The BMS market is likely to grow by 12% CAGR over next 5 years to become INR 44,000 crore market by 2023-24. Within the sub-segments, Electronic Security & Surveillance market has been projected to grow at 16 per cent CAGR over next 5 years due to wider adoption of CCTV cameras across cities. Other segments likely

to grow at a moderate CAGR of 7 – 8%. Key drivers for growth of Indian BMS market are

- Increased focus on energy efficiency
- Development in Electronics and Sensor technology
- Evolution of wireless technology; and
- Development of Energy Conservation Building Code (ECBC)

**2018-19 BMS Market in India
(INR 24,500 crore)**

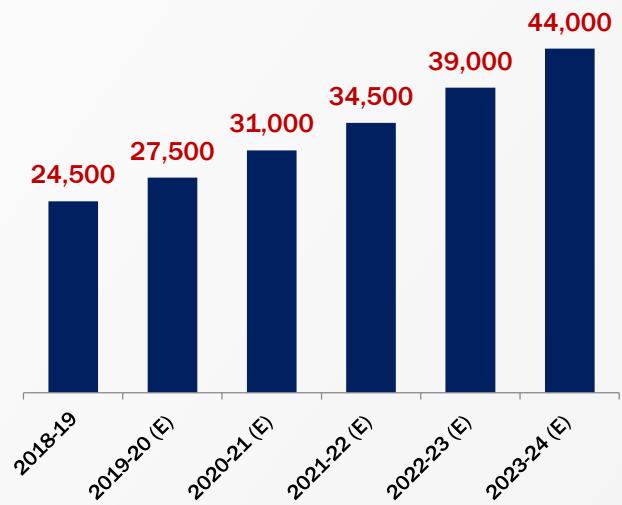


Source: Feedback Primary Research

The Security & Surveillance Systems market is estimated at INR 13,400 Crore for 2018-19 and likely to grow to INR 28,000 crore by 2023-24. It is largely an import based industry with approx. 80% of low cost security products can be seen in the unorganized market. Indian electronic security market is dominated by video surveillance; 40% of which is Analog Surveillance and rest is IP Surveillance. Key players in this market are CP Plus, Honeywell, Bartronics India, Hikvision, Dahua Technology and Axis Communication.

The Fire & Safety systems market size in 2018-19 is estimated at INR 8,000 crore. The market is likely to grow at a CAGR of 8% to CAGR of INR 11,750 crore by 2023-24. The Government has been continually regulating and making stricter rules regarding fire safety, life safety and fire

Indian BMS Market Growth (INR crore)



protection in residential, commercial as well as industrial building which is driving the growth of this sector. With rapid urbanization and industrialization, fire protection and prevention has become an integral part of all buildings.

Lighting Controls market is largely driven by the construction boom and increasing penetration of Green buildings which has hugely contributed to the growth of this market. Lighting Controls have strong presence in both residential and commercial sectors, and there is growing demand from Hospitality sector.

Upgrade in ecologically sustainable technologies and constant innovations in the HVAC market has been a key demand driver for the boom in the HVAC Controls market in India

Approach to estimate current employment in Indian Security & Surveillance industry

The Indian security & surveillance industry has about 700 companies which can be categorised based on their revenue levels. Of these 700 companies, about 15-20 companies having annual revenue greater than INR 200 crore can be categorised as Large companies. About 70-80 companies with annual revenue between INR 50-200 crore can be categorised as Medium scale companies. The remaining 600 companies are smaller with revenues less than INR 50 crore per annum.

A sample of 95 companies was identified – containing a healthy mix of companies from the

Large, Medium & Small category. The companies in the sample were interviewed to understand their current employee strength, and its categorization on various parameters such as – type of employees (on-role v/s contractual), function (design v/s manufacturing v/s service) and their level of seniority.

Norms for number of employees were established for companies falling in all the 3 categories. Estimates were arrived at for all the three segments through judicious extrapolation of the gathered data.

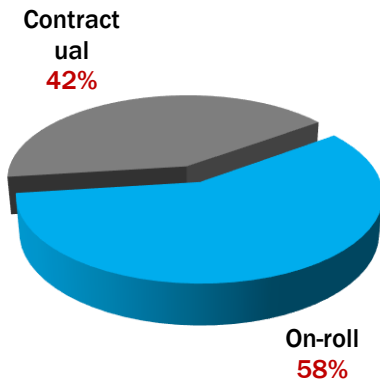


Employment scenario in Indian Security & Surveillance industry

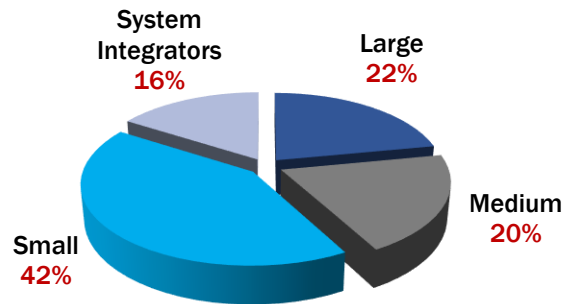
It is estimated that the Indian Security & Surveillance industry currently employs around 100,000 people across departments, and across the organisational hierarchy. The presence of a moderate manufacturing and significant sales & service base across the country, these functions employ more than 90 per cent of the current workforce of the industry. Share of contractual employees in the over workforce is considerably higher.

Apart from these stakeholders, the industry also has a strong base of security system integrators. It is estimated that there are about 900 system integrators in the country, with an average of about 8 employees per company. Additionally, the industry also has more than 100 companies providing video analytics services. These companies employ an average of about 90 employees per company.

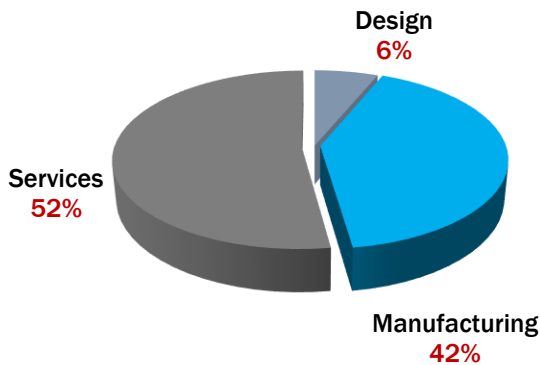
Approx. 60% employees in the Security & Surveillance industry are on company's pay roll



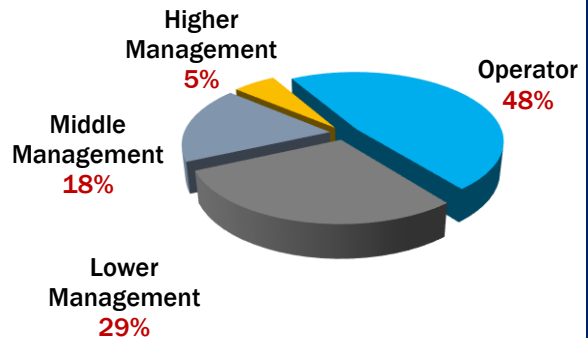
Small scale category employs significantly more people due to the presence of ~600 companies each with about 70 employees



Being an import driven market, more than half the employees work in Service sector in Security & Surveillance industry



23 per cent of the employee base manages the activities carried out by the operators & supervisory staff (about 77 per cent)



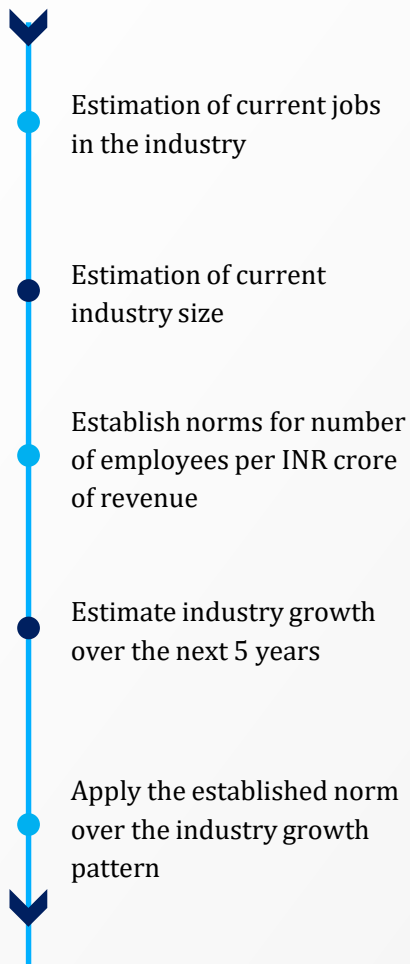
Approach to estimate future employment in Indian Security & Surveillance industry

Potential employment generation estimates were arrived at through 2 parallel approaches. The first approach used an industry norm (employee per INR crore of revenue) arrived at through discussions held with industry stakeholders. The industry norms are then superimposed onto the growth trend of the industry to arrive at a future estimate.

The second approach was based on primary interviews conducted with the HR department of sampled companies. The estimates arrived at through both the approaches were compared and reconciled to finalize the future employment estimates for the industry.

Approach 1

Based on Industry Growth

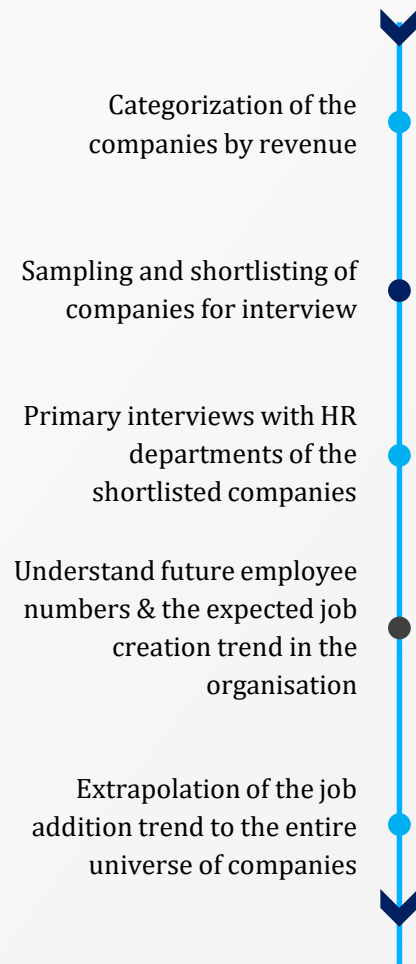


**ESTIMATED FUTURE
EMPLOYMENT SCENARIO**



Approach 2

Based on inputs from HR departments



**ESTIMATED FUTURE
EMPLOYMENT SCENARIO**

GAP / ERROR ESTIMATION & RECONCILIATION

Future employment scenario in Indian Security & Surveillance industry

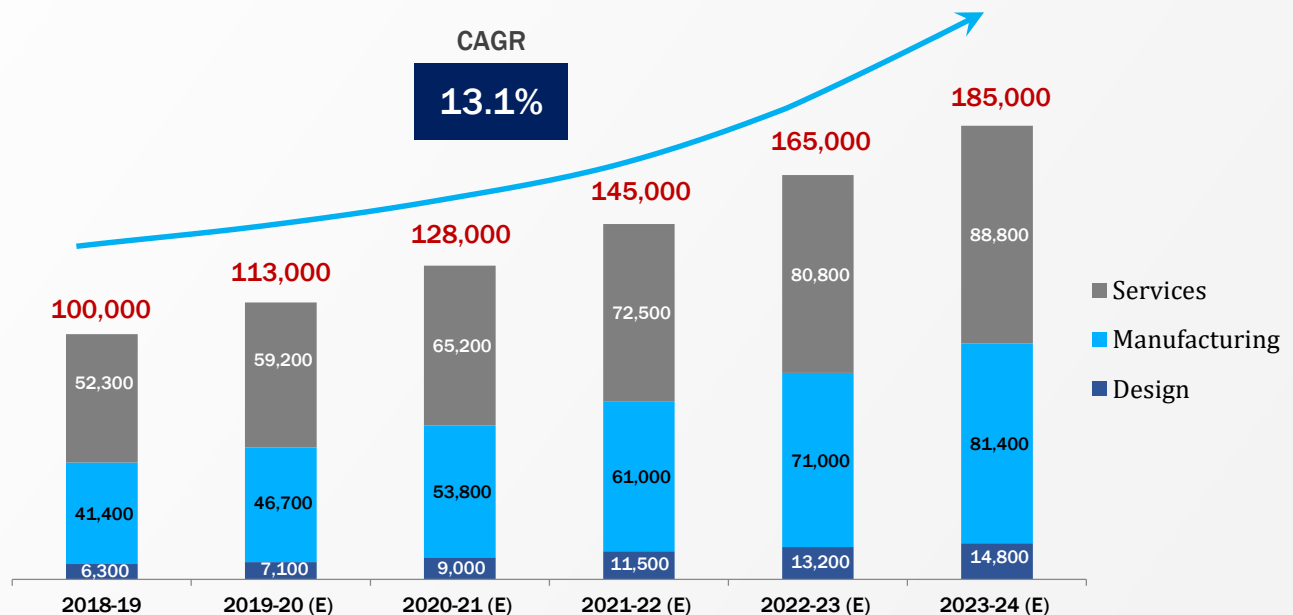
It is estimated that the industry would generate about 85,000 more jobs by the financial year 2023-24. This increase would raise the number of people employed in the industry to 185,000. This job creation in the industry is expected to take place at a CAGR of about 13 per cent over the next 5 years.

The industry has evolved over the past decade and matured to a great extent. As a result, no major change in the composition of the workforce is expected in the coming years. All three functions – design, manufacturing and service are expected to grow more or less uniformly.

The boom in the security & surveillance industry would be fed by several companies - ranging from

home grown companies such as CP Plus, to joint ventures such as Prama Hikvision, to multinationals such as Bosch, Panasonic and Honeywell.

Multiple factors are expected to drive this growth in the industry. There is a strong government push to enhance security for the citizens. Large purchases are expected to be seen under the Smart City scheme across 100 cities, and under the Nirbhaya Fund for women's safety, where INR 2,230 crore has been allocated across eight cities. The Delhi Government has also announced its intention to install more than 100,000 CCTVs across Delhi over the span of few years.



Emerging areas where skilling would be required in future

The evolution of advanced concepts like Artificial Intelligence and Deep Learning is opening up new dimensions of the security and surveillance

industry. The workforce of the future would be expected to be adequately trained and skilled in these aspects of the business.

Use of Artificial Intelligence and Deep Machine Learning in the field of video analytics has given rise to a new industry across the world. A number of system integrators & security solution companies are already offering video analytics solutions in the India market.

Along with AI and ML, technologies like Big Data, Fast Data, Cloud Computing & Edge are providing value by enabling deeper and wider analysis of security & surveillance data. Further integration with IoT systems also unlocks the potential for higher degrees of Building Automation.

Surveillance on mobile platforms, such as trucks, planes, trains and automobiles is another emerging segment. With estimated 60-100 sensors on an average vehicle, mobile surveillance provides a vast untapped opportunity in the Indian market.

Further trends in Access Control Systems include smartphone integration and multiple device management functionality from a single platform from around the globe.

Skilling requirement for Indian Security & Surveillance industry

Qualification requirement

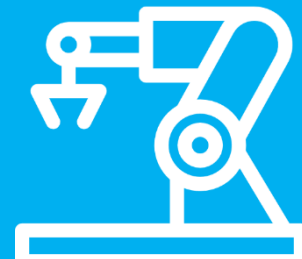
Level	Design	Manufacturing	Service
Operator	<ul style="list-style-type: none"> ITI or diploma in Computer Science, IT, Electronics & Communication or Electrical & Electronics Engineering. Experience as lab assistants or helpers preferred. 	<ul style="list-style-type: none"> Secondary or Higher Secondary Schooling. ITI or Diploma. 	<ul style="list-style-type: none"> Any degree (preferably a technical degree) or diploma in Electronics & Communications or IT Engineering. Higher Secondary schooling with experience in repairs also accepted.
Lower Management	<ul style="list-style-type: none"> Diploma or Graduate Engineer. 	<ul style="list-style-type: none"> Diploma with experience working as an Engineer. 	<ul style="list-style-type: none"> Any graduate degree.
Middle Management	<ul style="list-style-type: none"> Graduate Engineer with 5-10 years of experience. 	<ul style="list-style-type: none"> Bachelors degree in engineering with experience. Masters degree in engineering is not mandatory, but may be considered. 	<ul style="list-style-type: none"> Any graduate degree with 5-8 experience in sales. Masters in Management with 3-5 years of experience preferred.
Higher Management	<ul style="list-style-type: none"> Graduate Engineer with at least 10 years of experience. Masters degree or Doctorate in Engineering is not mandatory, but is preferable. 	<ul style="list-style-type: none"> Bachelors degree in Engineering with at least 15 years of experience (usually promoted from the same organization) Masters degree or Doctorate in Engineering is considered if recruited from the market. 	<ul style="list-style-type: none"> Technical degree with at least 10 years of experience. Masters in Marketing & Sales Management is preferred.

Skilling requirement for Indian Security & Surveillance industry

Skill requirement

Level	Design	Manufacturing	Service
Operator	<ul style="list-style-type: none"> Lab assistants assist engineers in circuit designing, lab testing and other minor works. Basic knowledge of various components, its working and applications. 	<ul style="list-style-type: none"> Knowledge of components, like sensors & transducers, diodes, resistors and other electronic components. Basic application of electronic principles, soldering and assembly. Knowledge of safety aspects of manufacturing plant. 	<ul style="list-style-type: none"> Education in field of electronic services, technical certification, troubleshooting, assembling and disassembling, repair and monitoring of alarm systems, CCTV (hardware and electronic devices), cable connections. Knowledge of various components like connectors, cords, LAN/WAN connectivity components, lighting controls, HVAC control repairs etc. Knowledge of products such as alarm systems, CCTV network, smoke detectors, notifiers, etc.
Lower Management	<ul style="list-style-type: none"> Knowledge of various circuit design, logic gates, MATLAB design, advanced mathematics. In case of software design, knowledge of LabVIEW, Linux, drafting using CAD, coding in C++, Python and other automation software. NICET certification (not mandatory). 	<ul style="list-style-type: none"> Knowledge of PLC, SCADA, signal & systems, communication systems, network protocols like CAN, HART, etc. Knowledge of Digital Control systems, digital signal processing, Bio-medical instrumentation etc. Knowledge of manufacturing process, quality and testing of products etc. 	<ul style="list-style-type: none"> System Integration, knowledge on different networking application, connectivity etc. Sales experience. Product knowledge (both technical and non-technical) is preferable but not mandatory. For BMS and other automation integration, knowledge of communication protocols like KNX, BACnet, Modbus, DCS etc.
Middle Management	<ul style="list-style-type: none"> Knowledge of various innovative technologies, like Artificial Intelligence. Team handling. Advance process control. 	<ul style="list-style-type: none"> Process optimization, production control, testing & approvals, and supply chain management. Supervision and managing various functions. 	<ul style="list-style-type: none"> Managing key geographical regions and sales territories, Institutional sales handling. Sales strategy implementation.
Higher Management	<ul style="list-style-type: none"> Lead the organization with innovative solutions. Experience in handling projects and ability to drive business. 	<ul style="list-style-type: none"> Understand market demand & plan for future. Production planning strategy. Understand all business units and their functions. 	<ul style="list-style-type: none"> Sales strategy, planning, business lead, acquiring new clients, expansion plans, growth strategy etc.

Industrial Automation



Segments included in this industry

Machine OEM's: CNC / NC / Machine Manufactures	Energy Service Companies - Energy meters / UPS & Inverter
HVAC OEM & Service Providers	Solution Providers
Product Automation	System Integrators
IIoT / Industry 4.0 / M2M / SCADA / Super SCADA	Mechatronics / PLC / HMI / ATM / KIOSK / AFD
Robotics / 3D Printing / Electric pneumatics	

Sector overview – Industrial Automation

Indian Industrial Automation industry is estimated to be as big as INR 420 billion during the year 2018-19, which is expected to grow at 11 per cent CAGR over the next 5 years to reach INR 730 billion.

This market is broadly segmented into three segments - Process automation, Factory automation, and Electrical automation, with about 250 companies providing their solutions across these segments. The market is dominated by large turnkey solution providers that offer end-to-end solutions for automation. Large and medium scale players include companies such as ABB, Siemens, GE, Fanuc, Rockwell Automation, Danfoss, Mitsubishi Electric, etc.

The most prevalent technologies implemented by the industry include Distributed Control Systems (DCS), Supervisory Control And Data Acquisition (SCADA), Programmable Logic Control (PLC),

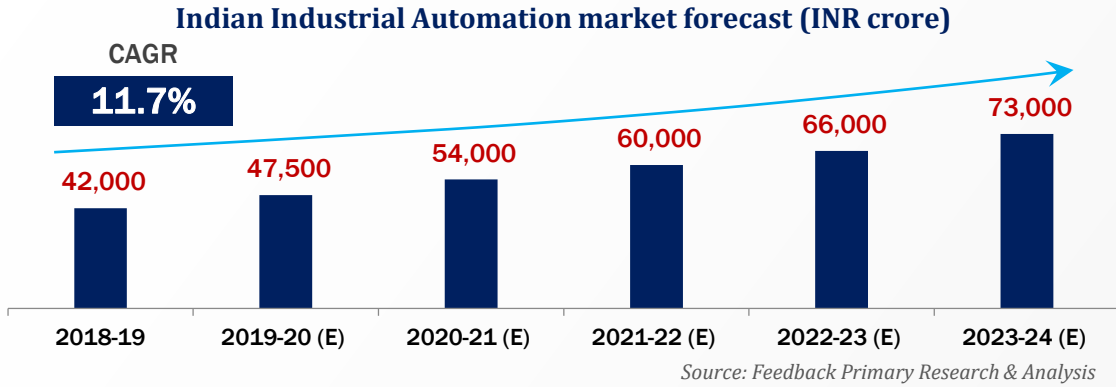
Manufacturing Execution System (MES) and Human Machine Interface (HMI). Among these, SCADA and MES are the technologies which are in high demand across the various industries owing to its high degree of versatility.

This market is driven by increasing investments in the secondary manufacturing sector owing to encouraging government policies and changing attitude towards technology adoption. Several Indian industries are upgrading their existing automation technologies with the aim to reduce production times and to promote safety & efficiency. Automation helps achieve operational excellence, improved productivity & quality, and maintain Six Sigma standards in the production processes. There is also an equal push from the government to improve efficiency & quality to ensure India's position as a competitive global manufacturing hub.

Split of domestic v/s imported products in Industrial Automation market

Total: INR 42,000 crore

	37,000	5,000
Domestic		Import



Sector overview – UPS & Home Inverter

Indian UPS and inverter market is gaining momentum, as these devices have become a necessity in almost every modern household, office and industrial facility. Even though the power supply scenario has improved significantly over the years, the demand for power backup products continues to grow due to the convenience offered by it and its need in critical systems.

The manufacturing ecosystem for UPS and inverters in India has also matured over the years. While technological requirements of inverter manufacturing are greater than the manufacturing and design capabilities present in India currently. The Indian Home inverter and UPS industry has about 150 companies across the segments. A sample of 18 companies was identified – containing a mix of all the large companies, and a few medium & small-scale companies from across the segments. Large and medium players include companies such as Luminous, Microtek, Vertiv, Schneider and TMEIC etc.

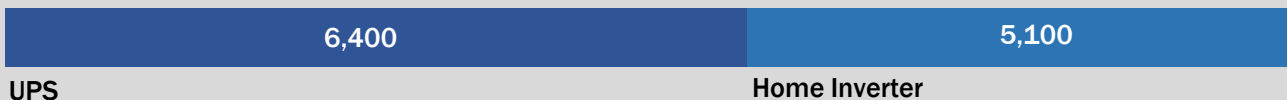
The overall market of Home Inverters & UPS in India is INR 11,500 crore in 2018-19. This market may grow at 7 per cent CAGR over the next 5 years to INR 16,000 crore. The demand in the Indian inverter/UPS market has increased due to

constant power outages and a strong push from the government to accelerate the National Solar Mission. India is a developing economy and our industrial base is increasing constantly. The per capita income of Indians has gone up, improving lifestyles. In this scenario, with increasing power cuts, domestic consumers will drive the trend of increased UPS system and inverter adoption. Although most of the UPS and power backup systems are used in the information technology (IT) and telecommunication industries to protect data, many industrial processes are now microprocessor and PC-based and are very susceptible and sensitive to power disturbances. Recent trend in this industry is shifting to hybrid inverters and solar inverter. Now a days many system integrators offering solar rooftop inverter solutions at affordable prices.

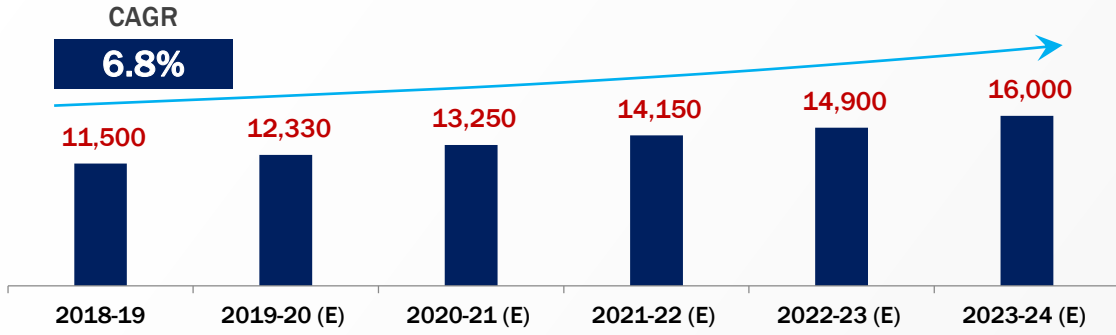
UPS manufacturers face many challenges related to machinery, raw materials, skilled manpower and land to build manufacturing plants, which makes it difficult to set these up in different locations. Also, lack of the easy availability of electricity and water are a major deterrent to the smooth running of manufacturing units. Most of the companies use machines and raw materials imported from other countries, which increases the overall costs. Not having skilled manpower also plays spoilsport.

Market split by Home Inverter and UPS for 2018-19

Total: INR 11,500 crore



UPS & Home Inverter market forecast (INR crore)



Source: Feedback Primary Research & Analysis

Sector overview – HVAC

Indian HVAC industry is estimated to be valued at around INR 28,000 crore in size during 2018-19. This market is expected to grow at 8.6 per cent CAGR over the next 5 years to reach INR 42,000 crore.

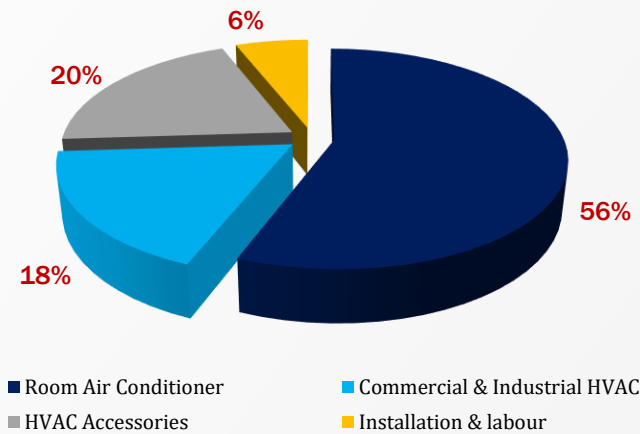
The Indian HVAC industry has about 100 companies across segments, which fiercely compete for market share in terms of price, energy efficiency, brand reputation, quality, and technical know-how. Some of the key large and medium scale players in this industry include Daikin, Voltas, Blue Star, Johnson Controls- Hitachi, Carrier, LG and Mitsubishi Electric.

The room air conditioning segment captures the largest share in the HVAC market, and is expected to retain its dominance till 2023-24. Centralized air

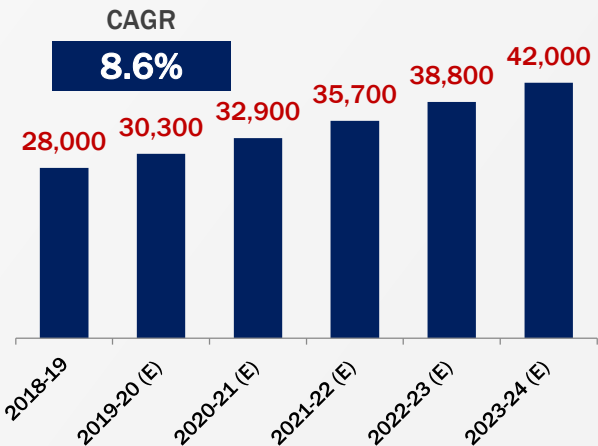
conditioners, in contrast, are more expensive, and are preferred as permanent cooling solution for large commercial complexes and office spaces, where larger capacities are required for effective cooling. Market for VRF or Variable Refrigerant Flow technology has grown significantly in the last 8 – 10 years and the technology currently enjoy highest market share in Commercial HVAC segment.

Then industry has been evolving with technological innovations taking place in recent years. Most recent product launches have been geared towards added functionalities such as space heating, humidity control and air purification. Advanced cooling technologies such as VRF, Magnetic Bearing Chillers etc. are likely to dominate the market in the coming years.

2018-19 HVAC Market in India



Indian HVAC market forecast (INR crore)



Source: Feedback Primary Research

Sector overview – Machine Tools

India stands 12th in the world in terms of production, and 8th in terms of consumption of machine tools. Machine tools are primarily used to cut and shape metal and other material as per specifications to make a finished product. The size of market for such machines & machines tools in India is estimated to be around INR 16,250 crore in 2018-19. The demand in this market is expected to grow at about 8-9 per cent CAGR to reach INR 24,000 crore by the year 2023-24.

The machine tools market can be categorized broadly into two categories - CNC machines, and Non-CNC machines. With a share of about 80 per cent, the market is dominated by CNC machines. Metal cutting tools accounted for 86 per cent of the market, while the rest consists of metal forming tools. The automotive sector is the largest consumer of machine tools in India, which is followed by the dies & moulds segment.

India has nearly 200 manufacturers of machine tools in the organized sector, along with another 400 small scale units making up an unorganized sector. Some of the large and medium scale companies in this industry include Hindustan Machine Tools (HMT), TAL Manufacturing Solutions, MTAB Engineers etc.

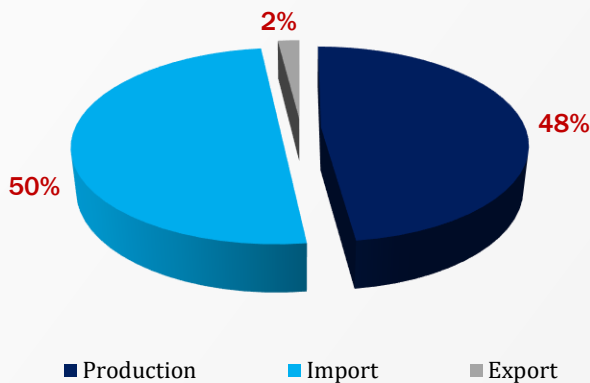
Indian manufacturers have grown rapidly over the last decade, and have marked their presence in the global market across all the categories of machine tools. Indian machines are price competitive in their

range making them suitable for exports. Many of these manufacturers are also exporting to countries like Germany, Turkey, China, Middle East, Russia, South Korea, etc. The country is set to become a more prominent player in the global machine tools market, and is expected to pave way for high-end machine tool manufacturing in the country.

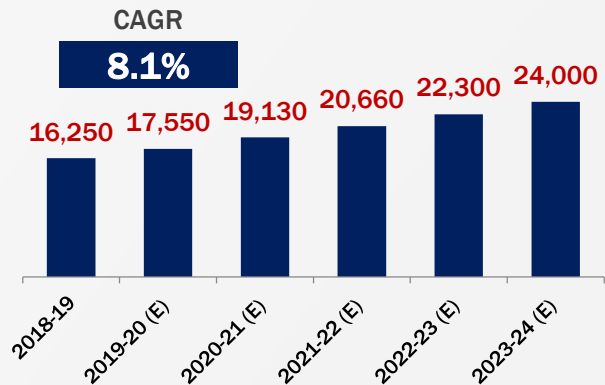
Demand for high precision machines is expected to increase especially from segments such as automobile, auto ancillaries, railways, dies & moulds. A key trend being observed in the industry is the emergence of optimized machine tools. Automation of the machine tools is another major trend that the machine tool sector that is currently witnessing

Machine tools are among the key sectors in the National Capital Goods Policy aimed at making the Indian capital goods sector globally competitive. The policy integrates major capital goods sub-sectors like machine tools, textile machinery, earthmoving and mining machinery, heavy electrical equipment, plastic machinery, process plant equipment, dies, moulds and press tools, printing and packaging machinery and food processing machinery as priority sectors to be envisaged under 'Make in India' initiative. The boost to the capital goods sector is expected to be initiated by the creation of an enabling ecosystem for capital goods through sustained incentives for domestic manufacturers to meet the demand from both the domestic as well as the export markets.

2018-19 Machine Tool market in India



Indian Machine Tool market forecast (INR crore)



Source: Feedback Primary Research

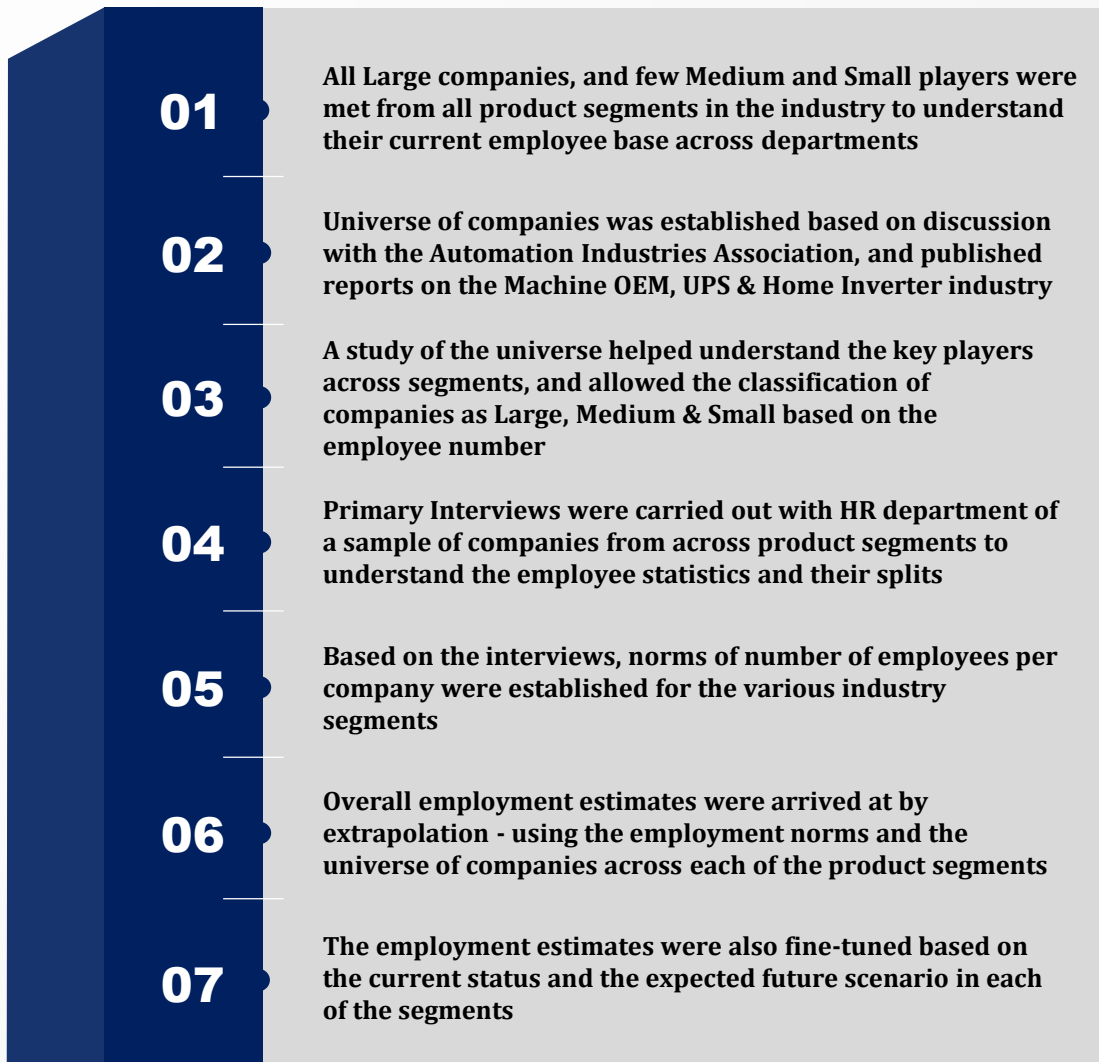
Approach to estimate current employment in Indian Industrial Automation industry

The industries under consideration have a total of about 800 companies across the 4 product segments – 100 HVAC companies, 150 UPS & home inverter companies, 400 machine tool companies and about 200 industrial automation companies. A sample of 108 companies was identified – containing a equitable mix of large, medium & small scale companies from across the 4 product segments.

The companies in the sample were interviewed to understand their current employee strength, and its

categorization on various parameters such as – type of employees (on-role v/s contractual), function (design v/s manufacturing v/s service) and their level of seniority.

Norms for number of employees were established separately for each of the product segments falling under the industry. Estimates were arrived at for all the product segments through judicious extrapolation of the gathered data

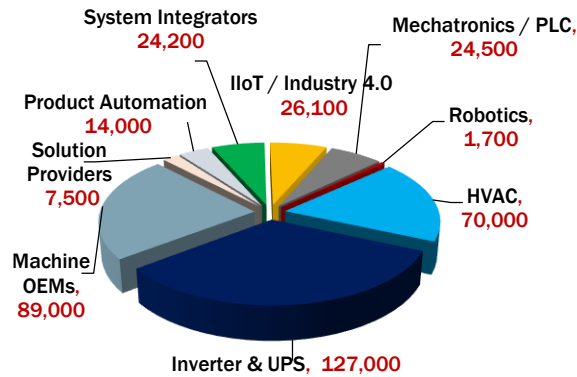


Employment scenario in Indian Industrial Automation industry

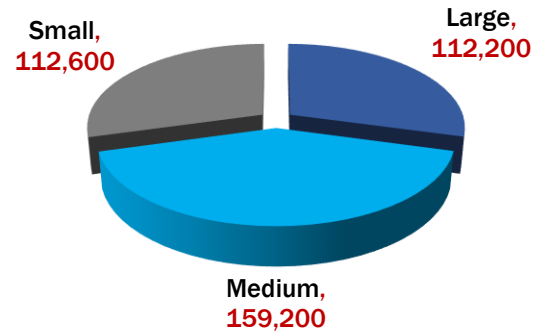
It is estimated that the industry currently employs around 384,000 people across departments, and across the organizational hierarchy in all the 4 product segments. A significant portion of the workforce (about 50 per cent) employed in these industries takes care of the service function, and about 42 per cent employed in the manufacturing function.

Under all the 4 segments, India has a strong manufacturing capacity which employs a large portion of the industry's workforce. The manufacturing business is augmented by a significant service sector, which not just provides maintenance services for the manufactured products, but also acts as system integrators which employ a significant number of employees.

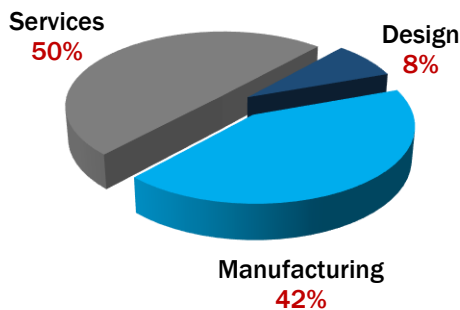
The EV and EV component segments of the industry employ the most number of people due to their manufacturing activities



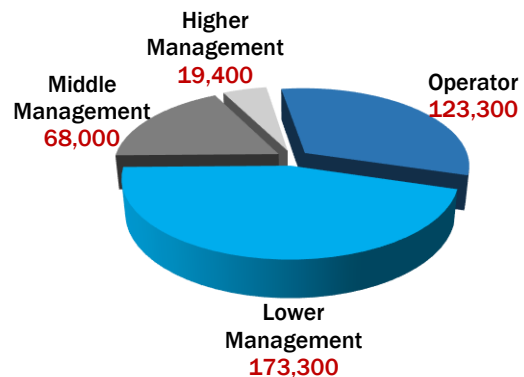
Large & medium scale companies together employ close to 80 per cent of the workforce employed in the industry



More than 85 per cent of the industry workforce is employed in the manufacturing and service functions



Close to 25 per cent of the employee base manages the work carried out by the operators & supervisory staff



Approach to estimate future employment in Indian Industrial Automation industry

Potential employment generation estimates were arrived at through 2 parallel approaches.

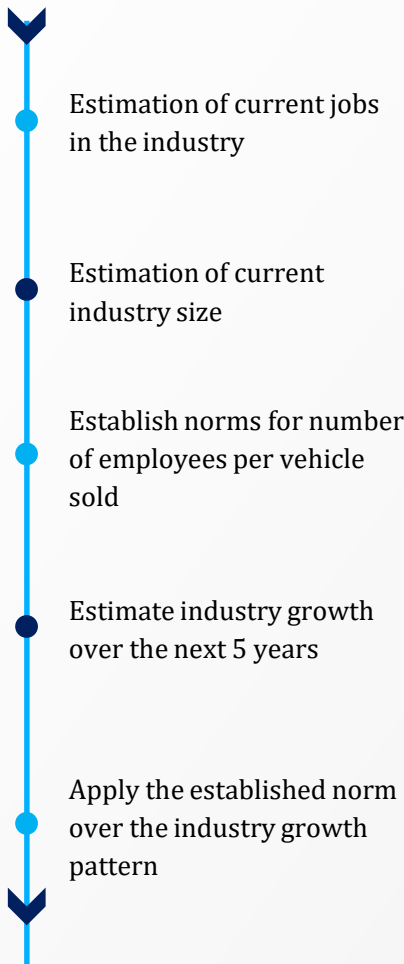
The first approach used an industry norm (number of employees per INR crore of revenue) which is established separately for the three types of companies encountered – Large, medium and small. The norms were established using the employment data collected from a sample of companies from

each of the segment. The norms are then superimposed onto the growth trend projected for the segment to arrive at a future estimate.

The second approach was based on linking the employment with the industry growth. For each industry a norm of employee vs output was derived and employment potential was estimated based on projected growth of the industry over next 5 years

Approach 1

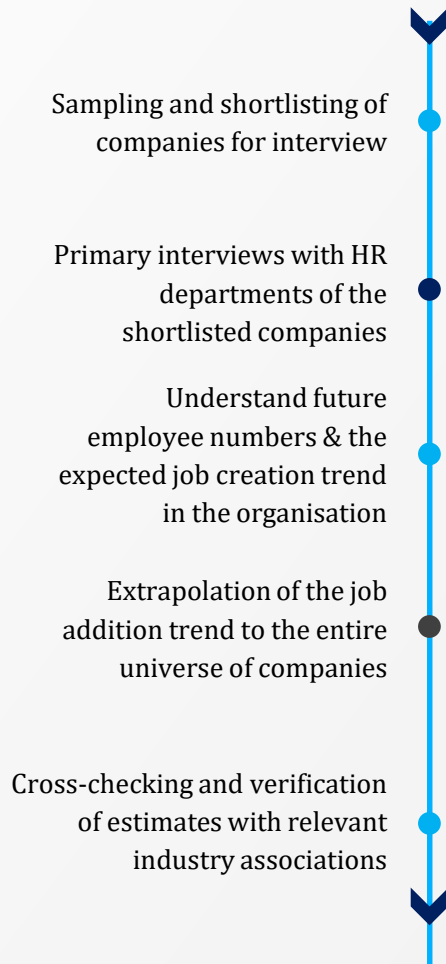
Based on Industry Growth



ESTIMATED FUTURE EMPLOYMENT SCENARIO

Approach 2

Based on inputs from HR departments



ESTIMATED FUTURE EMPLOYMENT SCENARIO



GAP / ERROR ESTIMATION & RECONCILIATION

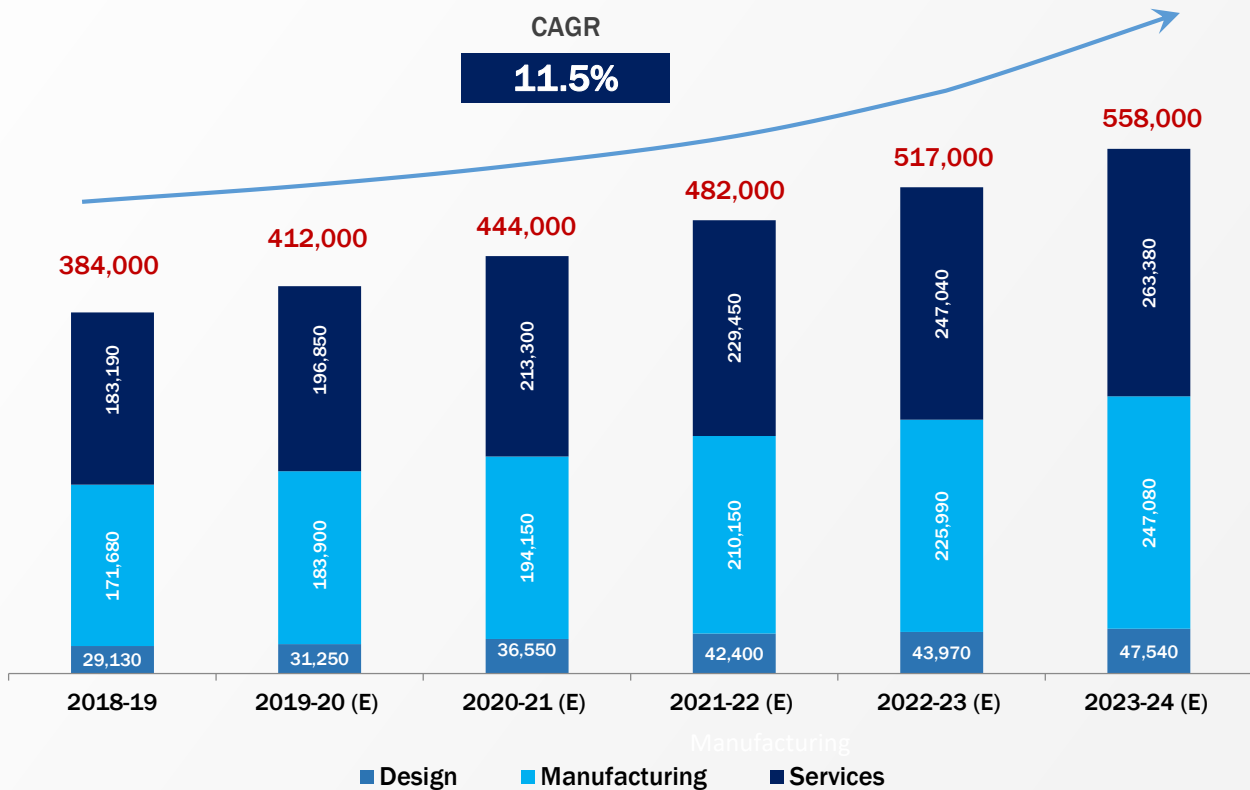
Future employment scenario in Indian Industrial Automation industry

It is estimated that approximately 174,000 additional jobs will be created in the industrial automation industry during the period between 2018-19 and 2023-24. The growth rate for the jobs in the industry is estimated to be around 7.8 per cent CAGR over this period.

Due to the well-established nature of the industry and its sub-segments, the growth across all the three functions – manufacturing, service and design are all moderate. One of the major factors driving growth in the Industrial Automation segment is the increasing efforts being made to make manufacturing processes through factory

automation solutions to achieve higher efficiency along with lower reject rates. Under such conditions, adoption of Industry 4.0 technologies and Industrial Internet of Things (IIoT) would become imperative to increase competitiveness and build efficient value chains.

There is an increased focus on the manufacturing sector of India to build it into a global hub for manufacturing, design and innovation. Currently, Indian government is trying to create jobs and attract Foreign Direct Investment in India to compete with larger manufacturing hubs like China, Taiwan, South Korea and Japan



Future employment in sub-segments of Industrial Automation

Segment	Industry Structure	Industry Overview	Employment Scenario	
			Current	Future
Home Inverter & UPS	The Indian Home inverter and UPS industry consists of about 150 companies. These companies can be classified into 3 categories – 5 national players, 50 regional players and more than 100 local players.	Home inverter and UPS market is expected to grow from INR 11,450 crore in 2018-19 to reach about INR 16,000 crore by the year 2023-24.	The industry currently employs close to 1,27,000. The industry has a significant service infrastructure, which employs a large number of people.	The future estimate for employment in the sector is expected to be as follows: 2018-19: 1,27,000 2019-20: 1,35,000 2020-21: 1,45,000 2021-22: 1,55,000 2022-23: 1,63,000 2023-24: 1,76,000
HVAC Industry	The Indian HVAC industry has more than 100 companies. These companies can be classified into 3 categories – 6 large MNC players, 7-8 domestic players and more than 80 importers,	Indian HVAC market for the year 2018-19 is estimated at INR 27,900 Crore, which is expected to grow and pass INR 42,000 crore by 2023-24. The expected growth rate for the industry is pegged at 8.6 per cent.	The industry currently employs close to 70,000. A large part of this workforce is employed under the service function.	The future estimate for employment in the sector is expected to be as follows: 2018-19: 70,000 2019-20: 75,000 2020-21: 82,000 2021-22: 90,000 2022-23: 97,000 2023-24: 1,05,000
Machine OEMs	The Indian Machine tools industry has more than 400 companies. Nearly 200 manufacturers can be categorized as part of the organised sector, while the remaining are operating in the small ancillary sector.	It is estimated that, as of 2019, close to INR 16,250 crore of Indian machine tools industry. India stands 12th in production and 8th in the consumption of machine tools in the world.	The industry currently employs close to 89,000. Being a manufacturing industry, a large part of this workforce is employed in under the design and manufacturing functions.	The future estimate for employment in the sector is expected to be as follows: 2018-19: 89,000 2019-20: 95,000 2020-21: 1,00,000 2021-22: 1,10,000 2022-23: 1,10,000 2023-24: 1,20,000
Industrial Automation	The Indian industrial automation industry has about 250 companies. These companies can be categorised into three – 10 International players, 40 National players and more than 100 local players.	Automation market for the year 2018-19 has been estimated at INR 42,000 crore, which is expected to grow at about 12 per cent CAGR to reach INR 73,000 crore by 2023-34.	The industry currently employs close to 98,000 people in various functions & capacities.	The future estimate for employment in the sector is expected to be as follows: 2018-19: 98,000 2019-20: 1,07,000 2020-21: 1,17,000 2021-22: 1,27,000 2022-23: 1,37,000 2023-24: 1,47,000

Skilling requirement in Indian Industrial Automation industry

Qualification requirement

Level	Qualification	Skillset
Operator	<ul style="list-style-type: none"> ITI / Diploma with 2-3 years of experience. 	<ul style="list-style-type: none"> ITI / Diploma in Electrical, Electronics or Mechanical Engineering. Bachelors degree in Science, with 2-3 years of experience in a modern manufacturing plant.
Lower Management	<ul style="list-style-type: none"> Bachelors in Engineering with 5 years of design experience. Knowledge of various tools. Masters in Engineering with specialization in Industrial Automation or Robotics. 	<ul style="list-style-type: none"> Bachelors degree in in Mechanical, Electrical or Electronics Engineering. 2-3 years of experience in project handling, supply chain management, operations control & coordination.
Middle Management	<ul style="list-style-type: none"> Any technical degree (Bachelors degree, Masters degree or Doctorate in Engineering) with at least 10-12 years of experience in an Industrial Automation company. 	<ul style="list-style-type: none"> Technical degree with more than 10 years of experience. Exposure to all aspects of running production & assembly lines. Masters degree in Engineering or Management is optional.
Higher Management	<ul style="list-style-type: none"> Bachelors degree, Masters degree, Doctorate in Engineering. Masters in Management with 15-20 years of experience in end-to-end R&D programmes in large corporate environment. 	<ul style="list-style-type: none"> Bachelors in Electronics or Computer Science Engineering with a Masters degree in Management. More than 15 years of experience in a leadership role at plant-level operations.

Skilling requirement in Indian Industrial Automation industry

Skill requirement

Level	Qualification	Skillset
Operator	<ul style="list-style-type: none"> Drawings of components, assembly of non-standard motors & other products in AutoCAD and NX General assembly drawings (GAD). Preparation of technical documents. 	<ul style="list-style-type: none"> Facilitate assembly process and layouts. Product validation & verification, reliability testing, ability to use various machines & hand tools. Exposure to welding, casting, forging, heat treatment. Manual dexterity.
Lower Management	<ul style="list-style-type: none"> Control systems design and process automation. PLC & HMI Programming, embedded software. Expertise in Six-Sigma, Kaizen, LabVIEW, MySQL & MS-SQL, C#, Python, Modbus TCP/IP, RS232 & RS485, Ethernet, Profinet & Profibus. 	<ul style="list-style-type: none"> Project budgeting. Process instrumentation, PLC, SCADA and DCS. Digitalization. Electrical instruments like drives, switchgears, instrumentation & control systems. Retrofitting, upgradation of machines and assembly lines.
Middle Management	<ul style="list-style-type: none"> Familiarity with PLC, SCADA and robotics. Advance programming in PLC, Ladder Logic Programming. Design and programming of SPMs, competency enhancement of team members. 	<ul style="list-style-type: none"> Production management, supply chain and operations management, resource management. Vendor development, cost optimisation, preparation of budget, EHS management. Industry 4.0, IoT and smart factory, Lean Manufacturing.
Higher Management	<ul style="list-style-type: none"> Knowledge of building & factory automation. Fostering a culture of excellence and best practices in design. End-to-end delivery of R&D programs, managing R&D using technical and management skills. 	<ul style="list-style-type: none"> Business P&L. Operational excellence, strategic planning. Continuous improvement strategies. End-to-end value chain management, leadership & team development. Industrial relations.

In summary

Electronic manufacturing in India and the current employment scenario

India is fast emerging as the manufacturing hub for electronics goods in the last 5 years. Presence of skilled and unskilled manpower at cost-effective salaries (as compared to global standards), greater emphasis on quality (as compared to China), presence of training institutes and colleges and the burgeoning middle-class which forms the bulk of the consumers, have all driven this trend.

The demand for electronic products in India is poised for significant growth in the next couple of years, driven by deeper penetration of digital platforms and technologies in Indian homes and industries..

India's economy is powered by sustained growth in consumer spending, fostered by moderate inflation,

favourable demographics, and strengthening FDI. Even though China had been the preferred destination for investors for decades, India has pipped its neighbour in 2018 for the first time in the last 20 years in terms of FDI, changing the dynamics of the Asian market.

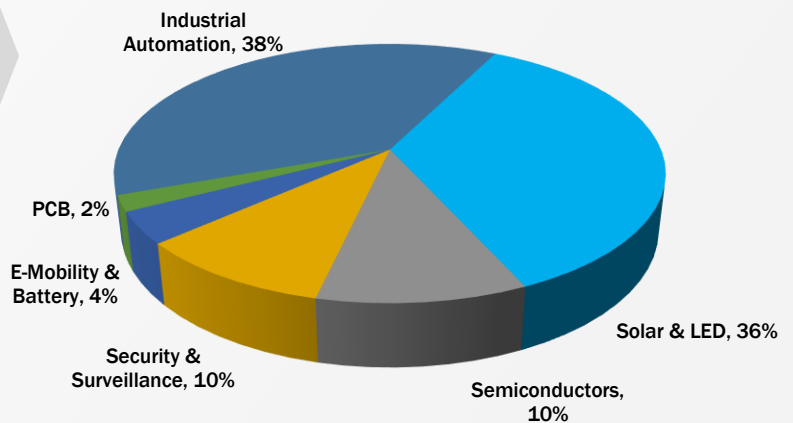
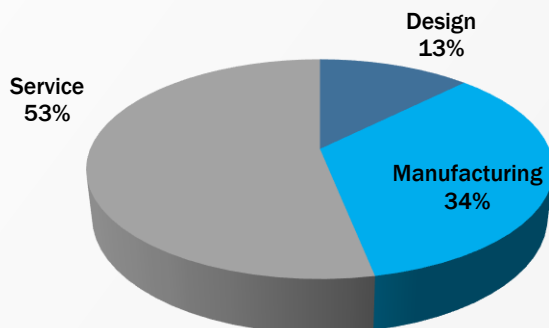
The new wave of manufacturing hubs in countries like India, Vietnam and Indonesia is largely due to one key factor viz., fast paced rising demand for Electronics in the domestic market.

Rise of manufacturing cost and wages in China has also proved to be a contributing factor. However, since most global firms are also looking to de-risk their investments from China, countries like India have gained as the emerging markets.



Current employment
in the six segments

10,10,000



At present, the Industrial Automation and the Solar & LED segments together employ more than 80 per cent of the workforce among the six segments. For both of these industries, the service functions has emerged as the largest employer.

The remaining segments show a diverse trend of employment. The semiconductor segment is heavily dominated by the design function, while manufacturing function dominates in the PCB and E-Mobility & Battery segments.

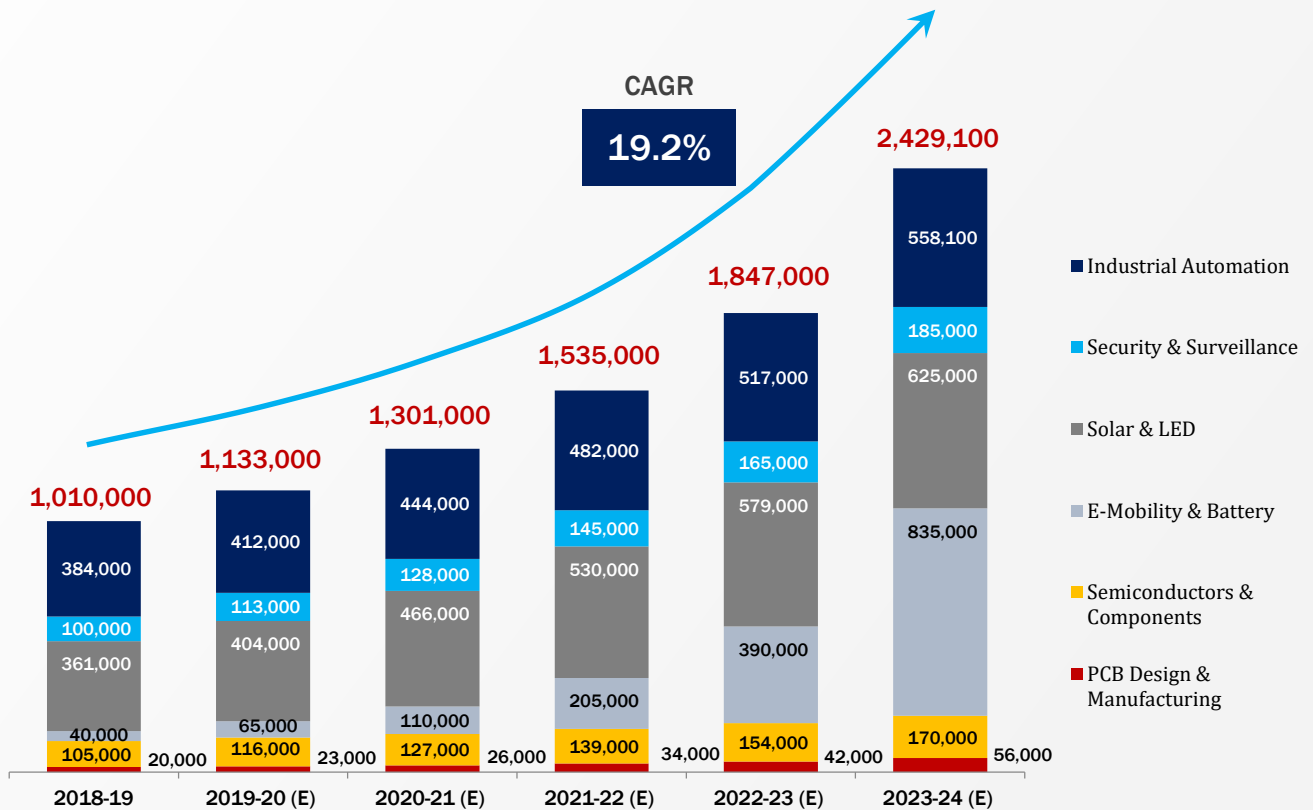
The share of contractual employees also varies widely between industries – the highest being the solar & LED segment where close to 50 per cent of the employees are on contract basis. For manufacturing dominated segments, the share of

contractual employees is well below the 25 per cent mark.

Going forward, employment in these segments is expected to grow by a CAGR of 19.2 per cent over the period between 2018-19 and 2023-24. E-Mobility & Battery segment is expected to be the largest contributor to this growth in employment.

Strong growth drivers also exist in the PCB industry which is expected to see a boom with the emergence of mobile manufacturing industry after 2020-21. However, growth in the more mature industries like the industrial automation, solar & LED, and the security & surveillance is expected to be fairly moderate.

Employment growth in the six segments of Electronics industry



Technological evolutions and associated skilling requirement

Artificial Intelligence & Machine Learning

AI and ML are finding applications across segments and industries, which makes this skill extremely valuable in the electronics industry. AI & ML can help with autonomous vehicles in the EV segment, help with forecasting and grid stabilization in the solar segment, and improve the level of automation being made available to the industries.

Digitalization, IIoT and Real-time Monitoring

Almost all industries and businesses are incredibly data & analytics-driven. Advanced automation and digitalisation are helping companies track processes and their progress in real time. These technologies, when coupled with AI & ML solutions have the potential to provide high levels of optimization in the processes being monitored.

Sustainability Aspects

Even though at a very nascent stage, inclusion of a sustainability aspect in business decision making has been gaining ground. Sustainability is not just a good practice but also helps the companies achieve better economics in the long term. Strategic thinking and planning keeping in mind the sustainability aspect is the need of the day.

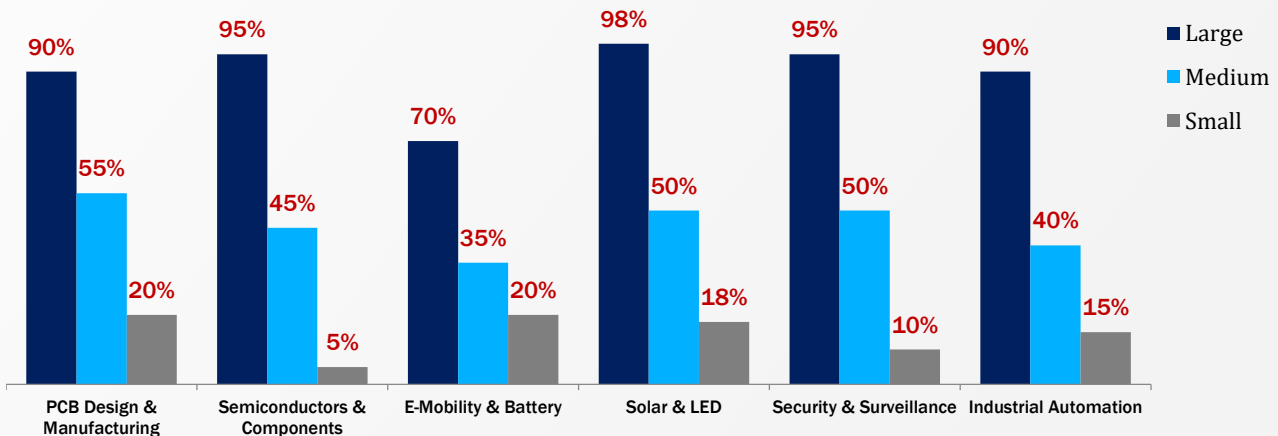
Industry’s awareness about Government’s Skill India Programme

It was noted that across the segments, the pattern of awareness among the six electronic industry segments tends to remain the same. More than 90 per cent of large companies across most of the segments are aware of the Skill India programme and its salient features.

The awareness levels have been seen to drop as we move across the board to medium & small scale companies. Awareness level in the medium companies is in the range of 35 – 55 per cent, while

for small companies it is further lower at 20 per cent and lower.

The higher levels of awareness among the large companies may not necessarily translate into a higher push to train or re-skill the employees. However, these higher levels of awareness can be easily attributed to the existence of a professional HR team that is caught up on all recent developments in the industry.



Key challenges faced by the industry at the skills front

Two key factors impacting this mega industry is the lack of multi-talented skilled professionals across the mid- and lower-levels and low employability of new entrants into the workforce. The companies today are thus forced to invest in capital and time, to retrain the employees to make them job-ready and productive.

Another key challenge is lack of technical competency. Many new manufacturing plants are feeling the need for niche operating skills combined with computer knowledge. And this combination of skills is not readily found with the existing employee-base.

Inability of manpower to quickly adopt new technologies and master them, is another drawback frequently faced by the players. This is mainly found in the lower-cadres; thereby having a direct impact on productivity.

Lack of soft skills is another weak spot impacting the hiring process. Poor verbal and written communication skills are a drawback, in all

segments across the board, as there are several consumer-employee touch-points in the value-chain.

Employees are also faced with financial constraints when it comes to self-learning, especially in the services segment. Migrant workers come from tier-3 cities or rural areas all of whom lack the financial muscle to self-train and upgrade their existing skills.

One major challenge faced by almost all the players in this industry is the lack of adequate number of educational institutions focusing on quality training for installation, service and repairs.

Other pointers raised include, inadequate government support for this initiative and out-of-sync academic courses that are impacting the skillset availability in the services segment. To counter this, OEMs have taken up the onus of providing training and certifications for their own service teams as well as technicians at the franchisee-levels.

1

Lack of multi talented skilled employee

Due to this, there is low employability of new entrants into the workforce – the firms employing them have to then invest capital and time to train the employees

2

Lack of Technical competency

Many new manufacturing plants are feeling the need for niche operating skills together with the computer knowledge – often not available together in the same employee

3

Quick adoption of newer technology

Due to this, there is low employability of new entrants into the workforce – the firms employing them have to then invest capital and time to train the employees

4

Lack of generic, soft skills in the service segments

Many new manufacturing plants are feeling the need for niche operating skills together with the computer knowledge – often not available together in the same employee

5

Financial constraints for self learning

Due to this, there is low employability of new entrants into the workforce – the firms employing them have to then invest capital and time to train the employees

Focus points for ESSCI and the Electronics industry



Need for hybrid skills

With newer technologies emerging every day, conventional recruitment processes and needs are expected to change going forward. The emerging requirement is the need for candidates with “Hybrid Skills”. Tech Savvy candidates with social skills and/or multifaceted-combination requirements would be the need of the hour.

Thus, candidates need to be skilled in Multidisciplinary requirements acquired from varied conventional and non-conventional courses and Certification Programs. These may include Big Data, Cloud Computing, Analytics, Communication

Skills and Leadership training and problem solving and client servicing to name a few.

In fact, the need of the hour for the entire sector, as per Feedback analysis, is for ‘System Thinkers’. As in those who not only have domain knowledge but also are skilled in the ability to take a creative and synergetic approach to problem solving.

The demand going forward thus will be for IT Communication Specialists, Creative Technologists, IoT Marketing Strategists, User Experience Designers, Digital Storytellers and the likes.

- Tech savvy candidates
- Social skills to position one as multifaceted personality

HYBRID
SKILLS WILL
BE NEEDED

MULTI-SKILLED
BY SIGNING UP

Different courses and certification programmes in big data, cloud computing, analytics, communication skills, leadership, etc.

NEED TO
DEVELOP

system thinkers who not only acquire the domain knowledge but also grasp the ability to take a creative and synergetic approach to problem-solving



Content development for digital learning

India’s digital learning market is growing at a fast pace. Use of Information and Communication Technologies (ICT) in education has led to the growth of Digital Platforms including Smart classes, e-learning courses, blended learning and app-based

learning.

Industry players as per the study are open to this mode of training provided as it adheres to global quality standards.

One way to promote this would be to, subject it to AICTE Regulations, invite foreign institutions or Universities into India to provide training and award Degrees, Diplomas and Post Graduate Diplomas in Technical Education by partnering with Indian institutions or be allowed to set up shop on their

own.

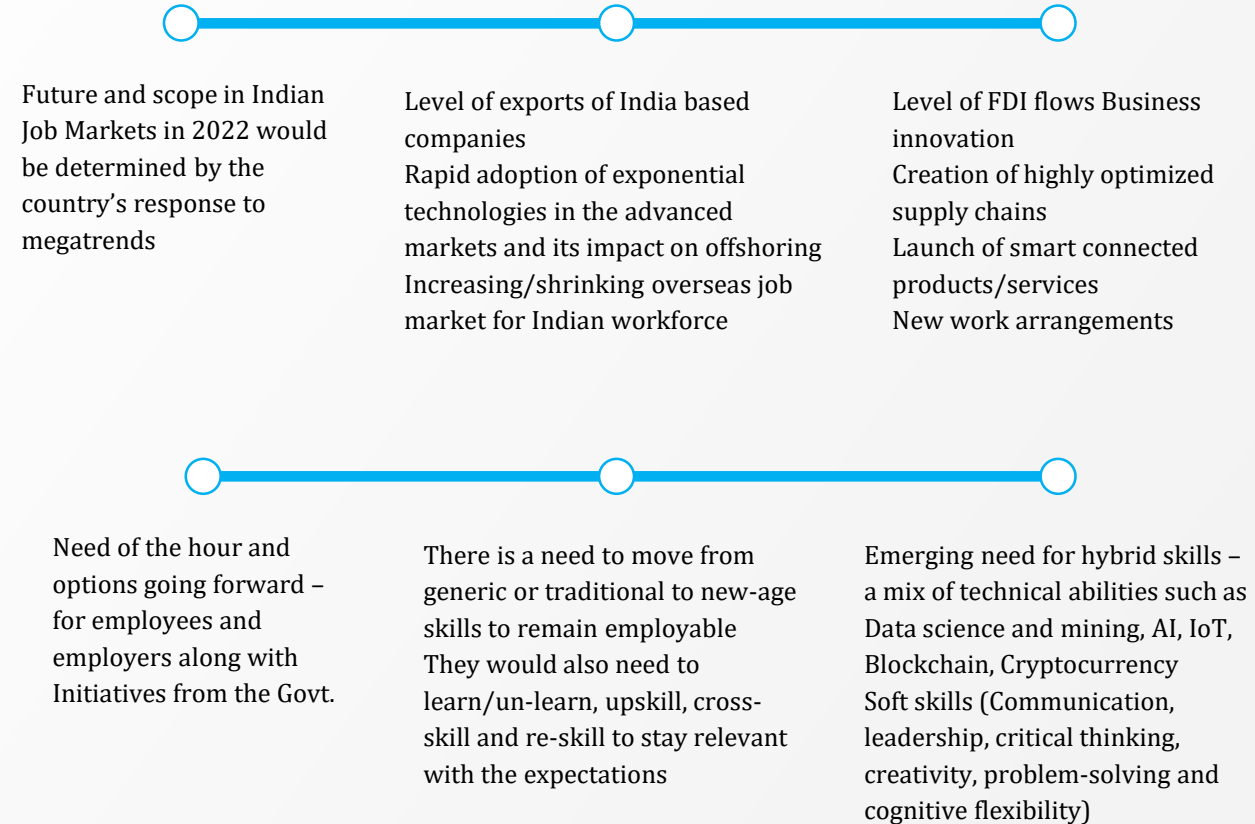
Alternately companies in the segment could be encouraged to partner with targeted colleges and institutes to offer vocational training and internships in order to have job-ready candidates.



Increasing industry focus on changing role of HR

The role of the HR personnel today has evolved from being a mere 'recruiter' to a 'creator'. Decision-makers need to be made aware of this transition and facilitate the Role of HR to improve and expand the skills enabling creation of right jobs and matching it with the requisite skillsets as per sector requirements.

The other recommendation is to enable change in company-thought processes, by focusing on aligning talent acquisition with business strategy. This can be achieved through seminars and business meets and workshops. Targeted at the senior-mid and top management, these initiatives would encourage in developing a blended methodology of recruitment and retention along with the right skill sets.





Training on cutting edge technologies

There is an increasing drive in the industries to adopt cutting edge technologies for their day-to-day business. There have been proven cases where implementation of technologies such as IoT, high-end automation and digitalization solutions have helped add value both in terms of money, as well as efficiency.

Companies are now trying to replicate these success stories across the industry, and one of the key links for making it work is the human resource need to operate and maintain such systems. Under IOT & AI regime, there would be huge requirement for data collection and data labelling where skill development of the human resource would prove extremely crucial.

As a result, it is expected that a tremendous demand for trained employees would be seen in the near future who can successfully carry out the implementation of such systems and champion its use for the companies.

Some of the most prominent technologies that are expected to break ground in the near future include augmented reality (AR) & virtual reality (VR), artificial intelligence, machine learning & deep learning, robotics, data mining and data analysis, big data and cloud computing. Implementation of IoT architecture could bring together more than one of these technologies together to create synergy in the industrial process.



Cluster-based approach to training & skill development

Although a significant amount of work has been done towards training and skilling in the electronics industry till date, a stronger impact could be had with targeted action.

India has certain pockets where clusters of electronics industries have been built over the years. Noida in Uttar Pradesh and SriCity in Andhra Pradesh are some examples where mobile manufacturing clusters have been set up as a cluster.

Targeted and customised training infrastructure around these clusters could help add more value to the human resource employed in the region. This would provide benefits such as direct interaction with the local industries in order to understand their growth plans, manpower requirements (permanent & contractual), skill sets requirements, training needs identified by the industries etc.

A cluster based approach would also help establish direct interaction with state governments, industrial areas, private developers in order to understand the investment planned in the area in the coming years.

Such an approach could also help create a supply ecosystem through network of colleges, universities in the region, which would also help assess skill gaps and skilling requirement of the existing and upcoming industries.

This could also help with designing of appropriate Skill Development Programmes and imparting skill / technical / vocational training to create a pool of workforce which is job ready from day one. This could help industries reduce their training expenses.



Initiatives to skill personnel from unorganised sectors

An integrated approach needs to be adopted when it comes to skilling this key segment of personnel, who form a vital chain in the performance of any company in this sector. Thus, all stakeholders from OEMs, Franchisees, Training Institutes and organizations like ESSCI need to make a consolidated effort in developing suitably trained manpower.

Setting up of institutes on the lines of the ITI but offering industry-specific skills in rural areas would be a key step in the right direction. In fact, a comprehensive cohesive initiative, focusing mainly in rural areas will help bridge the skill needs and demand-supply gap effectively. The OEMs as well as the Government need to work towards bringing the Unorganized Service Personnel into the organized mainstream in the long run.

This move would also help in re-aligning the course curriculum of the existing institutes like the ITIs and other training institutes, currently imparting training for this segment. The Government must be a key stakeholder in this partnership by providing

financial assistance in setting up new institutes and reorganizing or expanding the offerings of existing ones.

New and advanced technologies like connected devices, IoT, etc. need to be introduced in courseware, with an eye to future requirements by corporates, at academic institutions. Existing academic curriculum needs to be restructured with a greater focus on soft-skills training as well.

In addition to Government initiatives, various industry associations and bodies, that come under ESSCI’s purview, also need to be actively involved in developing technical curriculum; industry-specific need-based training modules and schedules. Focus areas recommended include skill upgradation programs and ongoing composite skill programs, to encourage continuous progress throughout the tenure of the service personnel.

A complete cohesive initiative, focusing more in rural areas will help bridge the skill needs and balance the demand-supply gap effectively.

An integrated effort from OEMs, franchises, training institutes, etc. to bring down the proportion of unskilled migrant workforce in the industry

Establish ITI type of institutes in rural regions for customized education

Aligning course curriculum at the ITIs and other training institutes with the industry requirements. Government to provide financial assistance to bridge the gap

A completely cohesive initiative, focusing more in rural areas will help bridge the skill needs and demand supply gap effectively

Apart from the Govt. initiatives, various industry associations and bodies to come forward with their technical curriculum, training modules and schedules to encourage continuous progress through out the tenure of the service personnel

New and advanced technologies like connected devices, IoT, etc. to be aligned with the futuristic requirements in academic institutions Academic curriculum also needs to be restructured to focus on soft skills training as well

3 point steps to be followed to increase skill enhancement activities in India at an overall level



Increase awareness amongst corporates

As per the survey, most the large corporates were only aware of the schemes that the Government has announced for development of their sector. Greater awareness needs to be built regarding skill enhancement programs and the incentives provided to implement them, specially among the small & unorganised sectors. This will encourage companies, and in turn – the employees to take a more proactive interest in these initiatives and thereby benefiting by them.



Increase Partnership Programs with Corporates

Offer incentives to set up, at-site training centres, in partnership with training institutes, have been successfully implemented in several countries, globally. They give the much-needed fillip to the corporate sector as they are able to do so at their manufacturing units. This method could be adopted in India as well.

These could also be recognized by way of awards and rewards, to help India achieve higher skills to meet the global demands.



Expand your reach for more number of vocational training centres

Focus on setting up of more vocational training centres, especially in pockets with higher migration rates for jobs, like Tier II & III cities, small towns or even villages, would enable better job-ready personnel. Such programs could be targeted at the youth, just passing out with a minimum 12th standard certificate. As it offers better job opportunities, it would also motivate the parents to educate their children till the 12th std. before encouraging him/her to get admission in these centres.



Ministry of
Skill Development
And Entrepreneurship



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