सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

Skill Assessment & Anticipation Study

Manufacturing Sector

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Message

The mean age of India's population is 29 years, with over 50% of the population size of 1.3 billion under twenty five. This demographic advantage could spur rich dividend for our country's growth and prosperity if we are able to prepare our manpower through quality skilling for work opportunities of today and tomorrow. Skills has indeed been recognized as the medium through which the nation's young can reap opportunities that an aspirational India presents while at the same time contributing to that aspiration.

There are about 20 central ministries/ departments that are implementing different skill development programs aimed at meeting the skill needs of various geographies and target groups. To coordinate the skilling efforts of all stakeholders, remove the disconnect between demand and supply of skilled manpower and build new skills through innovative thinking for existing and future jobs, the Ministry of Skill Development and Entrepreneurship (MSDE) was created in November 2014. MSDE is responsible for implementing short-term, long-term and apprenticeship programs through its implementation arms like Directorate General of Training, National Skill Development Corporation, Indian Institute of Entrepreneurship, NIESBUD and Directorate of *Jan Shikshan Sansthan* (JSS). Since 2015-16, the skilling eco-system under MSDE has trained over 3.3 crore persons, which is about 60% of the total 5.5 crore approximately trained by the entire skilling eco-system of Government of India.

Training is provided in a wide array of job roles. In the Industrial Training Institutes, there are about 140 industry trades in which long-term training through the Craftsmen Training Scheme is being provided. Under the flagship *Pradhan Mantri Kaushal Vikas Yojana* (PMKVY), short-term training is concentrated in about 350 job roles, even though the States, under the State Managed component, have been encouraged to provide training in a wide range of 1,800 job roles. JSS provides training in 89 job roles, while apprenticeship training under the National Apprenticeship Promotion Scheme is being offered in 261 job roles.

There is a need felt to make an assessment and anticipation of skills, where either skilled manpower is not available in adequate supply, or engaged manpower is not skilled enough. This would make skilling relevant and also help close the demand-supply mismatch wherever existing. A beginning has been made in the form of a Study in the Ministry that covers seven segments of the manufacturing sector. Some of the findings, I hope, will be useful for the skill eco-system, especially the various Ministries/Departments that are implementing skilling schemes, Sector Skill Councils, Training Providers, Awarding Bodies, etc. This Study should stimulate further research in related fields.

(Praveen Kumar)

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Preface

A Study Report on assessment and anticipation of current and future skill requirement in the manufacturing sector has been prepared. The Study was undertaken following the guidance given by Secretary, Ministry of Skill Development and Entrepreneurship, who had anticipated its need especially after the *Aatma Nirbhar Bharat* initiative was announced last year.

For skill assessment and anticipation, seven segments of the manufacturing sector, namely 'Apparel, Textiles, Leather & Footwear'; 'Automotive'; 'Rubber & Plastic Products'; 'Electrical & Optical Equipment'; 'Basic Metals'; 'Food Industry'; and 'Chemicals including Pharmaceuticals' were selected based on the criterion of maximum potential from an employment and skills perspective. (They were selected through a combination of economic indicators comprising Gross Value Added, Total Factor Productivity, exports performance, FDI inflows and employment growth). Primary data from about 100 firms from among the identified manufacturing segments was collected through an enterprise survey questionnaire.

The study provides an assessment of the skill development practices at the enterprise level including qualification profile of workers at the shop-floor, extent of in-house training, awareness about NSQF standards and Apprenticeship norms, among others. It also offers insights for Government skill programmes including experiences of industry with short-term training and ITI ecosystem pass outs.

Another significant part of the Study is the attempt made to identify occupations and skill sets which are deficient at the shop floor level. Section 7 contains an analysis by which skill gaps of existing workforce in industry job roles in each of the seven selected manufacturing segments have been arrived at. To make it more useful for practitioners of skilling schemes, the geographical alignment for these job roles have also been indicated. Next most significant finding is about job roles in these manufacturing segments where supply constraints are being encountered by the survey responders, and how the firms want to meet the demand-supply gap i.e. by hiring candidates with short-term skill certification, or fresh ITI graduates, or experienced skilled workers; or by re-skilling/ up-skilling existing workers. The Study also discusses the challenges and constraints in meeting the future demand of skilled workforce.

Overall, the implications from the Study could be useful for the present skill eco-system covering short-term and long-term skilling, apprenticeships, etc. There are a few limitations though. For one, the sample size of 100 enterprises has been made to represent sector trends across geographies. There is also non-availability of time-series data for youth capturing employability, career paths and education/ skills.

This study makes a base to make further enquiries into skill assessment and anticipation in the larger skilling landscape. For instance, there is a scope to extend the study to various emerging 'service' sectors to undertake a similar assessment and anticipation exercise. Also, a number of external factors including monetary compensation, working conditions, availability of community housing and migration patterns, among others, might be affecting skill development efforts. These could be deep-dived further in separate studies.

Acknowledgement

I would like to express my deep gratitude to Secretary, MSDE for his guidance and inspiration without which, it would not have been possible to successfully complete this Study Report. I would like to thank former Principal Adviser (Ms. Sunita Sanghi, retd.), who was actively involved and supported this exercise in the beginning. I place on record the outstanding work done by the Research team in the Policy Wing of MSDE, particularly Shri Sidharth Sonawat, ably assisted by Shri Akshat Garg and Ms. Mansi Awasthi. I also extend my gratefulness to the ILO, which provided valuable technical inputs and research support for this Study. I acknowledge the contribution of ten Sector Skill Councils who led the selection of enterprises and collection of primary inputs. The contribution of 8 industry associations and their functionaries who participated in the personal interviews including that of Automotive Component Manufacturers Association (ACMA); Consumer Electronics and Appliances Manufactures Association (CEAMA); Textile Association of India (TAI); Indian Technical Textile Association (ITTA); is also duly acknowledged. I am also thankful to the enterprises who had participated in the primary survey, which made the detailed analyses in the Report and the findings possible.

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Executive Summary

India progressed to a higher growth level during the 1990s and the first decade of the millennium, credited mainly to the economic reforms in 1991 and beyond. While growth relative to the world has remained high even in the decade of 2010-2020, there is an increasing realization of the need for second generation of administrative, economic and governance reforms to sustain high growth rates. To address Covid-19 induced economic disruption, the Government had come up with a series of measures to usher in such reforms. This included the incorporation of the *Aatma Nirbhar Bharat* ethos to socio-economic policy, Production-Linked Incentives (PLI) for several manufacturing sectors, privatization of public sector units in select strategic and non-strategic sectors and opening of more areas of the economy for foreign participation among others. Skill development has been identified as a critical enabler for the success of these reforms especially in the manufacturing domain.

The present study has been conducted with a view to provide an assessment of skill development initiatives so as to inform the ecosystem including policymakers about required changes in existing programmes and strategy. In particular, the study (i) identifies key manufacturing segments that are competitive and display potential for the future; and (ii) undertakes an assessment as well as anticipation of their current and future skill requirement.

In line with the *Aatma Nirbhar Bharat* program targeted at building domestic manufacturing capabilities, the study has chosen manufacturing in the first phase. To identify manufacturing segments with high potential, evaluation criteria with the elements of Gross Value Added; Growth in Employment; Export Performance; FDI performance; and Total Factor Productivity was put in place. In assessing trends, the period of 2000 to 2019 was considered with 2008-09 used as the mid-point coinciding with the Global Financial Crisis which had a seminal impact on global trade and growth potential of most countries. Data from RBI KLEMS database, Annual Survey of Industries, Ministry of Commerce & Industry Statistics and PLFS rounds have been relied on for the exercise.

Based on the evaluation criteria, 7 segments- ‘Apparel, Textiles, Leather & Footwear’; ‘Automotive’; ‘Rubber & Plastic Products’; ‘Electrical & Optical Equipment’; ‘Basic Metals’; ‘Food Industry’; and ‘Chemicals including Pharmaceuticals’ were selected for skill assessment and anticipation purpose. To gather primary evidence, data of around 100 firms from among the identified manufacturing segments was collected through an enterprise survey questionnaire. The segment ‘Coke, Refined Petroleum Products and Nuclear fuel’ displayed a high overall score, value added and buoyancy in exports; however, the same was not selected in the top 7 segments from a skill development perspective due to relatively low and declining labour share in the segment.

The identified segments display high level of competitiveness and growth potential both in terms of value addition and employment potential. The enterprise survey brings forth interesting insights on skill development in the identified manufacturing segments.

From a macroeconomic perspective, firm size and its relative state of maturity in the organized sector is a major determinant of skill development and overall human capital investment. Smaller firms especially in lower value addition segments of manufacturing are hard pressed to derive productivity from all available resources and skill development does not figure among high priorities.

In terms of qualification of workers on the shop floor, there is inadequate focus among the manufacturing segments on understanding and identification of the qualification profile of workers. This is due to a multitude of factors including easy replenishment for semi-skilled/un-skilled manpower from the labour market. There is a high proportion of low skilled workers as Plumbers; Maintenance Staff; Housekeeping; Helpers; Technician Assistants; Mechanics; Butchers; Turners; and Leather sector activities (skiving, cutting, stitching).

The skills intensity (defined in terms of production level workers) varies across manufacturing segments. The Iron and Steel segment is the most skill intensive segment with 88% employees as skilled workers followed by Apparel & Textiles (73.0%); Electronics & Capital Goods (67.2%) and Automotive sector (57.2%). The skills intensity is lowest for the Lifesciences sector at 29.8%. The requirement of skilled workers for the technology intensive sectors like life-sciences sector is largely not met by the current skill ecosystem. There may be a need to develop industry mechanism to understand the skill needs of the Chemicals sector which is only sparsely represented in the current SSC mechanism

In terms of barriers to skill development, lack of practical training/exposure to latest available equipment and technology has been cited as the biggest hindrance. For labour intensive and less value-add segments including Leather, Textiles and Apparels, cost and opportunity loss is the biggest hindrance for skill development.

For training of workers across all sub-sectors, on-the-job training accounts for the single most important mode of training the workforce. However, the duration of in-house training is varied for various segments. The definition and duration of apprenticeship programs as defined under the Apprenticeship Act 1961 and Rules framed thereafter is not strictly adhered to except by firms which have enrolled under the NAPS scheme. The structure, duration and profile of Apprenticeships pursued across sectors are hugely variable. There are instances where distinction between a worker and an apprentice is not apparent and a labour cost arbitrage may be at play. At the same time, there is a need to provide sector specific norms and flexibility in Apprenticeship rules and compliances. This is needed to increase adherence to laid down norms.

Since enterprises in general prefer re-skilling/up-skilling as the most preferred mode to meet the demand of skilled workers, there is scope for greater focus among Government supported skill programs to focus on re-skilling/up-skilling, in addition to fresh training.

The supply of VET certified pass-outs is considered adequate by enterprises. There is no apparent lack of availability of training institutions except for some rural-urban skew seen in Food Processing and Rubber segments.

The significance attached to 'Qualifications' of workers among employers is low. The general awareness about NSQF certifications is low among employers under the study group, and there is a need to build more employer-led demand for NSQF aligned certifications through a mix of demand and supply side incentives.

The experience of firms with ITI and short term training is mixed. There is high level of fitment for certain standard ITI roles reflected by 85% of the people at the Supervisory level having ITI/Diploma Qualification. Certain standard trades of Electrician, Fitter and Machinist and people deft at handling machines and mechanics coming from the ITI system are in high demand in the manufacturing sector. 68.5% of the enterprises are satisfied with ITI pass-outs and feel that they are generally doing better compared to other entry level workers. The key reasons cited for the same were better technical knowledge; and better ability to pick the technicalities of the job. However, there is significant scope of improving practical training/ exposure to latest technologies being used in industry, especially for the Rubber, Iron & Steel, Lifesciences, Automotive and Textiles segments.

On the short term training front, the most striking experience of firms about workers with a Short Term Training certification is their ability to learn/re-skill on the job and better attitude and orientation towards the tasks compared to unskilled candidates. The relevance of STT is highly varied across sectors; higher for segments like Food Processing, Leather and Apparel & Textiles. It appears that the relative alignment of short term job roles is better for segments like Food Processing, Leather, Apparel and Automotive compared to others.

Looking forward, firms clearly envisage that their production process would be more automated and application of robots and digital technologies shall increase. Larger firms are gearing up towards application of AI and IoT in production processes. Skill-sets of basic data management, computer literacy and handling digital machines shall necessarily be required in the workforce at the shop-floor. Moreover, firms feel that their stock of low skilled workers would reduce over time. The strategic priorities of firms also vary across segments. The Automotive, Electronics & Capital Goods and Lifesciences segments have placed highest strategic focus on exports in order to penetrate existing or accessing new markets. Towards that, they are enhancing the quality of their products to successfully compete with global suppliers. On the other hand, segments of Apparel/Textiles, Food Processing and

Rubber are at a stage where they feel that there is significant scope of improving productivity and efficiency and are positioning their enterprises as such.

The study also identifies key occupations across segments where availability of skilled manpower is found deficient either in terms of skill-sets available or in terms of constraints to supply of workers in quantitative terms. These may be addressed directly through existing Government supported programs in skill development. There is also a need for an incentive/disincentive mechanism targeted at small and medium firms to take up re-skilling/up-skilling of their workforce. The concept of lifelong learning among enterprises needs to be encouraged through innovative policy propositions. Looking forward, there is a strong trend towards use of digital technologies in production processes especially in larger firms. Skill-sets of basic data management, computer literacy and handling digital machines shall be necessarily required in the workforce at the shop-floor. Also, skill development initiatives need a differentiated approach towards various segments in all its aspects (skill training, apprenticeships and lifelong learning) as the needs, strategic priorities and industry structures vary hugely. Customized solutions are expected to deliver better outcomes than a uniform approach.

1. Background and Objectives

As the global economy deals with the fallout of the pandemic, new opportunities are being created for the leading manufacturing economies including India. These economies may rely on fiscal incentives to allocate more resources towards the factor of production, undertake proactive policy-making and display bold political leadership for developing sustainable pathways and identifying 'win-win' spaces to fully leverage the new opportunities provided by the COVID-19 outbreak.

For India, this phenomenon has been on display by its policy response of '*Aatma-nirbhar' Bharat*', which can be seen as a follow up to the 'Make in India' program initiated in 2015, to create large scale employment and enhance manufacturing output to account for 25% of GDP by 2025. Covid-19 induced disruption has been seen as another opportunity for India to re-align its strategies to make a significant leap in its economy in the manufacturing sector.

In order to achieve higher productivity and global competitiveness, the approach taken by policymakers for the 'self-reliance' initiative is at a marked difference from all previous efforts as it seeks to support leading firms within key sub-sectors with production linked incentives. The approach may also be guided by the fact that global growth and trade patterns have seen distinct changes post the Global Financial Crisis of 2007-09.

The essential ingredients for India emerging as a manufacturing hub exist through various aspects. India is the third-largest economy by purchasing power parity after the USA and China. It has a massive workforce, sound supply base and access to natural resources for production – especially iron for engineering goods, cotton for textiles and apparel, and abundance of both renewable and coal reserves for power generation, which makes India a viable manufacturing alternative to other major manufacturing economies in wide ranging industries. The Government's commitment to the efforts in implementing regulatory reforms and demonstrating tangible progress has led to improvement of a massive 79 positions in the Ease of Doing Business (EoDB) rankings over the five year period of 2014-19. The continued jump in the global ranking in ease of doing business – 63rd position in the Doing Business Report 2020 - is expected to provide confidence to foreign investors to invest and diversify their manufacturing base in India. A comparative position of EoDB rankings of some manufacturing economies is at Appendix-1.

Although positive developments have emanated in recent years, one important challenge is the low capital and labour productivity, which can hinder in taking quick advantage of the economic burnout and disruptions in global trade. This is the reason that competing countries like Vietnam and Taiwan besides China may be benefitting more from manufacturing

growth. A comparison of India with other key developing countries in value added and positioning in global value chains is placed at Appendix-2.

Besides, structural shifts are needed to align education-skills policy to industrial policy to become a technology and innovation hub in Industry 4.0. Low R&D expenditure (0.7% of GDP to R&D[1]) and its skewed distribution across corporations, public funded research institutes and universities is another problem. These elements of an industrial strategy are needed urgently and would provide a huge opportunity to reverse the tide in its favour when companies are increasingly looking to expand their existing manufacturing supply chains in the region.

Vocational training and vocationalisation of general education has been recognized as a significant element which shall enable the country to make the most of the available opportunities. Skill development initiatives by the Government are, therefore, seen as critical enablers for not only taking vocational training to the masses but also to up-skill/re-skill the existing workforce for new age technologies in manufacturing. Another significant objective is to prepare the workforce coming out of Agriculture, which remains high at 42.5%[2] compared to peer developing nations.

Skills anticipation and assessment can enable policy makers, training providers, employers and workers to make better educational and training choices, and through institutional mechanisms and information resources leads to improved use of skills and human capital development. This is an opportunity for India to intertwine skill strategies with economic and social policy to create complementarity and promote comprehensive economic development.

The study that forms the basis of this report has the twin objectives: First, to identify manufacturing segments which are competitive and demonstrate potential for growth and employment; and second, the granular details of the skill-sets which are/shall be required in these segments.

[1] Ministry of Finance, Economic Survey 2017-18
[2]Source: PLFS 2018-19

2. Scope and Data Sources of the Study

Section 1 provides the background and objectives of the study. Section 2 provides the sources of data and the modalities of the Enterprise Survey conducted for collating primary data. Section 3 provides the literature review of factors impacting manufacturing growth. Section 4 provides detailed steps undertaken to select sub-sectors relevant for skill development. Section 5 elaborates on the basis of selection of sub-sectors for study. In Section 6, we undertake an assessment of the current need for skills and educated workforce in the industrial sub-sectors. Further, a study in the trends in future demand for skilled workforce in the manufacturing sub-sectors is undertaken in Section 7. The report concludes with a set of conclusion and recommendations basis the findings of the study.

2.1 Sources of Data

The study involved primary and secondary data collection and research. For primary data, a sample of around 100 enterprises was chosen across 8 manufacturing segments to solicit VET related information. Personal interviews were conducted with 8 industry specific associations to gather information on opportunities and challenges in their sectors.
The secondary data sources include the following:

1. Annual Survey of Industries [Annual Survey of Industries (ASI) is the principal source of industrial statistics in India providing information on important characteristics of registered manufacturing sector]
2. RBI KLEMS Database
3. Periodic Labour Force Survey (rounds 2017-18 and 2018-19)

Enterprise Survey: A survey of selected enterprises from selected manufacturing sub-sectors was carried out for the study. For the purpose of collecting enterprise data, assistance was taken from respective Sector Skill Councils to help collect the data through questionnaires.
The following sector skill councils facilitated the survey in their respective sectors:

1. Automotive Skill Development Council
2. Textiles Sector Skill Council
3. Electronics Sector Skill Council
4. Apparel Made-Ups & Home Furnishing Sector Skill Council
5. Food Industry Capacity & Skill Initiative
6. Rubber Skill Development Council
7. Leather Sector Skill Council
8. Capital Goods Skill Council
9. Life Sciences Sector Skill Development Council
10. Indian Iron and Steel Skill Council

A mix of small, medium and large enterprises was selected from each sub-sector. The small, medium and large enterprises have been characterized using the following criteria: Small: up to 50 Employees; Medium: >50 and up to 250 Employees; Large: > 250 Employees.

As per the above classification, 60% of the enterprises were large, 27% were medium in size and 13% were small in the study group.

2.2 Selection of Period

For the purpose of the study, the period starting the year 2000 has been considered. The periods before and after the financial crisis of 2008-09 shall be juxtaposed for relevant changes in competitiveness and other trends. This is due to evidence that there was a change in trajectory of growth, global trade and economic strategies after the GFC. India and China have seen some declines in their 'Trade to GDP ratio' over the period 2010 to 2019. For India, 'Trade to GDP' ratio was recorded at 40% in 2019 compared to 49.2% in 2010; China has seen the ratio decline from 50.7% to 36% in the same period[3]. At the same time, emerging manufacturing countries like Vietnam (152.2% to 210%) and Mexico (60.7% to 78.0%) have seen greater trade integration.

[3]Source: World Bank Statistics, accessed from https://data.worldbank.org/indicator/NE.TRD.GNFS.ZS

3. Review of Studies on Performance of the Manufacturing Sector

It is widely recognized that raising the level of competitiveness in the manufacturing sector is fundamental to sustaining high growth regime and to ensure adequate employment. This section undertakes an evaluation of India's manufacturing sector and identifies the conditions that affect the competitiveness of the sector.

Manufacturing sector is the second largest contributor to India's GDP after the service industry. It witnessed a growth of 6.9% in 2019, accounting for 16.4% of the country's GVA[4]. The multiple factors which impact manufacturing and trade success were reviewed from multiple sources:

3.1 Global Value Chains: Level of Global and Regional Integration

Global value chains (GVCs) expanded in the 1990s and 2000s, but that expansion has slowed since the financial crisis of 2008. Although GVCs have expanded both globally and regionally, the pattern across regions and countries is highly varied. Global value chains in North America depend somewhat more on global partners, elsewhere global value chain integration has been mostly global and is primarily continuing in that direction[5]. Europe is the most integrated region with four times as many regional linkages as global linkages[6]. That number is 1.5 when considering East Asia. With the recent signing of the RCEP, this integration quotient is expected to go up for the region. However, the South Asia region with India at the center is the least integrated region with global linkages amounting to close to 40 times.

Today, however, it can no longer be taken for granted that growth in trade will remain a force for prosperity. Since the global financial crisis of 2008, the growth of trade has been sluggish, and the expansion of GVCs has slowed. And these trends are only being exacerbated by the ongoing global COVID-19 pandemic.

This is due to the fact that post the transformative multilateral trade progress in the 1990s and early 2000s (integration of China, Eastern Europe, WTO Uruguay Round and NAFTA), the pace of trade relaxations has dramatically slowed or reversed in some aspects. At the same time, two potentially serious threats have emerged to the successful model of labour intensive, trade-led growth. First, the increased adoption of labour saving technologies such

[4]https://www.statista.com/statistics/801821/india-annual-real-gva-growth-in-manufacturing-industry/#:~:text=Manufacturing%20accounted%20for%20about%2016.4,GVA%20in%20fiscal%20year%202019.
[5]World Development Report 2020, Page 14
[6]World Development Report 2020, Page 16

as automation and 3D printing which could draw production closer to the consumer and reduce the demand for labour at home and abroad. Second, trade conflict among large countries especially the US and China spurred on by the spread of COVID-19 could lead to a retrenchment or a segmentation of GVCs.

3.2 Impact of FDI

The manufacturing sector in India has received a cumulative FDI of USD 88.45 billion from April 2000 to March 2020.[7]Goldar & Banga (2018) analyse the effects of foreign direct investment (FDI) on productivity and how country of origin of FDI makes a difference to the impact of FDI on firm-level productivity in 7000 manufacturing companies drawn from *Prowess* covering the period from 2000-01 to 2014-15. Firms with FDI component have higher TFP than domestic firms and foreign acquisition positively impacts TFP of domestic manufacturing firms in India. The impact of FDI on TFP of the acquired firm is relatively bigger for FDI from developed countries (USA & Europe). In addition, there are indications of horizontal spill over and forward linkage vertical FDI productivity spill over to domestic firms. As regards to horizontal spill over, FDI from developed countries seems to be relatively more beneficial and FDI from Asian countries seems beneficial for forward linkage vertical spill over. Acquisition of equity in a domestic firm by a foreign firm (from developed country and beyond a threshold of 10%) has a significant positive effect on TFP of the domestic firm as well.

3.3 Factors of Competitiveness

In terms of overall competitiveness, India was ranked 68 by the World Economic Forum in 2019. Indicators on Technological governance (25), macroeconomic stability (43), market size (3), deep and stable financial sector (40) and innovation capability (35) helped raise India's competitiveness while those on Electricity (103), healthy life expectancy (109), skills base (107), product market efficiency (101), trade openness (131) and female labour participation (128) were the key items which defined our overall competitiveness.

It is significant to note that performance of human capital (healthcare and skills) and low participation of females in labour force is bearing a negative impact on competitiveness. Specific to skills, the high dropout rate from schools, relative low employability of graduates and a high pupil- teacher ratio in primary education have been identified as factors where overall score on 'Skills base' has been impacted.

[7] https://www.ibef.org/industry/manufacturing-sector-india.aspx

3.4 Size of Firms

The productivity and efficiency of the manufacturing sector is still not driven by the size of the firms. The country has a high number of SMEs. Kumar and Gupta (2008) indicate that the small scale industry promotion policy has discouraged small firms from scaling upwards. Programs such as subsidized credit, tax exemptions or product reservations have not relaxed the constraints faced by small firms, but further incentivized them to remain small. These have resulted in high attrition rate and unsupportive investment environment, and a shortage of firms of a scale suited to competing internationally. Although the changes in labour laws will be beneficial for the small scale industries, they can now employ more workers with lesser regulatory compliance issues (Mehta and Rajan, 2017). These units are unable to compete in the global market due to higher costs and lower production. To be more competitive, the government needs to provide this sector with more support especially financial impetus. Credit constraints due to weaknesses in the financial sector have held back small and medium sized firms from expanding (Banerjee & Duflo 2008).

3.5 Research & Development

Low investment in R&D in firms continues to be a major bottleneck for India (Kumar and Gupta, 2008). R&D is found to have a positive impact on TFP (Singh, 2016). R&D activity is still mostly restricted to big firms. Firms with greater access to resources are more likely to patent as the cost of patenting may be too high or due to the lack of research funds available with small firms and start-ups (Kanwar and Singh, 2016). Singh (2016) also suggests that technology spillover, productivity gains and internationalisation of firms through R&D and imports are positively related. The learning-by-importing is crucial for developing economies as the imported raw material and capital goods help to spread the new technologies and innovations coming from developed countries.

3.6 Trade Impact on Technology

Trade and growth theories point out that international trade is a driver of technology transfer providing dynamic productivity benefits in the manufacturing sector. Rijesh (2018) underlines a positive and statistically significant impact of technology import on Indian manufacturing output for 4616 manufacturing firms for the period of 1995-2016. It is found that most firms occasionally engage in the import of technology and the preferred mode of acquisition is embodied technology. Acquiring technology from abroad is favoured by the firms as compared to the internal technological effort (domestic R&D). The consumer goods and intermediate producing segments are the major consumers of foreign technology inputs.

3.7 Trade Impact on Productivity

Maiti (2019) investigates how trade influences the labour share and the resultant productivity growth of the industrial sector using semi-parametric approach for 15 major states at three-digit level of industries during 1998-2014. The paper suggests that trade weakens the bargaining power of workers and hence raises productivity through reducing the labour share and it does not depend much on the legislative form of the state.

4. Structural Changes in Indian Manufacturing

This section highlights the major trends in major aspects of Indian manufacturing, namely contribution to GDP and employment, especially over the past four decades, primarily on the basis of the employment-unemployment rounds.

The share of manufacturing has been relatively constant at 17 to 18 percent during the period 1990-91-2010-11, thereafter there is a decline to 15.1 percent by the year 2019-20. The growth of the Indian economy over the last 30 years has been primarily services – driven is well established. Within Services four services, namely, Trade, Transport, Communication, and Banking and Insurance have contributed more or less the entire GDP growth in services sector during the period 1990-91 to 20019-20. It may be noted that these changes coincided with the increasing importance of the organised private sector and declining importance of the public sector.

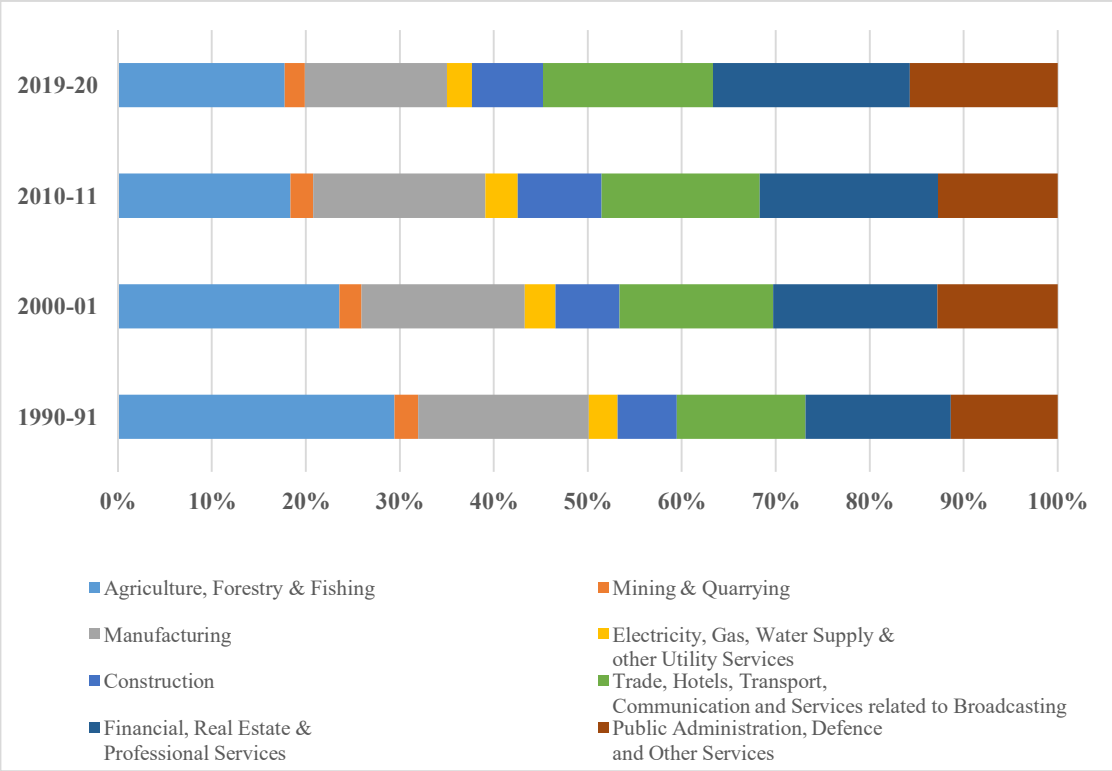


Figure 1: Sectoral makeup of Indian Economy through the years

Note: The share of gross value added is calculated in current prices
Source: Ministry of Statistics and Programme Implementation

4.1 Distribution of Workers in Manufacturing

Overall, only 12.1 percent of the workforce is employed in manufacturing. The proportions of male and female workers in rural areas engaged in 'manufacturing' sector were 7.3 percent and 9.0 per cent respectively and for urban male and female workers was 21.9 percent and 24.5 percent respectively as reported under PLFS 2018-19. This has mostly fluctuated between a narrow range over the various NSS rounds since 1983 and has shown relative stagnancy.

Table 1: Percentage distribution of workers in usual status (ps+ss) by broad industry division during 1983 (NSS 38th round) to 2017-18 (PLFS)

	Category	38th (1983)	43rd (1987-88)	50th (1993-94)	55th (1999-00)	61st (2004-05)	66th (2009-10)	68th (2011-12)	PLFS (2018-19)
Manufacturing	RM	7.0	7.4	7.0	7.3	7.9	7.0	8.1	**7.3**
	RF	6.4	6.9	7.0	7.6	8.4	7.5	9.8	**9.0**
	UM	26.8	25.7	23.5	22.4	23.5	21.8	22.4	**21.9**
	UF	26.7	27.0	24.1	24.0	28.2	27.9	28.7	**24.5**

4.2 Informality in Manufacturing

Labour markets in India can be best characterized by their dualistic structure with the prevalence of an informal employment which coexists with a large 'formal sector enterprises'. While employment in the informal sector declined over the years, this sector continues to be persistently large. Out of 466 million workers in 2017-18, about 375 million workers or 80.47 percent were estimated to be working in the informal sector. Not only has the share of informal workers in total workforce remained stubbornly high but the enterprise landscape has also been dominated by informal enterprises. In manufacturing, 74% of the enterprises were informal as reported in the latest round of PLFS 2017-18 which was marginally better than the overall figures**.**

Table 2: Number of workers engaged in the informal and formal sector enterprises by industry groups in 2017-18

Sector	Enterprise Type	Rural	Urban	Total
Formal Sector Enterprises (Overall)	Formal	29378010 (25.50)	31878206 (32.53)	61256216 (28.73)
Informal Sector Enterprises (Overall)	P&P	84588220 (73.43)	63364610 (64.67)	147952829 (69.40)

	P&P + Employer's HH	85812325 (74.50)	66110031 (67.47)	151922355 (71.27)
Manufacturing	P&P	15509643 (77.33)	17026117 (71.20)	32535760 (74.00)
	Formal	4547869 (22.67)	6885746 (28.80)	11433615 (26.00)

Note: Figures are for usual status workers.
P&P is proprietary and partnership.
Enterprise type employer's households include private household employing aid servants, watchman, cook, etc.
Figures in parenthesis are percentages.
Agriculture includes industry groups/ divisions 012, 014, 015, 02, 05 excluding 011 and 013.
Source: Computed from unit records of PLFS 2017-18

4.3 Informalisation in Organised Sector

Another striking feature of India's labour market has been the increasing informalisation of the organized sector over time. Most of the growth in employment in the organized sector came through the growth of informal workers. The informalisation of the organised manufacturing sector is also reflected in data from the Annual Survey of Industries, which covers formal firms registered under the Factories Act. The last decade has been marked by a steep rise in the use of contract workers in place of directly employed workers. The share of contract workers in total employment increased sharply from 15.58 percent in 2000-01 to 27.51 percent in 2014- 15, while the share of directly employed workers fell from 61.26 percent to 50.41 percent in the same period. Total employment in the organized manufacturing sector increased from 7.75 million in 2000-01 to 13.26 million in 2014-15, with 44.26 percent of this increase being explained by the growing use of contract workers.
For the purpose of measuring informal employment, the following information on conditions of employment was collected in PLFS:

i) type of job contract (no written job contract, written job contract for 1 year or less, written job contract for 1 year to 3 years and written job contract for 3 years or more)
ii) whether eligible for paid leave
iii) availability of social security benefits (PF/pension, gratuity, health care, maternity benefits, etc.)

Employees with written job contract in manufacturing sector. The distribution of usual status workers having written job contract at the all-India level is presented in table 3

Table 3: Number of workers who have written job contract among employees in informal and formal sector enterprise in 2017-18

Written Job Contract	Enterprise Type	Rural	Urban	Total
Manufacturing	P&P	256283 (3.81)	487934 (5.93)	744215 (4.98)
	Formal	1158419 (25.47)	1733539 (25.18)	2891959 (25.29)
Overall	P&P	1394683 (3.24)	1591457 (5.57)	2986136 (4.16)
	Employer's HH	1448986 (3.27)	1694086 (5.41)	3143068 (4.15)
	Formal	9287531 (31.61)	11486414 (36.03)	207739404 (33.91)
Eligible for any Social Security Benefit				
Manufacturing	P&P	452083 (22.49)	828885 (17.75)	1280969 (19.89)
	Formal	1975660 (45.65)	3705980 (55.41)	5681641 (51.58)
Overall	P&P	1648733 (15.63)	2606591 (17.83)	4255329 (16.51)
	Employer's HH	1686381 (15.63)	2694376 (17.49)	4380764 (16.40)
	Formal	10714247 (38.21)	18386973 (59.43)	29101219 (49.34)
Eligible for Paid Leave				
Manufacturing	P&P	585560 (8.72)	1129898 (13.74)	1715458 (11.48)
	Formal	1642664 (36.12)	3079941 (44.73)	4722606 (41.30)
Overall	P&P	3085851 (7.16)	4346528 (15.20)	7432376 (10.37)
	Employer's HH	3254412 (7.34)	4752414 (15.16)	8006823 (10.58)
	Formal	11751170 (40.00)	18087447 (56.74)	29838619 (48.71)

Note: Figures are for usual status workers.
Enterprise types – proprietary and partnership are classified as informal sector enterprises in NSS, 66th Round.
Figures in parenthesis are percentages.
Enterprise type, employer's households includes private household employing aid servants, watchman, cook, etc.
Source: Computed from unit records of PLFS 2017-18.

5. Selection of Sub-sectors

In the case of a developing country like India, it is natural to expect some degree of structural change due to relative difference in growth rates of various segments. This section undertakes an analysis of such changes with a view to identify sub-sectors that are currently significant in terms of output and employment. The same shall be used for further study from a skill development perspective. A set of indicators starting with GVA have been deployed to undertake this analysis.

5.1 Share in Gross Value Added (GVA)

The share of various manufacturing segments in GVA have been appended in the below table. The relative significance of these segments over the period has also been indicated by their ranking in year 2000, 2008-09 and 2016-17.

Table 4: Change in GVA Share of various manufacturing segments

Sectors	Share in Manufacturing GVA in 2016-17	Rank in 2016-17	Rank in 2008-09	Rank in 2000
Chemicals & Chemical Products	14.0%	1	2	4
Textiles, Textile Products, Leather & Footwear	13.4%	2	3	2
Basic Metals & Fabricated Metal Products	12.8%	3	1	1
Coke, Refined Petroleum Products & Nuclear fuel	12.7%	4	5	5
Transport Equipment	9.8%	5	8	8
Food Products, Beverages & Tobacco	8.5%	6	4	3
Machinery, nec.	6.8%	7	6	7
Other Non-Metallic Mineral Products	5.7%	8	7	6
Electrical and Optical Equipment	5.4%	9	9	9
Rubber and Plastic Products	3.9%	10	10	10
Manufacturing, nec; recycling	3.1%	11	11	13
Pulp, Paper, Paper products, Printing & Publishing	2.4%	12	12	12
Wood and Products of wood	1.3%	13	13	11

Source: RBI KLEMS Database

Key Inferences:

- The top four sectors- Chemicals, Textiles, Basic Metals and Petroleum products constituted 52.9 % of total manufacturing GVA in 2016-17.
- The relative significance of the Chemicals sector has increased over the start of the millennium over more labour intensive segments of Textiles and Leather.
- Transport Equipment (representing the automotive sector) has grown in GVA share and constituted 9.8% of manufacturing GVA in 2016-17 with an overall 5th rank.
- Paper products, wood products and other manufacturing remains on the lower rank of GVA over the 20 year period.

5.2 Productivity Analysis

Total Factor Productivity (TFP)

On the basis of TFP growth analysis of major manufacturing segments over the period 2000-2017, the manufacturing segments can be classified into three categories:

- **Category A (TFP growth >=3%):** Chemicals and Chemical Products; Paper products (pulp, paper, printing & publishing); Rubber & Plastic Products; Textiles, Textile Products, Leather and Footwear; Electrical and Optical Equipment; Other Manufacturing (including manufacturing of furniture, stationery, jewelry, musical instruments, sports goods, games, toys etc.)

- **Category B (TFP growth 0-3%):** Transport Equipment; Petroleum Products; Machinery, nec (weapons, domestic appliances, general purpose machinery, office equipment, repair of machinery etc.)

- **Category C (TFP negative):** Wood & products of wood; other non-metallic mineral products; basic metals & fabricated metal products;

Table 5: Total Factor Productivity of Manufacturing Segments

KLEMS Industry Description	Average Annual TFP Growth for the period 2000-2017
Textiles, Textile Products, Leather and Footwear	3.1%
Pulp, Paper, Paper products, Printing and Publishing	3.7%
Manufacturing, nec; recycling	3.0%
Transport Equipment	1.7%
Rubber and Plastic Products	3.4%
Chemicals and Chemical Products	3.7%
Wood and Products of wood	-0.4%

Other Non-Metallic Mineral Products	-0.2%
Electrical and Optical Equipment	3.0%
Machinery, nec.	0.0%
Food Products, Beverages and Tobacco	0.2%
Basic Metals and Fabricated Metal Products	-1.8%
Coke, Refined Petroleum Products and Nuclear fuel	0.6%

Source: RBI KLEMS Database

A distinction can be made for the period before and after the great financial crisis which acted as a big reset in several industries and trade. The following segments show consistent growth over the two periods:

- Electrical and Optical Equipment
- Manufacturing, nec; recycling
- Transport Equipment
- Machinery, nec.
- Rubber & plastic Products
- Basic Metals and Fabricated Metal Products
- Other Non-Metallic Mineral Products

5.3 Employment Growth

On the basis of growth rate of employment over the period 2000-2017, the manufacturing segments can be classified in the following buckets:

- **Bucket 1 (high growth):** Electrical & Optical Equipment; Manufacturing, nec (including manufacturing of furniture, stationery, jewelry, musical instruments, sports goods, games, toys etc.); Rubber & Plastic Products; Machinery, nec (weapons, domestic appliances, general purpose machinery, office equipment, repair of machinery etc.)

- **Bucket 2 (Moderate Growth):** Other non-metallic products; Basic metals & Fabricated metal products; Coke, Refined Petroleum Products and Nuclear fuel; Food Products, Beverages and Tobacco; Pulp, Paper, Paper-products, Printing and Publishing; Chemicals and Chemical Products; Textiles, Textile Products, Leather and Footwear.

- **Bucket 3 (Negative Growth):** wood & products of wood

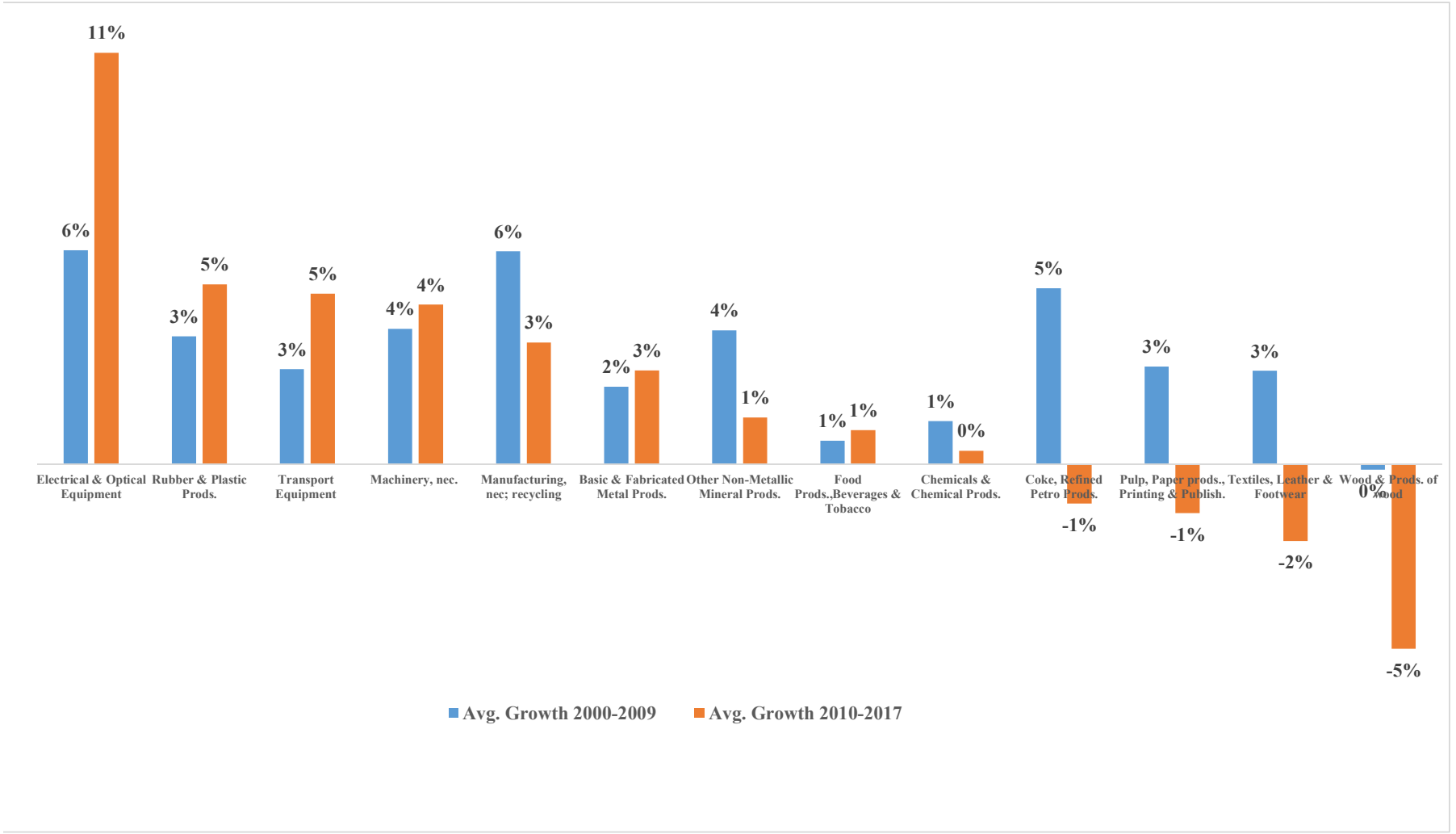


Figure 2: Growth Rate of Employment (log changes) over the period 2000-2009 and 2010-2017

Source: RBI KLEMS Database

5.4 Export Performance

Export performance is an important indicator of sector competitiveness. Data on export performance of key manufacturing segments is presented in Table 6 below. Manufacturing exports as a share of India's total exports has seen a decline over the study period. Share of manufacturing exports dropped from 77.8% in the year 2000 to 66.8% in 2009. There has been some improvement thereafter and it stands at 71.5% in 2019. While analyzing manufacturing exports, the following needs attention:

- Mineral fuels (refined petroleum products) constitute 14.5% of the total exports, however, its linkages with employment and skills is minimal due to very high capital intensity of the sector
- The polished diamond and stone segment under the commodity head 'Natural Or Cultured Pearls, Precious Or Semiprecious Stones, Precious Metals, Clad With Precious Metal And Articles thereof; Imitation Jewelry' is significant from a manpower and skill perspective but is a not a manufactured item in the strict sense of the term as it constitutes import of raw stones and export of polished finished goods.

Table 6: Data on export performance of key manufacturing segment

Manufacturing Segment	Commodity	2018-2019 (USD Million)	% Share in 2018-19	CAGR for 2000-01 to 2008-09	CAGR for 2008-09 to 2018-19
Other Non-metallic Products	Natural or Cultured Pearls, Precious or Semiprecious Stones, Precious Metals, Clad with Pre. Metal and Articles thereof, Imitation. Jewellery, Coin	40,449.2	12.3%	18.3%	3.6%
	Ceramic Products	1,590.2	0.5%	14.6%	22.2%
	Articles of Stone, Plaster, Cement, Asbestos, Mica or Similar Materials	1,580.2	0.5%	13.9%	5.8%
	Glass and Glassware	949.3	0.3%	14.7%	8.8%
Chemical & Chemical Products	Organic Chemicals	18,239.6	5.5%	20.1%	9.4%
	Inorganic Chemicals, Organic or Inorganic Compounds of Precious Metals, of Rare-Earth Metals, or Radi. Elem. or of Isotopes	2,011.7	0.6%	21.8%	5.8%
	Pharmaceutical Products	14,754.1	4.5%	23.4%	11.3%
	Fertilisers	148.0	0.0%	30.1%	7.0%
Transport Equipment	Vehicles other than Railway or Tramway Rolling Stock, and Parts and Accessories thereof	18,096.3	5.5%	26.2%	11.7%
Electrical & Optical Equipment	Electrical Machinery and Equipment and Parts thereof, Sound Recorders and Reproducers, Television Image and Sound Recorders and Reproducers and Parts	12,727.8	3.9%	28.4%	2.9%
	Optical, Photographic Cinematographic Measuring, Checking Precision, Medical or Surgical Instrument and Apparatus Parts and Accessories thereof	3,256.2	1.0%	20.0%	10.9%
Basic Metals & Fabricated	Iron and Steel	9,742.0	3.0%	26.7%	2.6%

Metal Products	Articles of Iron or Steel	7,290.2	2.2%	24.2%	2.3%
	Aluminium and Articles thereof	5,703.3	1.7%	16.8%	17.2%
	Copper and Articles thereof	999.7	0.3%	35.1%	-5.8%
	Tools Implements, Cutlery, Spoons and Forks, of Base Metal, Parts thereof of Base Metal	891.9	0.3%	11.4%	5.3%
	Miscellaneous Articles of Base Metal	636.5	0.2%	14.3%	6.2%
	Zinc and Articles thereof	603.1	0.2%	68.4%	4.0%
	Lead and Articles thereof	402.9	0.1%	50.0%	30.0%
	Nickel and Articles thereof	66.5	0.0%	33.1%	10.4%
	Other Base Metals, Cermets, Articles thereof	59.2	0.0%	28.9%	4.4%
	Tin and Articles thereof	10.2	0.0%	7.6%	-9.7%
Textiles, Textile Products, Leather & Footwear	Articles of Apparel and Clothing Accessories, Not Knitted or Crocheted	8,336.0	2.5%	5.7%	3.5%
	Articles of Apparel and Clothing Accessories, Knitted or Crocheted	7,820.4	2.4%	13.9%	4.5%
	Other Made-up Textile Articles, Sets, Worn Clothing and Worn Textile Articles, Rags	5,257.4	1.6%	9.5%	8.3%
	Footwear, Gaiters and the like, Parts of such Articles	2,908.0	0.9%	11.6%	6.5%
	Articles of Leather, Saddlery and Harness, Travel Goods, Handbags and Similar Cont. Articles of Animal Gut (Other than Silk-Worm)Gut	2,558.7	0.8%	5.8%	4.8%
	Man-made Filaments	2,291.7	0.7%	14.8%	4.0%

	Man-Made Staple Fibres	1,905.2	0.6%	12.6%	4.3%
	Carpets and Other Textile Floor Coverings	1,766.0	0.5%	6.7%	5.1%
	Knitted Or Crocheted Fabrics	440.2	0.1%	14.6%	16.0%
	Wadding, Felt and Non-wovens, Special Yarns, Twine, Cordage, Ropes and Cables and Articles thereof	427.3	0.1%	15.6%	10.2%
	Special Woven Fabrics, Tufted Textile Fabrics, Lace, Tapestries, Trimmings, Embroidery	377.9	0.1%	1.1%	5.8%
	Impregnated, Coated, Covered or Laminated Textile Fabrics, Textile Articles of a kind suitable for industrial use	258.4	0.1%	12.3%	9.5%
Plastic & Rubber Products	Plastic and Articles thereof	8,014.9	2.4%	17.5%	12.2%
	Rubber and Articles thereof	3,206.7	1.0%	19.9%	7.6%
Manufacturing, nec	Furniture, Bedding, Mattresses, Mattress Supports, Cushions and Similar Stuffed Furnishing, Lamps and Lighting Fittings not elsewhere specified or included	1,710.2	0.5%	33.9%	12.0%
	Toys, Games and Sports Requisites, Parts and Accessories thereof	417.4	0.1%	11.1%	11.4%
	Musical Instruments, Parts and Accessories of such Articles	19.9	0.0%	9.8%	2.6%
Wood & Products of wood	Wood and Articles of Wood, Wood Charcoal	491.2	0.2%	23.3%	10.8%
Pulp, Paper, Paper-products, Printing & Publishing	Paper and Paperboard, Articles of Paper Pulp, of Paper or of Paperboard	1,990.3	0.6%	14.9%	13.9%
	Printed Books, Newspapers, Pictures and other Products of the Printing Industry; Manuscripts, Typescripts and Plans	400.1	0.1%	17.8%	6.0%

	Pulp of Wood or of other Fibrous Cellulosic Material, Waste and Scrap of Paper or Paperboard	3.5	0.0%	-2.0%	10.6%
Food Products, Beverages & Tobacco	Animal or Vegetable Fats and Oils and their Cleavage Products, Pre. Edible Fats, Animal or Vegetable Wax	1,097.6	0.3%	12.4%	6.4%
	Preparations of Meat, of Fish or of Crustaceans, Molluscs or other Aquatic Invertebrates	432.6	0.1%	63.0%	6.7%
	Sugars and Sugar Confectionery	1,629.2	0.5%	32.3%	3.8%
	Cocoa and Cocoa Preparations	192.7	0.1%	25.5%	26.5%
	Preparations of Cereals, Flour, Starch or Milk, Pastry cooks Products	535.0	0.2%	25.4%	8.4%
	Preparations of Vegetables, Fruit, Nuts or Other Parts of Plants	588.5	0.2%	19.0%	8.0%
	Miscellaneous Edible Preparations	770.2	0.2%	9.6%	11.5%
	Beverages, Spirits and Vinegar	325.8	0.1%	16.0%	10.3%
	Residues and Waste from the Food Industries, Prepared Animal Fodder	1,915.2	0.6%	22.4%	-1.9%
	Tobacco and Manufactured Tobacco Substitutes	981.3	0.3%	18.7%	2.7%

Source: Author Compilation based on Department of Commerce Statistics

Key Inferences:

Category A: Commodities with minimum 0.5% contribution to total exports and have displayed double digit growth in both the periods

- Pharmaceutical Products
- Transport Equipment
- Plastic and articles thereof
- Aluminum and articles thereof
- Optical and Medical Equipment (Commodity Head: Optical, Photographic Cinematographic Measuring, Checking Precision, Medical or Surgical Inst. and Apparatus Parts and Accessories thereof)
- Manufacturing, nec comprising furniture (Furniture; Bedding, Mattresses, Mattress Supports, Cushions and Similar Stuffed Furnishing; Lamps and Lighting Fittings not elsewhere specified)

Category B: Commodities with minimum 0.5% contribution to total exports and have displayed at least 5% CAGR growth in both the periods can be classified under category B

- Refined Petroleum Products (Mineral Fuels, Mineral Oils and Products of their Distillation; Bituminous Substances; Mineral Waxes)
- Organic Chemicals
- Inorganic Chemicals
- Sub-segment of Textiles (Other Made Up Textile Articles; Sets; Worn Clothing and Worn Textile Articles; Rags)
- Footwear (Footwear, Gaiters and The Like; Parts of Such Articles)
- Sub-segment of Textiles (Carpets and Other Textile Floor Coverings)
- Rubber and Articles thereof

5.5 Foreign Direct Investment

The cumulative inflow of FDI into major manufacturing segments since April 2000 has been captured below:

Table 7: Cumulative inflow of FDI into various manufacturing segments since April 2000

S No.	Major Manufacturing Segments Identified from FDI Classification	Cumulative April 2000-Mar 2020 (USD Mn)	Share of Total FDI into the country
1	Automobile Industry	24,210.7	5.1%
2	Chemicals (Other than Fertilizers)	17,639.5	3.8%
3	Drugs & Pharmaceuticals	16,500.6	3.5%
4	Metallurgical Industries	13,401.8	2.9%
5	Food Processing Industries	9,980.8	2.1%
6	Electrical Equipment	8,604.0	1.8%
7	Industrial Machinery	5,619.5	1.2%
8	Cement And Gypsum Products	5,281.4	1.1%
9	Misc. Mechanical & Engg. Industries	3,636.8	0.8%

10	Textiles (Including Dyed, Printed)	3,447.5	0.7%
11	Rubber Goods	3,018.1	0.6%
12	Fermentation Industries	2,989.5	0.6%
13	Electronics	2,791.1	0.6%
14	Prime Mover (Other than Electrical Generators)	2,227.5	0.5%
15	Medical And Surgical Appliances	2,129.5	0.5%
16	Paper And Pulp (Including Paper Products)	1,450.6	0.3%
17	Machine Tools	980.8	0.2%
18	Ceramics	871.2	0.2%
19	Fertilizers	688.2	0.1%
20	Leather, Leather Goods And Pickers	206.3	0.0%

Source: Department for Promotion of Industry and Internal Trade (DPIIT), Government of India

Inferences:

- The share of FDI in top 20 manufacturing segments stands at 26.7% of total FDI investments during the period April 2000 to March 2020.
- If we break this into the period before and after the GFC i.e. period 1 and period 2 respectively, it has grown from 21.7% during period 1 (April 2000- March 2009) to 27.8% during the period 2 (Apr 2009- March 2020).
- Top 10 manufacturing segments constitute 86.3% of total identified manufacturing segments FDI.
- Top 5 manufacturing segments constitute 65.1% of total identified manufacturing FDI.

Table 8: Relative Change in significance of sectors over the two periods (Apr 2009 –Mar 2020) and (Apr 2000-Mar 2009)

S No.	Major Manufacturing Segments Identified from FDI Classification	Rank during Period 2 (Apr 2009- Mar 2020)	Rank during Period 1 (Apr 2000- Mar 2009)
1	Automobile Industry	1	1
2	Chemicals (Other than Fertilizers)	2	3
3	Drugs & Pharmaceuticals	3	6
4	Metallurgical Industries	4	2
5	Food Processing Industries	5	7
6	Electrical Equipment	6	5
7	Industrial Machinery	7	14
8	Cement And Gypsum Products	8	4
9	Misc Mechanical & Engg. Industries	9	11
10	Textiles (Including Dyed, Printed)	10	9
11	Rubber Goods	11	15
12	Fermentation Industries	12	10

13	Electronics	14	8
14	Prime Mover (Other than Electrical Generators)	13	20
15	Medical And Surgical Appliances	15	17

Key Inferences:

- There is not much change in investor preferences for the top 5 segments among manufacturing sectors to invest in the country. Automobile segment remains the best attraction among foreign investment across the two periods.
- Industrial Machinery has climbed to 7th rank in the latest period compared to 14th in the period before GFC.
- The relative significance of Chemicals and Pharmaceuticals has increased and that of Metallurgical Industries has declined, though it continues to be in the top 5 segments.

5.6 Selection of Segments of Manufacturing

Based on the assessment of the manufacturing sub-sectors, the following are selected for support through TVET and other skill development initiatives for the purpose of this Skills Assessment and Anticipation Study:

- Chemicals and Chemical Products (including Pharmaceuticals)
- Transport Equipment
- Electrical & Optical Equipment
- Textiles, Textile Products, Leather and Footwear
- Basic Metals and Fabricated Metal Products
- Rubber and Plastic Products
- Food Products, Beverages and Tobacco

The selected segments have high share of GVA and score high on the combined weightage from the aspects of Contribution to GVA; Exports; Growth in Employment; TFP growth; FDI receipts and Labour Share. *(While 'Coke, Refined Petroleum Products and Nuclear fuel' have high share of value added and buoyancy in exports, the sector was not selected in the top 7 segments from a skill development perspective due to relative low and declining labour share in the segment.)*

6. Assessment of the Current Need for Skills and Educated Workforce in the Industrial Sub-Sectors

In this section, an attempt is being made to assess the current and future demand for skilled and educated workforce in the identified sub-sectors based on the survey responses and to provide suggestions on how to make the technical and vocational education and training (TVET) system more responsive to the labour market demand.

In the first instance, mapping out and analysis of the current occupational and skills qualification characteristics of the workforce in the selected sub-sectors is undertaken.

6.1 Current Mix of Educated and Skilled Workforce in the Sub-sectors

A measure of the current mix of the educated and skilled workforce in the companies is important in its own right because it represents the current labour market situation with regard to occupations and skills. Besides, measures of the education and skill levels of a workforce can be used as indicators of the quality of the workforce.

The enterprise survey reveals that in all the study sub-sectors taken together, skilled workers account for the largest proportion of the total workforce (52.1 per cent) followed in order by unskilled workers (18.8 per cent), Apprentices (11.7 percent), professional staff (11.2 per cent) and clerical staff (6.2 per cent). The overall share of Apprentices lies in the range of 0.5 to 7% of the workforce except for the Leather segment which has reported 13.5 percent share of Apprentices in the total workforce.

Across sectors, however, there is wide variation in skill intensity with the highest proportion of the skilled workers in the heavy metal sector represented by the Iron and Steel segment (88 per cent), Apparel & Textile Sector (73.0 percent), Electronics & Capital Goods (67.2 per cent) and Automotive sector (57.2 per cent) and the lowest in Life Sciences sector (29.8 per cent). The share of un-skilled workforce in the Iron & Steel segment is the lowest at 0.3 percent.

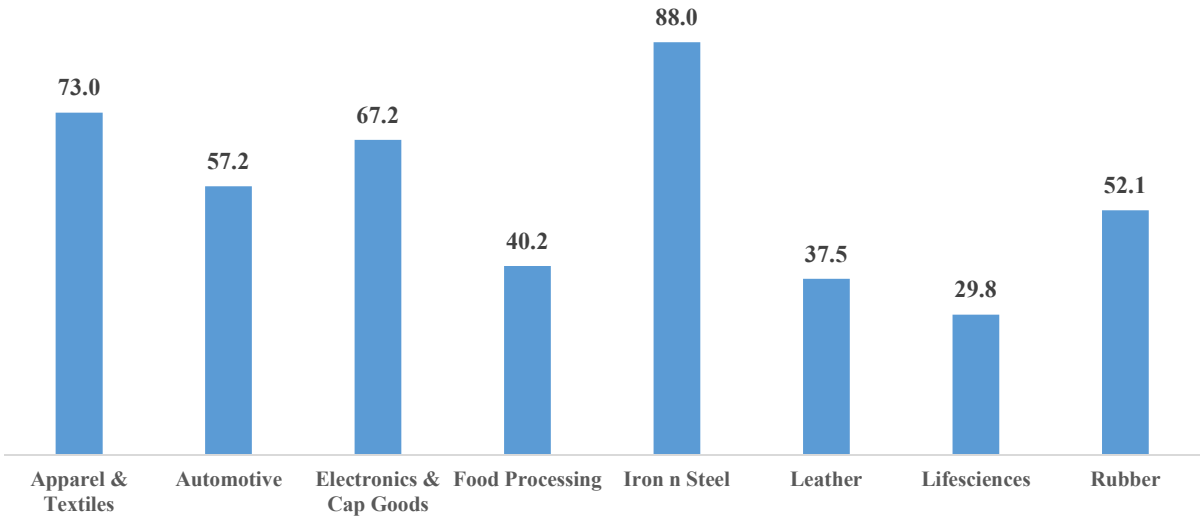


Figure 3: Skill Intensity across various Manufacturing Segments

6.2 Training of Workforce

Across all sub-sectors, on-the-job training accounts for the single most important mode of training the workforce in the study enterprises. The proportion of workers trained on the job among the study group ranges from ~58% in the Apparel and Textile Sector to 100% in Automotive, Life Sciences and Leather sectors. On-the-job training forms the core of the skills formation at the worker level across manufacturing sectors and is addressed primarily to new entrants to the workforce.

Table 9: Mix of Educated and Skilled Workforce in Enterprises of the Study Group Enterprises

Segment	Managerial, Engineering, Professional		Clerical Staff		Skilled Workers		Low Skilled/ Un-skilled workers		Apprentices		Total Current Workforce
	Number	%	Number	%	Number	%	Number	%	Number	%	Number
Apparel and Textiles	2484	5.0	2831	5.7	36153	73.0	7837	15.8	239	0.5	49544
Automotive	2957	13.8	352	1.6	12267	57.2	4299	20.0	1569	7.3	21444
Electronics & Cap Goods	1158	11.2	300	2.9	6933	67.2	1740	16.9	192	1.9	10323
Food Processing	609	10.8	420	7.5	2263	40.2	2128	37.8	203	3.6	5623
Iron n Steel	9304	9.1	278	0.3	89931	88.0	265	0.3	2460	2.4	102238
Leather	66	1.0	75	1.1	2560	37.5	3210	47.0	920	13.5	6831
Life Sciences	13250	55.5	2852	12.0	7122	29.8	4	0.0	637	2.7	23865
Rubber	463	11.2	257	6.2	2157	52.1	778	18.8	485	11.7	4140

Key Inferences:

- The Iron and Steel sector is the outlier in providing extensive external training at premier education institutions for both technical as well as managerial skills development.
- Firms' propensity to provide in-house/external training is directly correlated with size. Larger formal firms in sectors of Iron & Steel; Life Sciences; Automotive; Food Processing; Electronics & Capital Goods have structured training programs for orientation, continuous learning and technical competencies. Small and mid-sized firms are focused on providing orientation and short term training for new entrants into the technical workforce.
- The leather sector in general does not provide formal in-house/external training and on-the-job pick up of technical skills is preferred mode of training.

The duration of in-house training is varied for various segments. The median duration is 90 days for new entrants into the workforce for firms providing in-house training in the Apparel and Textiles segment. The Iron and Steel segment is again an outlier in terms of duration of in-house training wherein training can be provided for 6 months to one year.

However, on-the-job training tends to obscure the distinction between training and work, because priority is often given to production activities. This is true, more for labour intensive sectors of Leather, Apparel and Rubber segments. All round development of employees for greater lifetime incomes is not an objective or outcome of short term on-the-job trainings. Also, most medium and small firms do not have provisions for lifelong learning.

6.3 Apprenticeship

Apprenticeship has been recognized as one of the best means to provide initial industry relevant training in the country. While formal apprenticeship is almost 6 decades old in India, a number of reform measures have been made to the archaic rules formed in the 1961 Apprentices Act since 2014-15 including mandatory 2.5% (of their total workforce) enrolment of Apprentices for all establishments with minimum employment of 30 people and enhancing the upper limit to engage apprentices by employers to 15% of the total strength of the establishment to promote take off of apprenticeships.

The Government has rolled out the National Apprenticeship Promotion Scheme (NAPS) to provide financial support in the form of part reimbursement of Apprenticeship stipends paid to candidates. The stipend ranges between Rs. 6,000-9,000/- per month as per the education qualification of the candidate. As of December 2020, more than 70,000 establishments have enrolled under the NAPS scheme to take up apprentices.

At an operational level, a distinction has been made between standardised trades ('Designated'), which have traditionally been engineering oriented and linked with industrial undertakings, and customized trades ('Optional') that provide flexibility to employers to design their own Apprenticeship programs. Direct financial assistance has also been provisioned through part reimbursement of Apprentices stipends. All the flexibility now provided has led to an increase in numbers to ~2.5 Lakh apprentices enrolled from the skill ecosystem (comprising short duration training and post-secondary vocational schools). The system, however, is still to reach its potential. 68.4% of workers in India's non-agriculture sector were engaged in the informal sector[8]. This means a large share of employers is either not aware or is not able to extract value from apprenticeship programs. Also, enterprises may be able to pursue apprenticeship programs in greater numbers once procedures are further streamlined.

[8]PLFS 2018-19, released June 2020

Table 10: Major Trades amenable to Apprenticeship

Sub-sector	Major Trades where Apprenticeship is offered	Average Duration
Apparel & Textiles	Tenter/ Ring Frame Tenter/ Autoconer Tenter/Drawframe Tenter (spinning)	6 months to 1 year
	Doffer/Ring Frame Doffer (spinning)	
	Packing Checker (quality control)	
	Fabric Checker (Weaving)	
	Winder	
	Fitter (weaving/knitting maintenance)	
	Preparatory Operator (Spinning)	
Automotive	Fitter	1 year
	Machinist	
	CNC Operator/Machining Technician	
	Welder	
	Automotive Painting	
	Electrician	
	Electronics & Electrical Technician	
	Motor/Diesel Mechanic	
Food Processing	Mechanic	6 months to 1 year
	Machine Operator	
	Electrician	
	Boiler Operator/ Boiler Attendant	
	Fitter	
	Welder	
	Refrigeration	
	Dairy Operator/ Dairy Technologist	
Leather	Stitcher	300- 540 hrs
	Cutting Operator	
	Skiving Operator	
	Folder	
Rubber	Mill Operator, Mixing Operator/Mixing Supervisor (Mixing)	6-12 months

	Moulding Operator/ Injection Moulding Operator/Moulding Technician/ Pneumatic Tyre Moulding Operator/Compression Moulding (Moulding)	
	Machine Operator (Product Manufacturing)	
	Quality Supervisor (Quality Assurance)	
Iron & Steel	Welder	1-2 years
	Fitter	
	Machinist	
	Electrician	
	Computer Operator & Program Assistant	
Electronics & Capital Goods	Electrician	6 months
	Boiler Attendant	
	Fitter	
	Optical Fibre Technician	
	Welder	

Key Inferences:

- In general, larger formal firms are able to run structured apprenticeship programs. The definition and duration of apprenticeship programs as defined under the Apprenticeship Act 1961 and Rules framed thereafter is however not strictly adhered to except by firms which have enrolled under the NAPS scheme.

- For a section of the MSME sector enterprises, the distinction between a worker and an apprentice is not apparent gauging from the tasks assigned to them, as compared to regular workers and a labour cost arbitrage may be at play.

- The apprenticeship intensity across manufacturing companies, which are part of the study group, is highly varied, with Rubber and Leather segments registering high concentration at more than 13% each.

  The propensity to take up Apprentices is the lowest for the Apparel and Textile segment where only 0.5% of the total workforce is engaged as apprentices. Within this segment, Apparel based enterprises have the least propensity to take up Apprentices.

- The duration of apprenticeship is also highly varied across manufacturing segments. The Iron & Steel segment provides the longest duration of 1-2 years of Apprenticeship followed by Automotive where 1 year average duration is the most common. The Leather segment provides the shortest duration of apprenticeship with 300-540 hrs.

- In general, the asset heavy segments have more structured and longer apprenticeship programs. There is greater pressure on the relatively labour intensive segments of Leather and Apparels to derive immediate productivity gains from the workforce. The apprenticeships offered herein are fewer in number and shorter in duration.

6.4 How Firms Characterize Skilled Workers

Firms do not have a defined standard to categorize people as unskilled/low-skilled, semi-skilled and skilled. There is therefore high variation in how they define the skill level of workers.

The National Skills Qualification Framework notified in 2013 is based on competency based qualifications and aimed at integrating general and vocational streams of education and training and facilitate mobility between various streams in India and also globally. Over time, it has emerged as a significant convergence point at various levels- between short and long term training and with skill programs undertaken by various arms of the Government. A total of 4,137 Qualifications Packs have been approved so far[9]. While all major government program courses are now aligned with the NSQF, there are still concerns which need to be addressed.

- Employers (under the survey) in general were not aware of the modularity offered under NSQF.

[9]As per NCVET information sourced in February 2021

- The framework has not been able to promote much international mobility and benchmarking by default as against the 450 recognised ISCO occupations. This would call for continued global skill mapping exercises, mainly at G2G level.

- To consolidate the regulatory powers scattered across a number of entities, the NCVET (National Council for Vocational Education and Training) was notified in December 2018. NCVET has adopted the UK model of delegated regulation of on-ground training provision through recognised Awarding and Assessment Bodies. Once this mechanism matures over a period of time, it is expected to improve quality, consistency and credibility of VET qualifications and certifications.

- The fee based vocational programs outside of the Government eco-system have by and large not moved towards alignment with NSQF level based qualification mapping.

6.5 Qualification Profiles of Workers in Sub-sectors

Firms in general do not have ready data on qualification profile of workers on the shop floor. For the sample size, only around half of the respondents had some evidence on education qualification of the workers on the shop floor. Some key inferences on analysing such data reveal the following:

- At the supervisory level, there is a mix of people with higher education and ITI/Diploma level qualifications. Around 85% at that level either have a higher education qualification or an ITI/Diploma.

- For certain standard job roles like Electrician, Machine Operator; Mechanical Technician; Fitter and Machinist, ITI/Diploma courses figure as the primary qualification. This also implies relatively better linkages of ITI courses with these roles.

- Short term training and RPL certification figured highly for occupations like Stitching Operator; several textile related roles in Spinning, Draw Frame Operator and Speed Frame Operator.

- There is a high proportion of un-skilled workers in occupations like Plumbers; Maintenance Staff; Housekeeping; Helpers; Technician Assistants; Mechanics; Butchers; Turners; and Leather sector activities (skiving, cutting, stitching).

6.6 Experiences about Quality of Staff from ITI/other VET Institutions

According to most of the enterprises, Industrial Training Institute (ITI) pass-outs are doing better work than other entry level workforce. 68.5% of the enterprises are satisfied with ITI pass-outs and feel that they are generally doing better compared to other entry level workers. The key reasons cited for the same were: better technical knowledge; exposure to practical training; and better ability to pick the technicalities of the job. Only 12.3% firms feel that ITI pass-outs are worse off compared to other entry level workers. 19.2% of the study group companies were indifferent to ITI pass-outs as they are not engaging ITI pass-outs either due to their requirement are more basic

(mostly in the Leather and Food Processing segment) and they were depending on un-skilled or those certified under short term programs.

The relative dependence and satisfaction of sub-sectors on skill pass-outs from the ITI ecosystem is varied. On the basis of the responses from the study group companies, the sectors can be classified as high-medium-low dependency sectors.

Table 11: Classification of sectors basis dependency on ITI Ecosystem

Segment	Dependency Quotient	Satisfaction Level: Reasons for doing better than other entry level workforce				
		More Productive	Better Practical Knowledge	Sound Theoretical Knowledge	Better Attitude	Ability to Learn/up-skill
Apparel & Textiles	**Medium**					
Automotive	**Medium**					
Food Processing	**High**					
Leather	**Low**					
Rubber	**Medium**					
Iron & Steel	**Medium**					
Electronics & Capital Goods	**Medium**					
Life Sciences	**Low**					

Note: Colour Coding- Blue: Relative Satisfaction; Yellow: Relative Dissatisfaction

High Dependency Sectors:

- The Food Industry sector (with the exception of basic processes like rice milling) exhibits the maximum dependence and satisfaction from ITI pass-outs (Table 11). Both the theoretical and practical knowledge requirements of the segment are well met under the ITI programs. The ITI pass-outs also score well on behavioural and soft skills aspects.

Low Dependency Sectors:

- Leather: the sector's satisfaction level with ITI pass-outs is very high in general. However, both the processes involved and competitive intensity obliges them not to engage ITI pass-outs in large numbers. They are largely dependent on semi-skilled people emanating out of the short term training ecosystem or unskilled candidates who can be provided quick orientation.

- Life Sciences: the hiring ladder in the life sciences segment especially larger companies in general starts from the diploma engineers and as such they believe that more skill development is required for ITI pass-outs to contribute beyond a specific trade where an ITI is trained.

Medium Dependency Sectors:

- The Apparel, Automotive, Rubber and Iron & Steel sectors have depicted a moderate dependency on the ITI system.

- The Iron & Steel segment is in general hiring higher skilled personnel and feel that there is scope for improvement in the practical knowledge and productivity aspects of ITI pass-outs.

- The Apparel and Textiles segment in general feel that while ITI pass-outs score well in productivity and theoretical knowledge but they are lacking on practical knowledge. The Apparel segment also indicated that there are not many courses in the ITI system which fit their requirement.

- The Rubber segment companies are satisfied with their experience with ITI pass-outs but feel that there is scope for improvement in practical knowledge.

- The Automotive sector is satisfied with the performance of the ITI pass-outs, however, they feel that they lack exposure to the latest machinery and processes and have been trained in conventional methods and older machinery.

- The Electronics and Capital Goods segment rates ITI graduates better in terms of technical knowledge, learning ability and productivity.

6.7 Experiences about Quality of Staff from Short Term Training

The most striking experience of firms in the study group about workers with a Short Term Training (STT) certification is their ability to learn/re-skill on the job and better attitude and orientation towards the tasks. In general, firms feel that those exposed to short term training were performing better than unskilled candidates in terms of productivity and attitude to work. The technical-practical knowledge advantage over un-skilled personnel is however limited.

Table 12: Classification of sectors based on dependency on STT Ecosystem

Segment	Dependency Quotient	Satisfaction Level: Reasons for doing better than other entry level workforce				
		More Productive	Better Practical Knowledge	Sound Theoretical Knowledge	Better Attitude	Ability to Learn/up-skill
Apparel & Textiles	High					
Automotive	Medium					
Food Processing	High					
Leather	High					
Rubber	Medium					
Iron & Steel	Medium					
Electronics & Capital Goods	Medium					
Lifesciences	Low					

Note: Colour Coding- Blue: Relative Satisfaction; Yellow: Relative Dissatisfaction

On the basis of the responses from the study group companies, the sectors can be classified as high-medium-low dependency sectors.

High Dependency Sectors

- Apparel & Textiles: workers with STT certification are better than un-skilled candidates in terms of their ability to learn and general attitude to work. However, most of the time they have to be re-trained/up-skilled for the specific tasks.

- Leather: the STT program training is ideally suited to the segment as they fulfil their requirement of handling machinery. The segment is highly dependent on the STT certified candidates as the job requirement is ideal to the exposure provided in STT programs.

- Food Processing: the accuracy, precision and dexterity of STT certified people is better than unskilled candidates. They are also easier to train/re-train and exhibit better behavioural aspects and adaptability. However, the advantage of STT-certified workers in terms of technical knowledge can be compensated by untrained personnel in 7-10 days.

Medium Dependency Sectors

- Automotive: STT certified candidates are better equipped to be trained/re-trained on the job compared to untrained personnel. However, there is a need to expose them to latest technologies and software in vogue in the sector to make a big difference.

- Iron & Steel: the study group companies feel that there is considerable improvement in the performance and exposure level of the employees who undertake short duration training.

- Rubber: the rubber segment is also satisfied with their experience with STT certified people in general. There is scope for improvement in terms of exposure to latest machinery which can further improve their value proposition.

- Electronics: while STT certified workers perform well, they are skilled in a very narrow work area/specialization.

Low Dependency Sectors:

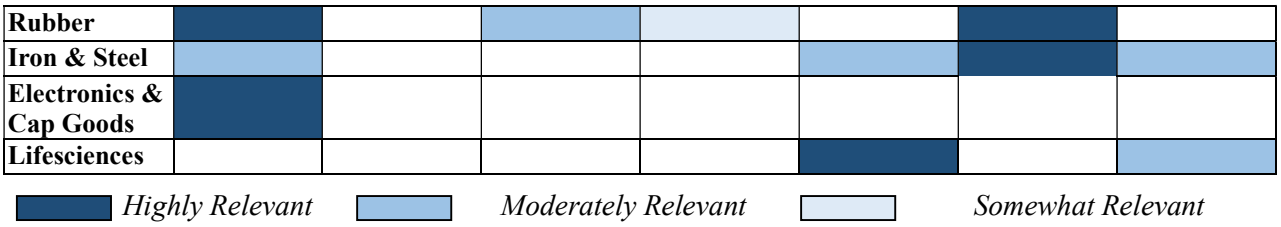
- Life Sciences: the STT certified candidates are easier to train and make productive in life sciences roles. However, the segment has very low exposure to trained workers below the level of diploma engineers.

6.8 Key Barriers to Skill Development

Based on 80 subjective responses from the study group enterprises, the key barriers to skill development have been classified into 7 broad themes of – Behavioural Aspects/ Attitude; Attrition/Absenteeism; Cost; Awareness & Economic Rationale not obvious; Inadequate/obsolete practical training; and Qualified Trainer Availability. The sub-segments experience varied challenges in different intensity to skill development.

Table 13: Analysis of key Barriers to Skill Development

Segment	Key Barriers to Skill Development						
	Behavioural Aspects/ Attitude	Attrition/ Absenteeism	Cost	Awareness &Economic Rationale not obvious	Availability of Quality Training Facilities	Inadequate/obsolete practical training	Qualified Trainer Availability
Apparel & Textiles							
Automotive							
Food Processing							
Leather							



- The Iron & Steel segment has identified lack of practical training and trainers in AR/VR format for the sector as a key challenge in skill development. While a lot of a social stigma issue has been addressed, there is some behavioural challenge to working in the iron/steel sector compared to desk jobs. In parallel, the Rubber and Automotive sectors also identify obsolete/inadequate practical training as a key hindrance in skill development.

- On the other hand of the spectrum, cost and opportunity loss involved in participating in vocational training is a key hindrance in the Leather and Apparel & Textile segment. For Leather, the economic rationale for investment into skill development is not obvious to enterprise promoters and managers.

- Attrition: attrition and absenteeism is a cause of concern for many sectors. The Automotive segment firms say that they are most impacted by high attrition rates.

- Availability: The Life sciences segment is concerned about the availability of quality training facilities in the VET system to cater to the needs of the specialized firms.

6.9 Supply of Skilled Candidates

The supply of VET certified pass-outs is considered adequate in numbers by enterprises part of the study group. Out of a total 83 enterprises which responded to adequate supply of VET pass-outs for recruitment, 84% felt that there was adequate pool of certified VET pass-outs which were available. There were, however, two outliers, viz. Rubber and Life Sciences segments. Half of the Rubber segment enterprises felt that although there are many aspirants who could benefit from training, there is a lack of relevant training courses/modules for ready absorption by the segment. The Life Sciences sector firms feel that there is a gap between sector demand and curriculums of existing programs.

In general, the availability of practical training for relatively complex or capital intensive training processes is a constraint. There is no apparent lack of availability of training institutions to provide training, except for some rural-urban skew seen to affect the Food Processing and Rubber segments wherein there is lesser availability of training infrastructure in rural areas.

6.10 Employee Attrition

The reason for employee attrition indicated most frequently was ‘Better opportunities either within the same sector or another sector’ by ~43% of the firms. Another significant factor (~30%) for attrition was cited as natural reasons including re-location, retirement and illness. Nearly a fifth (20.4%) of the respondents indicated Covid-19 and general economic slowdown as a reason for an increase in attrition. Nearly 10% firms cited automation and technology up-gradation as the key reason for attrition.

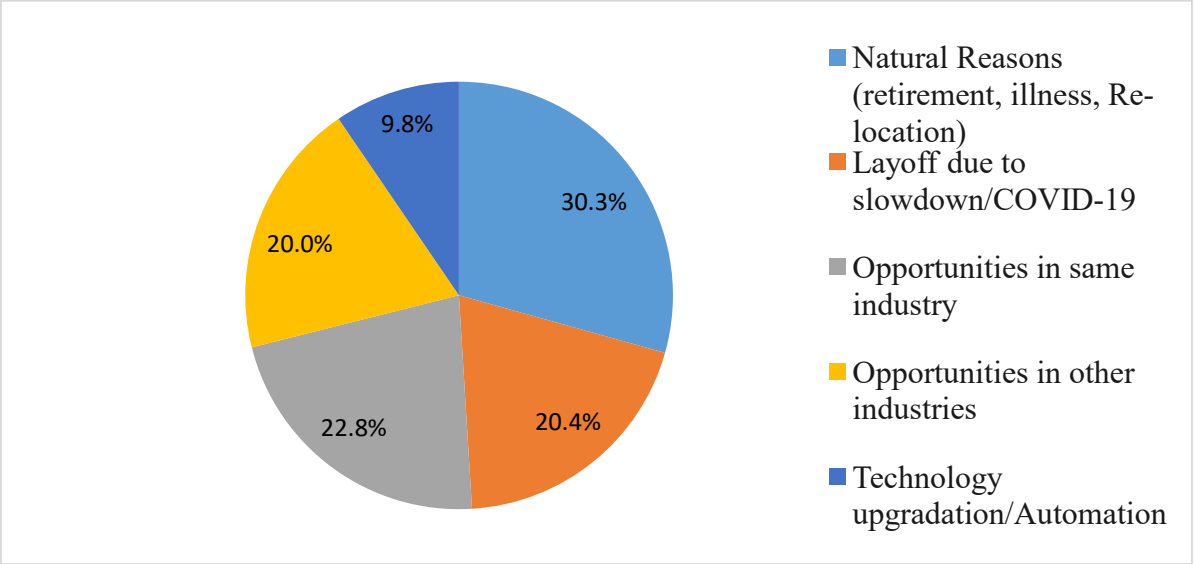


Figure 4: Key Reasons for Attrition among Manufacturing Firms

6.11 Key Occupations/Job Roles where there is Mismatch

Current Skill Gaps of Workers

It is important to understand the current skill gaps at the shop floor to improve planning of future skill initiatives. Skills gaps in the present context means the skills or attributes which are unavailable to the manufacturing sector due to a variety of reasons including inadequate training, poor skill levels of existing workers or constraints in the job market.

Based on 90 valid responses received on skill gaps at the shop floor, the following emerges (Table 14):

Table 14: Skill gaps at the shop floor

Sector	Key occupational skill sets inadequate on the Shop Floor	Identification of skill gaps for each occupation	Geographical Alignment based on Survey Responses
Apparels & Textiles	Doffer; Checker/Re-checker/Final Checker; Machine Operator; Ring Frame Tenter; Autoconer Tenter; Welder; Electrician; Sider/TFO Sider; Winder; Draw Frame Operator; Packing Checker; Blow-room Operator; Speed Frame Operator; Mechanic; Tailor; Ironer/Pressman; Fabric Cutter; Calendaring Machine Operator; Weavers; DCS operators; Ring frame operators; Supervisors; Sewing Machine Operators (more numbers required)	Doffer: Low empty feeding rate, low gaiting rate, machine cleaning	Ludhiana- Panipat-Hisar Cluster
			Bhilwara Cluster
		Machine Operator: For supervision and operation of machinery, accuracy, precision, manual dexterity, knowledge of machine operations etc.	Tirupur Cluster
			Ludhiana- Panipat-Hisar Cluster
			Bengaluru Cluster
		Ring Frame Tenter: Piecing speed, quality of work, discipline, teamwork, safety procedure, accuracy, precision, manual dexterity, knowledge of machine	Ludhiana- Panipat-Hisar Cluster
			Bhilwara Cluster
		Autoconer Tenter: Cop feeding rate, quality of work, discipline, teamwork, safety procedure, accuracy, precision, manual dexterity, knowledge of machine	Bhilwara Cluster
		Sider: Side load handling, piecing rate, machine cleaning	Ludhiana- Panipat- Hisar Cluster
		Winder: Empty magazines issue, low bobbin feeding rate, high red light	Ludhiana- Panipat- Hisar Cluster
		Weaver: Technical skills of weaving	Ludhiana- Panipat- Hisar Cluster
		Tenter: High roving breakage attending time, low sliver piecing rate, machine cleaning	
		TFO Sider: High cone starting time, low knotting rate, machine cleaning	Ludhiana- Panipat- Hisar Cluster
		Welder: Accuracy, precision, manual dexterity, knowledge of machine maintenance, etc.	Ludhiana- Panipat- Hisar Cluster
		Ring Frame Doffer: Doffing & piecing speed, quality of work, discipline, teamwork, safety procedure	Tirupur Cluster

		Electrician: Knowledge of electrical work/ maintenance	Ludhiana- Panipat-Hisar Cluster
			Ludhiana- Panipat-Hisar Cluster
		Draw Frame Operator: Working efficiency, quality of work, discipline, teamwork, safety procedure	Tirupur Cluster
		Packer/ Packing Checker: Quality of checking, discipline, teamwork, safety procedure	Ludhiana- Panipat-Hisar Cluster
		Blowroom Operator: Knowledge of machine maintenance	Bhilwara Cluster
		Calendaring Machine Operator: Knowledge of machine maintenance	Bhilwara Cluster
		Speed Frame Operator Tenter & Doffer: Accuracy, precision, manual dexterity, knowledge of machine	Bhilwara Cluster
		Tailor: Multi machine handling, accuracy, knowledge basic of m/c maintenance, knowledge of measuring, customer requirements, set folding knowledge	Kolhapur Cluster
		Ironer/Pressman: Press handling, machine breakdown handling	Kolhapur Cluster
		Fabric Cutter: Cut plan knowledge, cutting machine handling, layering and measuring knowledge	Kolhapur Cluster
		Sewing Machine Operator: Machine maintenance knowledge, safety knowledge, ability to read and write, understanding capability, better education about machines and quality standards	Ludhiana- Panipat-Hisar Cluster; Tirupur Cluster
		Mechanic: Machine maintenance knowledge, safety knowledge	Kolkata Cluster
		DCS Operator	Ludhiana- Panipat-Hisar Cluster
		Sewing Machine Operator (Numbers Required)	Ludhiana- Panipat-Hisar Cluster
		Checker/Re-checker	Ludhiana- Panipat-Hisar Cluster
		Supervisors	Ludhiana- Panipat-Hisar Cluster

		Packer	Ludhiana- Panipat- Hisar Cluster
		Machine Operator Assistant	Tirupur Cluster
Automotive	Fitter; Welder; Electrician; Operator; Machinist; Machine Operator; Electrical & Electronics; Automobile Assembly; Die Maintenance; CNC Operator; Painter/Automized Spray booth painters; Automobile QC analyser; Injection moulding operator; Hand soldering; Assembly of head lamps; PU Shop operator; Robotic welder operator; Quality Inspector; PLC Member	CNC Operator: Knowledge of off set and setting basic Program	Delhi-NCR Cluster
		Automobile Assembly: C19Assembly operations requirement, highest level of quality and process reliability	Gujarat
		Automized Spray booth Painter: Vehicle body spray painting using robots/automation or manual application	Gujarat
		Auto QC Analyzer: Specialized QC for automobiles	Gujarat
		Injection Moulding Operator: Know-how of injection moulding process, material understanding	Delhi-NCR Cluster
		Hand Soldering: Know-how of handling PCBA and knowledge of hand soldering	Delhi-NCR Cluster
		Assembly of Head Lamps: Fitment of child parts via tools/ fixtures	Delhi-NCR Cluster
		Painters: Knowledge of paint chemistry and application, manual dexterity, skill on setup changes and part programming, end to end process knowledge	Pune Cluster
		Machinist: Knowledge of feedback devices like sensors, integration with HMI, PLC and changing trends in future technologies (Cobots, Robots, IIoT, etc.)	Pune Cluster
		Machinist: Understanding CNC program, tool, fixture setting, basic problem solving, handling, reading and setting measuring instruments, maintenance /fixture, fundamentals of mechanics & electricals	Delhi-NCR Cluster
			Chennai-Bengaluru-Hosur Cluster
		Welder: Manual dexterity in CO_2 welding	Delhi-NCR Cluster
			Delhi-NCR Cluster Mumbai-Pune- Aurangabad-Nashik

			Cluster
			Chittoor, Andhra Pradesh
		Forging Operator: Die setting, defect identification	Chennai-Bengaluru-Hosur Cluster
		Fitter	Delhi-NCR Cluster
		Electrician	Delhi-NCR Cluster
		Operator	Delhi-NCR Cluster
		Die Maintenance	Gujarat Cluster
		PU Shop Operator	Delhi-NCR Cluster
		Robotic Welder operator	Delhi-NCR Cluster
		Electrical & Electronics: Knowledge of feedback devices like sensors, integration with HMI, PLC and changing trends in future technologies (Cobots, Robots, IIoT, etc.)	Mumbai-Pune- Aurangabad-Nashik Cluster
			Chennai-Bengaluru-Hosur Cluster
			Delhi-NCR Cluster
		Quality Inspector: Handling, reading and setting measuring instruments	Chennai-Bengaluru-Hosur Cluster
		Maintenance/Fixture Technician	Chennai-Bengaluru-Hosur Cluster
			Delhi-NCR Cluster
		Machine Operator	Delhi-NCR Cluster
			Kolkata-Jamshedpur Cluster
		PLC Members	Delhi-NCR Cluster
		Carpenter- Precision and finishing Skills,	Chittoor, Andhra Pradesh
		Plumber	Chittoor, Andhra Pradesh
Electronics and Capital Goods	Painter & Polisher; Welder; Assembler; Technician; Machine	Fitter: Knowledge of tools operating	Delhi-NCR Cluster
		Carpenter: Accuracy, precision, manual dexterity	Delhi-NCR Cluster

	Operator; Fabricator; Supply & Logistics; Extruder operator; Fibre Technician; Fitter; Carpenter; Electrician; RAW Parts assemble Operator; Trouble Shooter; Wireman		Chittoor, Andhra Pradesh
		Extruder Operator: Tool selection, knowledge to process, parameter, temp. validation	Delhi-NCR Cluster
		Welder: Spotless welding, minimal defects, accuracy issues	Chittoor, Andhra Pradesh
			Chennai-Bengaluru-Hosur Cluster
		Electrician: knowledge of circuit diagram etc.	Delhi-NCR Cluster
		Wireman: Knowledge of schematic design	Chittoor, Andhra Pradesh
		Raw Parts Assemble Operator/ Assembler	Delhi-NCR Cluster
			Bangalore Cluster
		Machine Operator	Delhi-NCR Cluster, Vadodara-Rajkot Machine Tools Cluster
		Trouble Shooter	Chittoor, Andhra Pradesh
		Painter	Chennai-Bengaluru-Hosur Cluster
		Polisher	Chennai-Bengaluru-Hosur Cluster
		Fabricator	Chennai-Bengaluru-Hosur Cluster
		Technician	Vadodara-Rajkot Machine Tools Cluster
		Supply & Logistics	Vadodara-Rajkot Machine Tools Cluster
		Operations & Maintenance	Bangalore-Mysuru cluster
Pharmaceuticals	Maintenance Fitters; Electrical & Instrumentation technicians; Technician; Automated sequencing; Genome sequencing by NGS technology;	Maintenance Fitters: Knowledge and experience of pharma specific purpose equipment	Bengaluru
		Electrical & Instrumentation Technician: knowledge and experience needed on automation and digital solutions	Bengaluru
		Technician: Learning ability, specific technical job knowledge for pharmaceutical process	Gujarat

	Molecular Genetic Diagnostics; Bioinformatics outsourcing services	Automated sequencing: Adequate knowledge of machine maintenance being high end equipment	Delhi-NCR
		Genome Sequencing Technician: Adequate knowledge about latest software and techniques/databases	Delhi-NCR
		Molecular Genetics Diagnostics	Delhi-NCR
		Bio-informatics outsourcing operations	Delhi-NCR
Food Industry	Electrician; Mechanic; Machine Operator; Plumber; Fitter; Boiler Mechanic; Boiler Operator; Refrigeration Operator; Welder; Janitor; Production Operator; Mech. Technician; Chef; Oven Operator; Mixing Operator; Sweeper; Packager; Factory Helper; Baker; Sortex Foreman; Furnace Operator; Quality Analyst; Material Handler; Packaging & Products handling team	Electrician: Understand electronic set up including for latest equipment, safety norms and soft skills, time management, precision, accuracy, better technical skills to understand machine issues, lack in correct identification of critical problems, problem solving skills, communication, self-learning, exact resolution of problem, basic precautions; automation, self-learning	Agri-hubs, meat processing and baking centres of key agricultural states like Aligarh, Bahraich, Sambhal, Jhansi (UP) Sangli, Malegaon, Kolhapur, Mulund, Pune, Jalgaon, Nasik, Bhiwandi (Maharashtra); Raipur (Chhattisgarh); Modasa, Surat (Gujarat); Ludhiana (Punjab); Indore, Ujjain (MP)
		Mechanic: Able to understand, better communication and soft skills, basic maintenance is fine but serious issues have to be outsourced, soft skills, detailed knowledge, basic communication, precision, lack in accuracy	Agri-hubs, meat processing and baking centres of key agricultural states like Aligarh, Bahraich, Sambhal, Jhansi (UP) Sangli, Malegaon, Kolhapur, Mulund, Pune, Jalgaon, Nasik, Bhiwandi (Maharashtra); Raipur (Chhattisgarh); Modasa, Surat (Gujarat); Ludhiana (Punjab); Indore, Ujjain (MP)

		Machine Operator: Parameters checking, problem solving, concentration, detailing, soft skills, accuracy, communication, soft skills, time management, adequate understanding, work under pressure, soft skills, quick and accurate problem solving	Agri-hubs, meat processing and baking centres of key agricultural states like Aligarh, Bahraich, Sambhal, Jhansi (UP) Sangli, Malegaon, Kolhapur, Mulund, Pune, Jalgaon, Nasik, Bhiwandi (Maharashtra); Raipur (Chhattisgarh); Modasa, Surat (Gujarat); Ludhiana (Punjab); Indore, Ujjain (MP)
		Plumber: Decision making, accuracy, soft skills, waste/lean management	Meat processing centres around Aligarh, Bahraich, Sambhal, Jhansi (UP)
		Fitter: Soft skills, time management, accuracy, time management, not aware about different machine manuals, need to be trained on advance machines, communication, written skills, soft skills, time management, ability to work with functions which are technical with sensors	Dairy processing hubs around Sangli, Malegaon, Kolhapur, Mulund, Pune, Jalgaon, Nasik, Bhiwandi (Maharashtra); Modasa, Surat (Gujarat)
		Boiler Mechanic: Knowledge about sterilizer and other process machines, communication	Dairy processing hubs around Sangli, Malegaon, Kolhapur, Mulund, Pune, Jalgaon, Nasik, Bhiwandi (Maharashtra); Modasa, Surat (Gujarat)
		Boiler Operator: Soft skills, logbook maintenance, information about Indian Boiler Regulations, soft skills	Dairy processing hubs around Sangli, Malegaon, Kolhapur, Mulund, Pune, Jalgaon, Nasik, Bhiwandi (Maharashtra); Modasa, Surat (Gujarat)
		Refrigeration Operator: Upgradation in knowledge, communication, ability of self-initiative, communication, upgradation in knowledge, communication with suppliers	Dairy processing hubs around Sangli, Malegaon, Kolhapur, Mulund, Pune, Jalgaon, Nasik,

			Bhiwandi (Maharashtra); Modasa, Surat (Gujarat)
		Welder: Accuracy and approach towards work	Agro processing centres in UP, Tamil Nadu and Maharashtra including Bahraich, Dindigul, Kolhapur and Nashik
		Janitor: Communication and understanding importance	Meat processing centres around Aligarh, Bahraich, Sambhal, Jhansi (UP)
		Production Operator: Not well versed with sortex machine, poor communication, low accuracy	Rice Mill units in UP and Chhattisgarh including areas like Bahraich and Raipur
		Mech. Technician: Ability to identify fault, soft skills	Food processing units in Maharashtra and Gujarat including Nashik and Modasa
		Butcher: Time management, soft skills, documentation, safety norms, teamwork, communication, adaption to new technology, waste/lean management, accuracy, physical stamina, commitment	Meat processing centres around Aligarh, Bahraich, Sambhal, Jhansi (UP)
		Chef: Time management, team building	Sangli, Malegaon, Kolhapur, Mulund, Pune, Jalgaon, Nasik, Bhiwandi (Maharashtra)
		Mixing Operator: Ability to understand ingredients and recipes	Ludhiana (Punjab)
		Oven Operator: Precision, safety norms, soft skills	Sangli, Malegaon, Kolhapur, Mulund, Pune, Jalgaon, Nasik, Bhiwandi (Maharashtra)
		Packager: Ability to identify faulty product packaging	Ready to eat food processing units in Maharashtra, Gujarat and UP

		Baker: Curiosity and creativity	Agro processing and Baking centres around Sangli, Malegaon, Kolhapur, Mulund, Pune, Jalgaon, Nasik, Bhiwandi (Maharashtra)
		Material Handler: Right amount of ingredients usage in recipe	Agro processing and Baking centres around Sangli, Malegaon, Kolhapur, Mulund, Pune, Jalgaon, Nasik, Bhiwandi (Maharashtra)
		Quality Analyst: Sorting the products, accuracy	Agro processing and Baking centres around Sangli, Malegaon, Kolhapur, Mulund, Pune, Jalgaon, Nasik, Bhiwandi (Maharashtra)
		Furnace Operator: Communication, logbook maintenance	Agro processing and Baking centres around Sangli, Malegaon, Kolhapur, Mulund, Pune, Jalgaon, Nasik, Bhiwandi (Maharashtra)
		Sweeper: Physical stamina, commitment	Agri-hubs, meat processing and baking centres of key agricultural states like Aligarh, Bahraich, Sambhal, Jhansi (UP) Sangli, Malegaon, Kolhapur, Mulund, Pune, Jalgaon, Nasik, Bhiwandi (Maharashtra); Raipur (Chhattisgarh); Modasa, Surat (Gujarat); Ludhiana (Punjab); Indore, Ujjain (MP)
		Helper: Sorting the products according to their categories	Agri-hubs, meat processing and baking centres of key agricultural states like Aligarh, Bahraich, Sambhal, Jhansi (UP) Sangli, Malegaon, Kolhapur, Mulund,

			Pune, Jalgaon, Nasik, Bhiwandi (Maharashtra); Raipur (Chhattisgarh); Modasa, Surat (Gujarat); Ludhiana (Punjab); Indore, Ujjain (MP)
		Sortex Operator	Rice Mill units in UP and Chhattisgarh including areas like Bahraich and Raipur
		Foreman	Rice processing units around Agri-hubs of Uttar Pradesh
Rubber	Welder; Fitter; Electrician; Instrument Mechanic; Machinist; Boiler operator; Chiller operator; Aluminium Fabricator; Plumber; Wireman, Rubber moulding, Rubber Calendaring, extrusion, and Rubber mill mixing, Rubber moulding operator, Lathe Machine operator; Turner; Grinders & CNC; Mixers, Press Operator, Carpenter, Machine Operator; Injection Moulding, Machine Operator; Extrusion Machine Operator; Blow Moulding; Machine Operator;	Welder: Accuracy, precision, tool handling skills, specific knowledge to understand fabrication drawings, accuracy, precision, manual dexterity, knowledge of machine maintenance, etc.	Delhi-NCR Region
		Fitter: Overhauling skill, troubleshooting skill	Kerala
		Instrumentation Mechanic: Troubleshooting skill, electrical safety awareness, firefighting skill, energy saving skill	Kerala
		Machinist: Troubleshooting skill, Automation skill	Kerala
		Chiller Operator: Troubleshooting skill, Process control skill;	Kerala
		Plumber: Tool Handling skills, troubleshooting skill;	Kerala
		Wireman: Electrical systems & equipment handling skill	Kerala
		Boiler Operator: Maintenance skill, Tools handling skill;	Kerala
		Aluminium Fabricator: Troubleshooting skill, Process control skill; accuracy	Kerala
		Rubber moulding, Rubber Calendaring, extrusion, and Rubber mill mixing: Accuracy, precision, knowledge of machine maintenance, etc.	Pune-Mumbai Region
		Mixer: Insufficient knowledge of the process and knowledge of Machine maintenance	Pune-Mumbai Region

		Lathe Machine Operator: Operation is not on efficiency on time scale	Pune-Mumbai Region
		Turner: Accuracy, precision, knowledge of machine maintenance etc.	Pune-Mumbai Region
		Press Operator: He should have knowledge about machine operating system and should know how to give production.	Delhi-NCR Region
		Electrician: Troubleshooting skill, electrical safety awareness, fire-fighting skill, energy saving skill	Kerala
		Housekeeping	Pune-Mumbai Region
		Grinder	Pune-Mumbai Region
		CNC operator	Pune-Mumbai Region
		Carpenter	Delhi-NCR Region
		Machine Operator	Delhi-NCR Region
		Injection Moulding	Delhi-NCR Region
		Blow Moulding	Delhi-NCR Region
		Machine Operator Plastic Sacks	Delhi-NCR Region
		Extrusion	Delhi-NCR Region
Iron & Steel	HT cable jointer; Belt Jointing; CNC Machine Operators; Heavy Equipment Operators; EOT Crane Operators; Hydraulic & Pneumatic Systems Operators; Workmen for various trades including maintenance, safety & problem solving	HT Cable Jointer: Skill of jointing HT cables	Specific to plant locations in AP and Odisha
		Conveyor Belt Jointer: Skill of belt jointing	
		Heavy Equipment Operators: Skill of operating heavy equipment like dumpers, dozers, etc.	
		EOT Crane Operators: Skill of operating EOT cranes of various capacities in major production units	
		Workmen for different trades including plant operations, safety, mechanical maintenance, mills operations etc.	

Leather	Stitching Operator; Toe Lasting operator; Supervisor/Asst. Supervisor; Skivers; Checking (inspection); Shoe upper passer; Cutter component passer; Cutting operator; Soldering; Folding & Attaching; Pre Assembly	Stitching & Cutting Operator: Multi-skill training is required to undertake the tasks of cutting, stitching, checking, folding, attaching, skiving, soldering etc. Other relevant roles include Toe Lasting Operator, Shoe upper passer, Cutter component passer; pre-assembly skills, soldering skills etc.	Chennai-Vellore Cluster
		Supervisors, Assistant Supervisor	Chennai-Vellore Clusters
		Skiver	Chennai-Vellore Clusters
		Toe Lasting Machine Operator	Chennai-Vellore Clusters
		Helpers	Chennai-Vellore Clusters

Beyond the inferences drawn from the enterprise survey, a secondary analysis of key clusters for the identified manufacturing segments indicates the following:

Table 15: Key manufacturing Zones in India

Segment	Key Manufacturing Zones
Textiles, Apparels	Ludhiana, Panipat (North for woollens); Ahmedabad, Surat, Mumbai, Surat, Vadodara (West for cotton); Kolkata, parts of Bihar & UP (East for Jute and cotton); Tirupur, Coimbatore, Madurai (South for hosiery); Bengaluru, Mysuru, Chennai (South for Silk), Bhilwara (Rajasthan)
Automotive	Delhi NCR region; Mumbai-Pune-Nashik-Aurangabad region; Kolkata-Jamshedpur region; Chennai-Bangalore-Hosur region
Rubber	North (Punjab, UP, Haryana and Delhi NCR), South (Kerala, Karnataka, Tamil Nadu), West (Maharashtra, Gujarat, Rajasthan) and East (West Bengal, Jharkhand) and some states of North Eastern region
Leather[10]	Chennai, Ambur, Ranipet, Vaniyambadi, Vellore, Pernambut, Trichy, Dindigul and Erode (Tamil Nadu); Kolkata (West Bengal); Kanpur, Agra, Noida, Saharanpur (UP); Mumbai (Maharashtra); Jalandhar (Punjab); Bengaluru (Karnataka); Telangana Hyderabad; Ambala,

[10]Source: Invest India

	Gurgaon, Panchkula, Karnal, Faridabad (Haryana); Delhi; Dewas (MP); Kozhikode and Cochin (Kerala); Rajasthan; Jaipur; Srinagar (J&K)
Pharmaceuticals	Pharmaceuticals Manufacturing has diversified pan India over time. Leading areas include Baddi, Himachal Pradesh; Hyderabad, Rajamundry, Andhra Pradesh; Dholka, Gujarat; Mumbai, Tarapur, Maharashtra; Guwahati, Assam; Mandideep, Indore, MP; Bangalore, Karnataka
Electronics	Delhi NCR (North); Bengaluru, Hyderabad, SriCity, Tirupati, Mysuru, Sriperumbudur, Chennai (South); Pune (West)
Capital Goods	Diversified base pan India. Key centres include MMR region, Pune, Aurangabad (Maharashtra); Patiala (Punjab), Jajpur (Odisha); Jaipur (Rajasthan); Kanpur (UP); Erode, Vellore, Coimbatore, Kanchipuram (Tamil Nadu); Vadodara (Gujarat), Belagavi (Karnataka)

In addition to the technical skills identified in Table 14 above, firms have also identified certain soft skills which are currently inadequate including discipline; ability to work as a team; basic problem solving skills; ability to read and comprehend; and learning ability. The geographical alignment is based on location of firms reporting skill gaps on the shop floor.

Quantitative Constraints

Besides the technical skill-sets identified by firms, labour market constraints have also been reported for acquiring skilled workers for certain roles. The occupations where supply of skilled TVET candidates as indicated by employers in a quantitative interviewed to be insufficient are listed in Table 16.

Table 16: Key Occupations where supply is a constraint

Segment	Key Occupations where supply of workers is a constraint
Apparel & Textiles	• Weavers; • DCS operators; • Ring frame operators; • Operators with woven made-ups product knowledge;
Automotive	• Machinist; • Automobile Assembly; • Die Maintenance;

	• Automized Spray-booth painters; • Automobile QC analyser; • Injection Moulding Operator; • Metalizing Machine Operator; • Painters; • Welders
Food Processing	• Food Technologist; • Geographical skew (supply of skilled labour in rural areas); • Quality & Safety norms
Leather	• Line Supervisor; • Multi Skilled Operator; • Cutting Trainer
Electronics & Capital Goods	• Extruder operator; • Fibre Technician; • Machine Fitter
Rubber	• Mixing Operators; • Injection moulding; • Machine Operators; • Workmen trained in rubber specific processes; • Grinders and Skilled Turners
Iron & Steel	• Conveyor Belt Operations & Maintenance; • CNC Machine Operators; • Heavy Equipment (Dumpers, Dozers) Operators; • EOT (Electric Overhead Travelling) Crane Operators; • Hydraulic & Pneumatic Systems Operators; • Plant Operations; • Steel plant safety, mechanical maintenance, mills operations
Lifesciences	• Machine Operators; • Handling Reactors; • Injectable technicians; • Technicians to support Biotechnology R&D, molecular genetics diagnostics, lab work etc.

6.12 How Firms want to meet their Skilled Worker Demand in Order of Importance

The preference of firms to meet their demand for skilled workers varies widely among the manufacturing segments.

- Re-skilling and Up-skilling is the most preferred mode to satisfy the demand for skilled workers. 4 out of the 8 segments have indicated 'Re-skilling and Up-skilling of existing workforce' as the most preferred mode to meet the need including Iron & Steel, Rubber, Leather and Apparel/Textiles. This highlights the significance of OJT and in-company training for the enterprises and the skill ecosystem.

- At an aggregate level, hiring from ITIs and short term training programs emerges as the second most preferred option overall among various manufacturing segments.

- The needs of the Food Processing, Automotive and Electronics & Capital Goods segment are better suited to pass-outs with short term training certificates over other options reflecting the better alignment of these Qualifications with sector requirements.

- The Leather segment rated hiring from ITIs in the least preferred category. The limited value addition in the Leather segment is apparently the main reason for them not to seek specialized skill sets. (Table 16).

Table 17: Preferred way to meet skill workers' demand

Segment	Most Preferred way to meet skill workers' demand	Least Preferred way to meet skill workers' demand
Apparel Textiles	Re-skill & Up-skill existing workers	Hire candidates with short term training certifications
Automotive	Hire candidates with short term training certifications	Hire fresh ITI Graduates Hire experienced skilled workers from market
Food Processing	Hire candidates with short term training certifications	Hire un-skilled workers who would be trained 'on-the-job'
Heavy Metals/ Iron and Steel	Re-skill & Up-skill existing workers	Hire experienced skilled workers from market
Leather	Re-skill & Up-skill existing workers	Hire fresh ITI Graduates
Lifesciences	Hire un-skilled workers who would be trained 'on-the-job'	Hire experienced skilled workers from market
Rubber	Re-skill & Up-skill existing workers	Hire candidates with short term training certifications
Electronics & Capital Goods	Hire candidates with short term training certifications	Hire experienced skilled workers from market

7. Trends in Future Demand for Skilled Workforce in the Manufacturing Sub-Sectors

Subjective responses from firms and focused interviews with industry associations have been collated to derive trends in future skill requirements of the various manufacturing sub-sectors. This exercise could in principle be adapted to produce quantitative estimates of future demand for skills by occupation once time series data on historical skill demand could be collected and analysed. However, growth in manufacturing output and employment has been volatile over the last two decades due to a variety of factors including rapid integration of technology in production processes. Based on the responses, the following inferences emerge:

Common Inferences:

- There is a strong inclination among employers consulted to build a skilled workforce for the future which has digital capabilities and can work in automated facilities. Firms clearly envisage that their production process would be more automated and with increased use of robots and digital technologies. Larger firms are gearing up towards application of AI and Internet of Things in production processes.
- Skill-sets of basic data management, computer literacy and handling digital machines shall be required.
- Another common striking feature across sectors is that firms feel that their stock of low skilled workers would reduce over time. All employees would therefore have exposure to skill development. Continuous up-skilling and lifelong learning shall be the key to sustain competitiveness.

Sector specific Inferences:

- **Food Processing:** As firms in the Food processing sector expand into export markets, they shall enhance skill intensity in the production and post-production activities including product handling, quality checking and packaging which is critical for maintaining quality and regulatory compliance.

- **Shared Training:** firms from the MSME segment in sectors like Food Processing, Rubber and Leather segments are looking for cluster/area based sharing of training resources which may be anchored by their respective associations and supported by local government resources.

- **Automotive**: OEMs among the automotive sector are looking for enhanced computer, mechatronics and robotics skills among skilled workers who can then work in IoT/connected factories. Skills about automotive production processes also need to be enhanced.

- **Life Sciences**: The life sciences segment requires better technology oriented skilled workers who can assist in research activities, bio-informatics, lab technicians, instrumentation technicians and IT backed data management.

7.1 Factors Affecting Future Demand for Skills

The future demand for skilled workers is strongly related to strategic priorities of various manufacturing segments. Attempt has been made to classify priorities on five broad themes:

- **Lowering Cost** of production to sustain competitive position
- Achieve **higher productivity** and efficiency
- Focus on launching **new products** (product/stream innovation)
- Access **new export markets** by improving quality
- Invest in **Digital technologies** and value capture in global value chains

Table 18: Relative Importance ascribed to various strategic directions for enterprises across sectors (higher ranks indicating greater focus)

Strategic Priorities/ Segment-	Apparel Textiles	Automotive	Electronics & Cap Goods	Food Processing	Iron and Steel	Leather	Lifesciences	Rubber
Lowering cost of products	3.9	4.1	1.3	3.2	1.9	3.9	3.7	2.8
Achieving higher productivity & efficiency	4.6	4.1	3.7	3.9	1.1	3.5	2.3	3.7
Focused on launching new products	3.8	4.0	3.7	3.0	4.9	4.1	3.3	3.0
Improving quality of products to access new export markets	4.0	4.4	4.3	2.1	3.0	2.5	3.7	3.3
Digital technologies & value capture in GVCs	4.0	4.0	3.7	2.8	4.1	1.4	2.0	3.0

Note: The figures in the table above are the average of the responses from surveyed enterprises in the respective segments on a scale of 1 to 5

The relative strategic priorities of sectors are varied and the following inferences can be drawn:

- Firms consulted in the Automotive, Electronics & Capital Goods and Lifesciences segments have placed highest strategic focus on penetrating existing or accessing new export markets. Towards that, they are enhancing the quality of their products to successfully compete with global suppliers.
- Segments of Apparel/Textiles, Food Processing and Rubber are at a stage where they feel that there is significant scope of improving productivity and efficiency and are positioning their enterprises as such.
- The Iron & Steel and Leather segments have focused their energies on launching new products which can add greater competitiveness and profitability to their commoditised businesses.

- The automotive sector is a significant outlier in its parallel pursuit of all key strategies viz. exports, productivity, cost, digitization and quality of products.
- The Life sciences segment is focused on fixing the twin engines of cost and quality as they are scattered across the value chain for commoditised products (like APIs) and speciality/bio-similar, etc. for accessing lucrative export markets.

1. **Level of informality and contractual manpower:** High incidence of informality in the workforce is a significant barrier to higher investment into skill development and overall human capital development.

   - Where workers are employed temporarily on contracts, employers do not have strong incentives to invest in their skills.
   - There is a challenge of very high use of contract labour in the apparel/textile segment and therefore investments into skill development are low.
   - The extent of contractualisation of human resources has increased over the years and it increases progressively as we move down the lower tiers of suppliers. For the automotive segment, for instance, it is estimated that over the last 5 years, the level of contract labour as a share of total manpower employed has more than doubled and is estimated to be close to 75-80% of the total. This trend has also been boosted by the covid-19 induced disruption and firms have resorted to higher level of contractualisation during the pandemic period to protect profitability and market share to compensate for loss of business during the lockdown period.
   - Within various geographies, the trend of contract labour is more acute in the northern automotive clusters followed by West and South. Increasing contract labour has also implied negligible investment into skills and HR.

2. **Employment benefits:** In addition to skill development, other employment benefits like provision of community housing/dormitories for the employee and his/her family can be a productivity driver for various industries which are more labour intensive.

3. **R&D** has been identified as a significant challenge across the manufacturing segments. Beyond a few large corporates with scale and deep pockets, there is low investment into R&D for newer techniques and products. Among the survey group, 36% firms reported having a registered R&D unit/facility either with the DST/DBT or other Government authority. Most of the medium and small units are currently at the stage of incremental efforts to maintain quality and enhance effectiveness of the production process and do not have dedicated R&D facilities.

   - In spite of global competitiveness of India's Automotive sector, it has not increased R&D spend significantly. The R&D expenditure for the OEM space ranges between 0.7-0.8% and that of the component sector is ~0.5% of the turnover. This is as compared to leading automobile hubs like Germany, Japan, South Korea and US which spend 5-7% of their turnovers on R&D. The segment, therefore, remains at the stage wherein it adapts and adopts technological inputs and products for the Indian market instead of creating IPs and new technologies. Of late, however, a number of global giants like BMW, Hyundai, etc.

have set-up design centers in India to benefit from the engineering and design capabilities present in the country. The sector is warming up to E-mobility investments encouraged by a financial incentives announced by the Government.

- Pharmaceuticals sector is the most R&D intensive segment followed by the Rubber and Food segments. There is lower focus for R&D among the Leather and Apparel & Textiles segment. None of the study group firms in the Leather segment reported any R&D facility at their premises.

- Among Textiles, Technical textiles as a sub-segment is dependent on developing customized and niche products and require constant product and process innovation to sustain growth and competitiveness. In addition, testing facilities for global quality and standards is inadequate in the country and companies have to share samples to overseas labs for the same. The technical textile sector is one of the fastest growing segment among textiles and is expected to reach to USD40 billion in 2023-24, increasing at a CAGR of 16.05% over 2018-19. It accounts for ~13% of India's total textile and apparel market.[11]

4. Sector Specific Conditions

a. Textiles/Technical Textiles

Textile centric courses are being rolled out through the ITIs (1-2 year diploma courses) and training providers under various short term training programs administered by MSDE or the Textiles Ministry. However, the segment feels that bulk of the skill requirement is still being met through on-the-job training and company specific efforts. There is scope for more standardized courses for the weaving, spinning and processing segments.

High level of skills in design and value addition are in adequate supply and quality courtesy several design institutes in the public and private sector including the National Institute of Design. The extreme cost competition in the domestic and external market impedes investing in greater absorption of such talent in the enterprises, hindering their ability to upgrade and innovate.

In addition to extreme cost sensitiveness, low aspiration value for textile sector blue collar jobs is another impediment for skill development. High cost competition drives down the wage level in this segment. Also, relatively difficult working conditions contribute to a lower aspirational value. Attrition level in the entry level jobs is as high as 50%, which reduces to a great extent from supervisor level onwards.

In general, attaining a wage premium through high value products is apparently the breakthrough point for unleashing greater skill investments in the sector. Until a new equilibrium is achieved, the segment shall largely depend upon government sponsored training programs and brief on-the-job interventions.

[11]Source: Indian Technical Textiles Association

Technical Textiles: From a skilling perspective, there are three addressable sub-segments where interventions can be made at reasonable scale:

- **Non-woven**: The skills hierarchy in the segment can be classified as the following:

    - Shop floor staff (Machine Operators, Maintenance Staff and Supervisors);
    - Quality Control & Ancillary production services; and
    - Middle Management (responsible for overall production, quality, productivity and standards).

To address the needs of the first two levels, tie-ups with ITIs for specific and special curriculums can be made to satisfy the specific needs of the segment. 3-4 technologies can be clubbed together to build critical mass for such training programs. To provide practical training, specific pilot plants can be used as a common resource along with industrial visits.

- **Composites**: it is expected to be a future growth area and skill-sets have to be determined for this segment.

- **Coating and Lamination**: within this sub-segment, skilling can be undertaken at the following occupations:

    - **Chemical Mixing (Formulations)**: this is a critical process where there is no formal skill/education program. It can add a lot of value to the production process. Basic education required herein is a B. Sc. With Chemistry specialization. The starting salary of such personnel is 25-30k and their career growth path is steep due to indispensability of such personnel to the organization.
    - **Fabric inspection**: generic skill which is multi-disciplinary
    - **Coating Skill-set**
    - **Curing/Stenter Handling**: this skill-set is also multi-disciplinary in nature and can cater to needs of other textile segments

    Overall, targeted Chemistry or Polyester Technology Programs have the biggest potential for value addition in the sector. The candidates coming out of the VET programs- ITI and short term training are not commanding value from technical textile enterprises. They are of immense value for generic segments like spinning and weaving but are not valued highly in the core technical textile applications. For the middle management level, the segment is dependent on Degree/Diploma holders in Textiles mostly from HEIs and dedicated textile training institutions. However, skill-sets of such personnel are less than satisfactory in general and they undergo 3-6 months on the job training to be able to do justice to their roles.

b. **Automotive Sector:**

In spite of the sector being one of India's export competitive sectors, it is faced with structural challenges in making the leap to the next level of its growth and development:

- **External Competition:** There is increasing competition in the immediate region, especially from China, which has attained a huge scale and size (auto-component sector is 11x India's) and by virtue of that commands cost competitiveness in the global market. It has also followed a model wherein foreign technology has been internalized through forced JVs, a lax IP protection system and its overall model of development. However, Indian suppliers in general command better trust and credibility as global suppliers.

- **Doing Business:** In spite of the progress made in EoDB rankings, there still appear to be constraints toward competitiveness by way of high cost involved in land and logistics. Some amount of rationalization of the existing regulatory compliances and documentation, and addressing inter-State variance would, according to the industry, spur greater investment.

c. **Consumer Electronics:**

- There is no supply constraint for qualified white collar workers. For blue collar jobs, the job profiles are broadly divided into manufacturing and retailing and service of finished products. A large chunk of manufacturing manpower is temporary workforce employed for seasonal/festive spikes in demand. The segment undertakes a host of in-house training programs to prepare people for customized and company specific design and technologies. For most of the generic trades, the Electronics Sector Skills Council (ESSC) has developed course curriculums and qualifications under various STT programs. There is scope for tie-ups with ITIs to develop specific course curricula/modules to address any specific gaps in skilled personnel so that industry -ready workforce can be created.

  The envisaged growth of the component ecosystem driven by production linked incentives has been identified as the big driver of employment in the sector. ACs has been identified as the champion sub-segment due to a variety of drivers. In addition, labour cost is steadily emerging as a cost arbitrage for the domestic industry as costs are moving up in other competing geographies like China.

8. Conclusion and Recommendations

There is a need for differentiated and granular approach towards skill development efforts. The needs and challenges in skill development vary across manufacturing segments.

8.1 Macro factors Impacting Skill Development at Enterprise Level

- Firm size and its relative state of maturity in the organized sector is a major determinant of skill development and overall human capital investment. Smaller firms especially in lower value addition segments of manufacturing are hard pressed to derive productivity from all available resources and skill development does not figure among high priorities.

- The extent of contractualization of human resources has increased over the years and it increases progressively as we move down the lower tiers of suppliers. For the automotive sector, for instance, it is estimated that over the last 5 years, the level of contractual labour as a share of total manpower employed has more than doubled and is estimated to be close to 75-80% of the total. This trend has also been boosted by the covid-19 induced disruption and firms may have resorted to higher level of contractualization during the pandemic period to protect profitability and market share to compensate for loss of business during the lockdown period.

8.2 Relevance for Current/New Government Programs

- The relevance of Government supported skill programs is differentiated for various manufacturing segments. There is a need to understand the skill needs and gaps at the sectoral level while formulating implementation strategies of Government sponsored skill schemes.

- The mid and small firms in labour intensive sectors are looking for a ready pool of skilled workers who can be readily deployed in production. Larger, specialized and capex heavy firms are ready to spend on skill development. The scope of collaboration for larger firms with relevant skill development institutions includes co-creation of curriculums and greater exposure to practical training.

- The skill gaps identified for specific job roles may be suitably addressed through suitable changes in existing curriculums/training/pedagogy, etc.

- The identified occupations where there are perceptible constraints in supply may be prioritized in current/future skill programs including *Pradhan Mantri Kaushal Vikas Yojana* (PMKVY).

- **Re-skilling/up-skilling**: Since enterprises in general prefer re-skilling/up-skilling as the most preferred mode to meet the demand of skilled workers, Government supported skill programs may need to adequately focus on re-skilling/up-skilling, in addition to fresh training. There is also a need for an incentive mechanism targeted at small and medium firms to

take up re-skilling/up-skilling of their workforce. The concept of lifelong learning among enterprises needs to be encouraged through innovative policy propositions.

- **Supply of VET pass-outs**: The supply of VET certified pass-outs is considered adequate by enterprises. There is no apparent lack of availability of training institutions except for some rural-urban skew seen in Food Processing and Rubber segments. There is a scope for greater availability of food industry relevant candidates in rural areas as many of the firms are located in rural areas, close to their sources of raw materials. Also, there is scope of more skilled candidates in 'biosciences' segment.

- **Granular Approach to Apprenticeships**: The definition and duration of apprenticeship programs as defined under the Apprenticeship Act 1961 and Rules framed thereafter is not strictly adhered to except by firms which have enrolled under the NAPS scheme. The structure, duration and profile of Apprenticeships pursued across sectors are hugely variable.

  There is a need to provide sector specific norms and flexibility in Apprenticeship rules and compliances. This is needed to increase adherence to laid down norms. For instance, Apprenticeship duration cannot be similar for the Leather and Iron & Steel segments. Even within sectors, norms may differ for various roles and applications. The relative relevance of Apprentices for labour intensive and low value added segments needs to be differentiated vis-à-vis other asset heavy segments and incentives have to be re-designed. A detailed review of the program is warranted with 'economic impact' vis-à-vis costs involved.

- **Adherence to Apprenticeship Norms**: There are instances where distinction between a worker and an apprentice is not apparent and a labour cost arbitrage may be at play. Re-drawing the norms basis sector and size of firms could build credibility of Apprentices for both candidates and employers.

- **Qualifications and Standards**: The general awareness about NSQF certifications is low among employers. There is a need to build more employer-led demand for NSQF aligned certifications through a mix of demand and supply side incentives. On the demand side, norms which encourage recruitment of certified people may be developed. On the supply front, the credibility of NSQF certifications may need to be enhanced. It is expected that the new skills regulator- NCVET - shall progressively build the status and credibility of Qualifications through a robust Quality Assurance Framework for the ecosystem and also look at better linkages of the NSQF approved courses with the National Classification of Occupations (NCO) which in term looks at global (ISCO) alignment.

- **Relevance of ITI System:** There is high level of fitment and absorption of certain standard ITI roles reflected by 85% of the people at the Supervisory level having ITI/Diploma Qualification. Standard trades of Electrician, Machine Operator; Mechanical Technician; Fitter and Machinist from the ITI system are in high demand in the manufacturing sector.

- **Experience with ITI pass-outs**: 68.5% of the enterprises are satisfied with ITI pass-outs and feel that they are generally doing better compared to other entry level workers. The key reasons cited for the same were better technical knowledge; and better ability to pick the technicalities of the job. However, there is significant scope of improving practical training/ exposure to latest technologies being used especially for the Rubber, Iron & Steel, Lifesciences, Automotive and Textiles segment.

- **Qualification Profile of Workers on Shop-Floor:** There is inadequate focus among the identified manufacturing segments on understanding and identification of qualification profile of workers on the shop floor. This is due a multitude of factors including easy replenishment for semi-skilled/un-skilled manpower from the labour market. There is a high proportion of low skilled/un-skilled workers as Plumbers; Maintenance Staff; Housekeeping; Helpers; Technician Assistants; Mechanics; Butchers; Turners; and Leather sector activities (skiving, cutting, stitching).

- **Experience about Short Term Training Pass-outs**: The most striking experience of firms about workers with a Short Term Training certification is their ability to learn/re-skill on the job and better attitude and orientation towards the tasks compared to unskilled candidates. The relevance of Short Term Training is highly varied across segments. Relevance of STT is high for segments like Food Processing, Leather and Apparel & Textiles. It appears that the relative alignment of short term job roles is better for segments like Food Processing, Leather, Apparel and Automotive segments compared to the others. However, segments like Lifesciences have low exposure to skilled workers with short term certifications since entry is at sufficiently higher levels.

8.3 Micro Level Factors in Skill Development

- **Barriers to Skill Development**: Lack of practical training/exposure to latest available equipment and technology has been cited as the biggest hindrance to skill development. The quality of practical training in the skill ecosystem needs to be reviewed. For labour intensive and less value addition segments, cost and opportunity loss is the biggest hindrance for skill development.

- **Unattended Segments:** There may be a need to develop industry mechanism to understand the skill needs of the Chemicals sector which is only sparsely represented in the current SSC mechanism. 'Chemicals and Chemical Products' had displayed around 9% annual growth during the period 2000-01 and 2016-17 and is one of the largest contributors to manufacturing GVA.

- The requirement of skilled workers for the technology intensive sectors like Lifesciences segment is largely not met by the current skill ecosystem since the entry level requirements

are higher. Identification of relevant roles for the roles and review of existing roles may be undertaken for both the short and long forms of training.

- **Skill Intensity**: The skills intensity varies across manufacturing segments. The Iron and Steel segment is the most skill intensive segment with 88% employees as 'skilled workers' or production level employees followed by Apparel & Textiles (73.0%); Electronics & Capital Goods (67.2%) and Automotive segment (57.2%). The skills intensity is lowest for the Lifesciences sector at 29.8% signifying higher level education threshold for entry level workforce in the segment. The proportion of un-skilled/low skilled workers is high in the Leather segment (47%) and the Food Processing segment (37.8%).

- **In-house Training:** Across all sub-sectors, on-the-job training accounts for the single most important mode of training the workforce. However, the duration of in-house training is different for various segments. The median duration is 90 days for firms providing in-house training in the Apparel and Textiles segment. The Iron and Steel segment is an outlier in terms of duration of in-house training, wherein training is being provided for 6 months to one year.

8.4 Emerging Trends

- **Movement towards Digital Capabilities**: There is a strong inclination to build skilled workforce for the future which has digital capabilities and can work in automated facilities. Firms clearly envisage that their production process would be more automated and application of robots and digital technologies shall increase. Larger firms are gearing up towards application of AI and IoT in production processes. Skill-sets of basic data management, computer literacy and handling digital machines shall be necessarily required in the workforce at the shop-floor.

- Another common striking feature across sectors is that firms feel that their stock of low skilled workers would reduce over time. All employees would therefore have exposure to skill development. Continuous up-skilling and lifelong learning shall be the key to sustain competitiveness.

- **Strategic Priorities:** The strategic priorities vary across sectors. The Automotive, Electronics& Capital Goods and Lifesciences segments have placed highest strategic focus on penetrating existing or accessing new export markets. Towards that, they are enhancing the quality of their products to successfully compete with global suppliers. On the other hand, segments of Apparel/Textiles, Food Processing and Rubber are at a stage where they feel that there is significant scope of improving productivity and efficiency and are positioning their enterprises as such.

Limitations:

The key limitations for a study on skill assessment and anticipation are the following:

- Unlike most developed countries, India does not have formal aggregate employment projections at the level of the economy, sector and occupations. While the enterprise survey sample of 100 enterprises has been picked to be a representative of sector trends across geographies, it cannot be a substitute for aggregate data availability.
- Non-availability of time-series data for youth capturing employability, career paths and education/skills also pose a challenge.
- Institutional capacity in data collation, enterprise surveys and quantitative techniques is also somewhat limited.

8.5 Way Forward

While the study presents a detailed assessment and anticipation of skill development metrics for identified manufacturing segments, there is scope to undertake a further deep dive into region/cluster and state specific trends. In principle, the findings can also be quantified with long term time series data which is currently unavailable. Modelling with a combination of qualitative and quantitative data is expected to improve the insights presented in the report. There are a number of ways to take this exercise forward:

- **Horizontal Linkages:** there is a scope to extend the study to various emerging 'service' sectors to undertake a similar assessment and anticipation exercise. Also, the job roles accompanying the identified occupations can be studied further to unearth those which are not currently not covered by approved Qualification Packs.

- **Externalities to Skill Development:** A number of external factors including adequate monetary compensation, working conditions, availability of community housing and migration patterns among others might be affecting skill development efforts. These may be researched in a separate study.

- **Geographical Deep Dive**: While some geographical alignment of the identified skill gaps has been undertaken, there is scope of undertaking state/district level mapping of gaps, shortages and mismatches.

9. List of Definitions

1. **Apprentice:** Apprentice means a person who is undergoing apprenticeship training in pursuance of a contract of apprenticeship as stipulated under Apprentices act 1961. Period of apprenticeship training varies according to the designated trade. It is usually 6 month to 3 years but could last up to 4 years in a few trades.

2. **Apprenticeship Contract**: The Apprenticeship contract is an employment contract between an employer and a young person to undertake a course of training in any industry or establishment undergone in pursuance of prescribed terms and conditions under the Apprentices Act 1961.

3. ***Aatma Nirbhar Bharat Abhiyaan:*** *Aatma Nirbhar Bharat Abhiyaan* or Self-reliant India movement is the vision of new India envisaged by the Hon'ble Prime Minister Shri Narendra Modi. It signifies a shift in socio-economic policy focused on making India self-reliant in production and makes it a hub for global manufacturing and undertakes second generation of governance and administrative reforms. The five pillars of *Aatma Nirbhar Bharat* are – Economy, Infrastructure, System, Vibrant Demography and Demand.

4. **Common Norms:** Common Norms specify the input standards, outcomes, funding norms, fund flow mechanism, mechanism for monitoring & tracking, and empanelment of training providers & assessors. They were notified in August 2015 by Ministry of Skill Development and Entrepreneurship.

5. **Craftsmen Training Scheme (CTS)**: is a six months to two years training program undertaken by Directorate General of Training (DGT) under the aegis of the Ministry of Skill Development and Entrepreneurship. Prerequisites for the courses range from 8^{th} to 12^{th} class pass. Upon completion of the training, trainees write the All India Trade Test (AITT). Successful candidates receive the National Trade Certificate (NTC).

6. **Designated Trade**: "Designated trade" means any trade or occupation or any subject field in engineering or non-engineering or technology or any vocational course which the Central Government, after consultation with the Central Apprenticeship Council, may, by notification in the Official Gazette, specify as a designated trade for the purposes of Apprenticeship Act 1961.

7. **Directorate General of Training**: DGT is an arm of the Ministry of Skill Development and Entrepreneurship and is the apex organisation for development and co-ordination of long term vocational training. It functions through a network of around 15,000 Industrial Training Institutes (ITIs), 33 National Skills Training Institutes (NSTIs)/ National Skills Training Institutes for Women (NSTI-W) and other central institutes.

8. **Global Value Chain**: GVC is usually defined as the full range of activities (design, production, marketing, distribution and support to the final consumer, etc.) that are divided

among multiple firms and workers across geographic spaces to bring a product from its conception to its end use and beyond.

9. **Industrial Training Institutes**: Industrial Training Institutes (ITIs) are post-secondary schools in India constituted under Directorate General of Training (DGT), Ministry of Skill Development and Entrepreneurship to provide vocational training in various trades.

10. **Long Term Training**: The MSDE ecosystem refers 'Long term Training' to trainings that are undertaken under the aegis of Directorate General of Training (DGT). Normally such trainings are of duration 6 months to 2 years.

11. **Make in India (MII)**: MII is an initiative by the Government of India to encourage companies to manufacture in India and incentivize dedicated investments into manufacturing. The initiative targeted 25 economic sectors for job creation and skill enhancement and aimed "to transform India into a global design and manufacturing hub".

12. **Ministry of Skill Development and Entrepreneurship** (MSDE): MSDE is the administrative Ministry of Government of India set up on 9 November 2014 to coordinate all skill development efforts across the country.

13. **National Apprenticeship Promotion Scheme (NAPS):** NAPS was launched by the Government in August 2016. The scheme entails financial support to establishments undertaking apprenticeship programs for 'Designated' and 'Optional' trades and is administered through the Ministry of Skill Development and Entrepreneurship.

14. **National Apprenticeship Training Scheme (NATS)**: NATS is a one year programme equipping technically qualified youth under higher education with practical knowledge and skills required in their field of work. The Apprentices are imparted training by the organizations at their place of work. During the period of apprenticeship, the apprentices are paid a stipend amount, 50% of which is reimbursable to the employer from the Government. At the end of the training period, the apprentices are issued a Certificate of Proficiency by Government of India which can be registered at all employment exchanges across India as valid employment experience.

15. **National Council of Vocational Education and Training:** NCVET, notified on December 5, 2018 has been set up as an overarching VET regulator establishing regulations and standards to ensure quality in the TVET space, subsuming the responsibilities of National Skill Development Agency (NSDA) and the erstwhile National Council of Vocational Training (NCVT).

16. **National Industrial Classification Code (NIC Code)**: The "NIC Code" is a statistical standard for developing and maintaining a comparable database for various economic activities. This code has been developed with an intent to ascertain and analyse how each economic activity is contributing towards national wealth.

17. **National Classification of Occupations (NCO):** NCO is a classification of occupations which describes and assigns codes to the various occupations and aligns it with the ISCO. The Directorate General of Employment, Ministry of Labour & Employment is responsible for maintaining and updating the NCO.

18. **National Occupational Standards (NOS)**: NOS specify the standard of performance an individual must achieve when carrying out a function in the workplace, together with the knowledge and understanding they need to meet a standard consistently. The NOS are industry aligned through the mechanism of Sector Skill Councils.

19. **National Skill Development Corporation:** NSDC is a not-for-profit public limited company incorporated on July 31, 2008 under section 25 of the Companies Act, 1956 (corresponding to section 8 of the Companies Act, 2013). NSDC has the mandate to enable and support the skill eco-system by catalysing creation of large, quality and for-profit vocational institutions, ensuring quality assurance, information systems and train the trainer academies either directly or through partnerships.

20. **National Skills Qualification Framework:** The National Skills Qualification Framework (NSQF) is a quality assurance framework which facilitates the awarding of credit and supports credit transfer and progression routes within the Indian education and training system. It organizes qualifications according to a series of levels of knowledge, skills and aptitude. These levels are defined in terms of learning outcomes which the learner must possess regardless of whether they were acquired through formal, non-formal or informal learning.

21. **Optional Trade: "**Optional trade" is defined as any trade or occupation or any subject field in engineering or non-engineering or technology or any vocational course as may be determined by the employer for the purposes of the Apprentice Act, 1961. As per Rule 7A(6), an employer is required to upload the syllabi and duration of the Optional trade on the Apprenticeship portal.

22. **Pradhan Mantri Kaushal Vikas Yojana (PMKVY):** PMKVY was launched in 2015 to encourage and promote skill development in India by providing free short duration skill training and incentivize this by providing monetary rewards to youth for skill certification. Over the period 2016-17 to 2020-21, a total of 108.99 million candidates have been trained under the scheme as per the MSDE dashboard.

23. **Qualification Pack:** QP is a set of NOS aligned to a job role. QPs are available for a wide variety of job roles in each industry sector. These drive both the creation of curriculum and assessments.

24. **Qualification**: It means a final outcome of an assessment and validation process which is obtained when a competent body determines that an individual has achieved learning outcomes to given standards.

25. **Recognition of Prior Learning (RPL**): RPL is defined as the process of recognizing previous/ prior learning, often experiential, towards gaining a qualification. The program trains, assesses and certifies those who have acquired their skills informally. It is part of the training provided under PMKVY.

26. **Sector Skill Councils:** Sector Skill Councils are set up as autonomous industry-led bodies by NSDC under the aegis of MSDE. As awarding bodies, they create Occupational Standards, develop competency framework, conduct Train the Trainer Programs and conduct skill gap studies.

27. **Short Term Training:** Under the MSDE skill ecosystem, short term/duration training refers to training provided under the Government supported skill programs including PMKVY and JSS. Usually, such training is tailor-made to specific needs or problems of various target groups. They are conducted in a relatively short period of time, usually 200 to 600 hours including both core and soft skills, at empanelled training centres targeted at school/college dropouts or unemployed. However, there is no official definition of short term training.

28. **Skilled Worker**: A skilled worker is classified as an individual who is capable of working efficiently, exercising considerable independent judgement and of discharging his duties with responsibility. He must possess a comprehensive knowledge of the trade, craft or industry in which he is employed. For the purpose of the study, production/shop floor workers are considered as skilled workers.

10. References

AV Banerjee, E Duflo - Review of Economic Studies, 2014 - academic.oup.com
A., Y. M. (2017). Manufacturing Sectors in India: Outlook and Challenges. *Procedia Engineering Vol 174*, 90-104.

Abraham, V., & Sasikumar, S. (2017). Declining wage share in India's organized manufacturing sector: Trends, patterns and determinants. *ILO Asia-Pacific Working Paper Series*.

Bartlet, W. (2012). Skills Anticipation and Matching Systems in Transition and Developing Countries. *European Training Foundation*.

Con Gregg, E. V. (2011). *Skills for Trade and Economic Diversification (STED) in Bangladesh : the case of pharmaceuticals and agro-food.* Geneva: ILO.

(2019-20). *Economic Survey Chapter 5: Creating Jobs and Growth by Specializing to Exports in Network Products.* New Delhi: Department of Economic Affairs, Government of India.

Goldar, B., & Banga, K. (2018). Country Origin of Foreign Direct Investment in Indian Manufacturing and Its Impact on Productivity of Domestic Firms. *Working Papers (id:12730), eSocialSciences*.

Gregg, C., &Vinh, N. Q. (2016). Geneva: ILO.

Gupta, R. K. (2008). Towards a Competitive Manufacturing Sector. *ICRIER Working Paper No. 203*.

Islam Rahman, R., Mondal, A. H., & Islam, R. (2015). *Mapping and analysis of growth-oriented industrial sub-sectors and their skill requirements in Bangladesh.* Geneva: ILO.

Kumar, R., & Gupta, A. S. (2008, February). Towards A Competitive. *ICRIER Working Paper No. 203*.

Maiti, D. (2019, February). Trade, Labour Share and Productivity in India's Industries. *ADBI Working Paper Series no.926*.

Mitra, A., Sharma, C., &Véganzonès-Varoudakis , M.-A. (2002). Total Factor Productivity and Technical Efficiency of Indian Manufacturing: The Role of Infrastructure and Information & Communication Technology. *Economic Development and Cultural Change*, 395-426.

Rijesh, R. (2017, February). International Trade and Productivity Growth: Evidence from the Organised Manufacturing Sector in India. *ISID Working Paper 198*.

Sharma, C., & Sehgal, S. (2010). Impact of Infrastructure on Output, Productivity and Efficiency: Evidence from the Indian Manufacturing Industry. *Indian Growth and Development Review*, 100-121.

(2019). *Skills and jobs mismatches in low- and middle-income countries.* Geneva: ILO.

(2020). *World Development Report 2020: Trading for Development in the Age of Global Value Chains.* Washington DC: World Bank.

Rajiv Kumar and Abhijeet Sen Gupta (2008), “Towards a Competitive Manufacturing Sector.” ICRIER Working Paper No. 203

11. List of Abbreviations

1	AC	Air Conditioner
2	ADBI	Asian Development Bank Institute
3	AR	Augmented Reality
4	ASI	Annual Survey of India
5	BSc	Bachelor of Science
6	CAGR	Compounded Annual Growth Rate
7	CNC	Computer Numeric Control
8	DCS	Distributed Control System
9	EoDB	Ease of Doing Business
10	EOT	Electric Overheated Travelling
11	ESSC	Electronics Sector Skill Council
12	FDI	Foreign Direct Investment
13	GDP	Gross Domestic Product
14	GFC	Global Financial Crisis
15	GVA	Gross Value Added
16	GVC	Global Value Chain
17	HEI	Higher Education Institution
18	HT	High Tension
19	ICRIER	Indian Council for Research on International Economic Relations
20	ILO	International Labour Organisation
21	IoT	Internet of Things
22	IP	Intellectual Property
23	ISCO	International Standard Classification of Occupations
24	ISID	Institute for Studies in Industrial Development
25	IT	Information Technology
26	ITI	Industrial Training Institute
27	JV	Joint Venture
28	KLEMS	Capital-Labour-Energy-Materials-Services
29	LTT	Long Term Training
30	MSDE	Ministry of Skill Development and Entrepreneurship
31	MSME	Micro Small and Medium Enterprises

32	NAFTA	North Atlantic Free Trade Agreement
33	NAPS	National Apprenticeship Promotion Scheme
34	NCO	National Classification of Occupations
35	NCVET	National Council for Vocational Education and Training
36	NSQF	National Skill Qualification Framework
37	OEM	Original Equipment Manufacturers
38	OJT	On the Job Training
39	PLFS	Periodic Labour Force Survey
40	QC	Quality Control
41	QP	Qualification Pack
42	R&D	Research and Development
43	RBI	Reserve Bank of India
44	RCEP	Regional Comprehensive Economic Partnership
45	RPL	Recognition of Prior Learning
46	SME	Small and Medium Enterprises
47	SSC	Sector Skill Council
48	STT	Short Term Training
49	TFP	Total Factor Productivity
50	TVET	Technical and Vocational Education and Training
51	USA	United States of America
52	VET	Vocational Education and Training
53	VR	Virtual Reality
54	WTO	World Trade Organisation

12. Appendices

Appendix 1: Rankings of Select Manufacturing Economies: Ease of Doing Business in 2020

Table 19: EoDB Rankings of Select Manufacturing Economies

Indicators	Bangladesh	India	Indonesia	Mexico	Taiwan	Vietnam
Global Rank	**168**	**63**	**73**	**60**	**15**	**70**
Starting a Business	131	136	140	107	21	115
Dealing with construction	135	27	110	93	6	25
Getting electricity	176	22	33	106	9	27
Registering Property	184	154	106	105	20	64
Getting Credit	119	25	48	11	104	25
Protecting Minority Investors	72	13	37	61	21	97
Paying Taxes	151	115	81	120	39	109
Trading across Borders	176	68	116	69	61	104
Enforcing Contracts	189	163	139	43	11	68
Resolving Insolvency	154	52	38	33	23	122

Appendix 2: Trade in Value Added and Global Value Chains in 2015

Table 20: Trade in Value Added and Global Value Chains in 2015

	India	Indonesia	Mexico	Taipei	Vietnam
Direct domestic VA (from export industry)	44.0	46.9	32.9	48.3	36.2
Indirect domestic VA (supplied by other domestic industries to export industry)	28.7	35.5	20.3	14.1	15.6
Foreign VA (supplied by foreign GVC partners to export industry)	27.2	17.5	46.8	37.5	48.2
Top exports industries – Domestic and Foreign VA content of Exports (% share in economy total gross exports)	IT services (Domestic 17.8% & Foreign 1.5%) Textiles & Clothing (Domestic 7.8% & Foreign 1.5%) Chemical Products (Domestic 6.4% & Foreign 2.1%)	Mining (Domestic 16.8% & Foreign 1.4%) Food & Beverages (Domestic 14.2% & Foreign 1.2%) Wholesale & Retail Trade (Domestic 9.1% & Foreign VA 0.5%)	Motor Vehicles (Domestic 14.0% & Foreign 12.9%) Computer & Electronic Products (Domestic 9.2% & Foreign 10%) Wholesale & Retail Trade (Domestic 9.2% & Foreign 0.3%)	Computer & Electronic Products (Domestic 26.6% & Foreign 11.2%) Wholesale & Retail Trade (Domestic 9% & Foreign 0.9%) Chemical Products (Domestic 4.5% & Foreign 4.8%)	Textiles & Clothing (Domestic 13.7% & Foreign 11.7%) Food & Beverages (Domestic 9.3% & Foreign 5.6%) Computer & Electronic Products (Domestic 3.0% & Foreign 4.9%)
Total GVC participation	34.0	37.1	44.9	56.8	55.6
Forward participation	14.9	24.1	8.8	24.4	11.1
Backward participation	19.1	12.9	36.1	32.4	44.5
Annual % change in GVC participation, 2005-2015	9.5	4.4	6.3	3.4	16.5

Source: World Trade Organisation

Appendix 3: Enterprise Survey Questionnaire

Current and Future Demand for Skilled Workforce in Manufacturing Sub-Sectors in India

Colour code	Respondents
Yellow	Management
Blue	HR Manager
Grey	Floor manager/ supervisor

Please add extra sheets for additional information, if required.

Block A: Identification particulars

A1. Name of the Industrial undertaking	
A2. Address of the Industrial undertaking	
A3. Industrial sector and sub-sector	
A4. Industry code (4-digit level of NIC-2008)	
A5. Sector (Rural-1, Urban-2)	
A6. Type of organisation (code[12])	
A7. Year of initial production	
A8. Whether the share capital of the company	

[12] Type of organisation: Individual proprietorship-1, Joint family-2, Partnership-3, Public limited company-4, Private limited company-6, Co-operative society-7, Others (including joint family, trusts, waqf boards, handlooms, etc.)-8

includes share of foreign entities (Yes-1, No-2)	
A9. Any R&D unit in your factory? (Yes & registered with DST/DBT-1, yes & registered with others-2, no-3)	
A10. Whether the firm main activity is assembly operation or manufacturing of components or final goods? (Only assembly operations-1, Only manufacturing of components or final goods-2, Both-3)	
A11. Details of contact person/s Name & designation Telephone E-mail	

Block B: Products and by-products manufactured by the unit
B1.First ten major items manufactured by the firm
(Criteria for selection of major items should be Gross Sale Value)

Sl.no.	Products/ by-products description	Quantity manufactured	Share of Exports (%)
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.	**Total (items 1 to 10)**		
12.	**Share (%) of products/ by-products directly exported**		

B2. Please indicate the share of labour cost in the cost of production of major items.

Sl. No.	Products/ by-products description	Average cost to produce one unit	Share of labour cost for one unit
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

Block C: Workforce classification

C1. Employment

S No.	Category of staff	Total
	Details for category of staff	
1.	Professional, Managerial & Engineering	
2.	Clerical Staff	
3.	Skilled Workers	
4.	Unskilled Workers	
5.	Apprentices	
	Total Current Employees	
	Share of Contractual/Casual/Temporary Workers in Total	

C2. What is the share of labour in total expenditure in the current year?

_____

_____

C3.Break-up of permanent employees

Sl. No.	Field	Number of employees
1.	Engineering & design	
2.	Production	
3.	Technical	
4.	Managers	
5.	Finance	
6.	Administrative staff	
7.	Others	
8.	**Total**	

C4.Product Wise Workforce Details

Sl. No.	Products/ by-products description	Number of production workers employed	Number of other workers (Supervisory & managerial staff etc.)	Capacity utilization in current year	Capacity utilization over last five years (Increased, decreased or constant)
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

Block D: Formal vocational/technical training particulars

D1.Does your company provide any structured training to new workers and employees? (Yes/No)

_____

D2. Type of training, trainer (in-house or external) and common duration of **in-company training** for new workers and employees, if any:
(in days/weeks/months)

_____

_____

D3. Type of training and common duration of **external training** for new workers and employees, if any:
(in days/weeks/months)

_____

_____

_____

D3a. Number of workers who have received formal training in the latest financial year

_____

D4.Does your company provide **reskilling or up-skilling** for employees? If it does, which categories of employees are covered by such training?

_____

_____

D5.Indicate major trades where Apprenticeships are offered (if any):

Sl. No.	Major trades	Average Annual Intake
1.		
2.		
3.		
4.		
5.		

D6. What is the average duration of Apprenticeships offered?

_____

Block E: Academic Qualification of Employees in the Industrial Undertaking

E1. Qualification Profile of Staff

Sl. No.	Occupation	Total Number of Staff	Higher Education Qualification (%)	ITI/ Advanced Diploma/Diploma (%)	Short Term Training/ RPL Certification (%)	No Formal Certification (%)
Professionals						
1.	Managerial					
2.	Engineering & Design					
3.	Supervisory					
4.	Clerical					
Workers *E.g. Welder, Carpenter (Please extend the list to cover all the relevant job roles at your enterprise)*						
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						

E2. In your company, are vocational education graduates generally doing better than other entry-level workforce and in what sense? (Yes/No)

Yes, because _____
_____
No, because_____
_____

E3. What is your experience about quality of staff from ITI or other vocational institutions vis-à-vis other channels working in your undertaking?

_____
_____
_____
_____

E4.What is your experience about the quality of staff who have received short term training certification vis-à-vis unskilled workers working in your undertaking?
_____
_____
_____

E5.What are the main barriers to skill improvements?
_____
_____
_____

E6. Do you think there is an ***adequate supply*** of formally-trained workers for your industry?
Yes/No
_____

E6a. If Not, please specify.
_____
_____

E7. Do you think the quality and relevance of formally-trained workers are adequate for your industry?

Yes/No

E7a. If Not, please specify.

_____
_____
_____

E8. What is the Annual Attrition Rate (%) among Skilled Workers in your industrial undertaking?

_____

E9. What are the primary reasons for Attrition in your company?
(Select all the applicable response options)

1.	Natural Reasons (retirement, illness, Re-location)	
2.	Layoff due to economic slowdown/ COVID-19	
3.	Exploring opportunities at other companies in same industry	
4.	Exploring opportunities at other companies in other industries	
5.	Technology upgradation/ automation	
6.	If others, please specify.	

E10. What is the average pay difference (in %) between the following category of workers

- Un-skilled to semi-skilled _____
- Semi-skilled to skilled _____
- Skilled to highly skilled _____

E11. What is the average time taken for an un-skilled worker to become skilled through 'on-the-job' training? (*in months/years*)

- A semi-skilled worker _____
- A skilled worker _____

E12. What are the key skills which are inadequate at the shop floor level in your industrial undertaking?

Job Role(s)	**Description of Skill Gaps**
E.g., Welder, Carpenter….	*Accuracy, precision, manual dexterity, knowledge of machine maintenance, etc.,*

E13. How the firm is managing production without adequate skills?

_____

_____

_____

_____

E14. Are there any skills where there are high constraints in labour supply as required by the industry? Please specify.

_____

_____

_____

_____

E15. What is your opinion on future skill requirements in your firm?

_____

_____

_____

_____

E16. It is an industry perception that good basic and generic skills enable workers to take on the necessary vocational and technical skills. What is your opinion on this? Do you feel focus on basic and generic skills should be part of skill training?

_____

_____

_____

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____

Block F: Futuristic Business Strategy

F1. Rank the five items listed below which the company is currently actively pursuing.
(Please rank this question on a scale of 1 to 5 where 1 implies least impact and 5 implies maximum impact)

Lowering cost of products to sustain competitive intensity	
Achieving higher productivity and efficiency	
Focused on launching new products	
Improving quality of products to access new export markets	
Digital technologies and value capture in global value chains	

F2.To what extent can the degree of structural mismatch in the industry be ascribed to inadequate skills of the workers? (Please tick the appropriate option).

Entirely (90-100% i.e., an improvement in skills can solve the challenge)	
Significantly (50-80% of the challenge can be solved with skilled manpower)	
Partially (20-50% of the challenge can be tackled with skilled manpower)	
Marginally (<20% of the challenge is due to or can be solved with skilled manpower)	

F3. Do you expect any expansion in production capacity to serve domestic/export markets over the next 12 months?
Yes/No _____
If yes, please indicate as a percentage of existing capacity. _____

F4. Are you going to introduce any new technologies to reduce cost/enhance quality of products over the next 12 months?
Yes/No _____

F5. Rank the order of preference for replenish/improve your stock of skilled workers for future growth and development. (Please rank this question on a scale of 1 to 4 where 1 implies most preferred and 4 implies least preferred)

To hire un-skilled workers who would be trained 'on-the-job'	
To hire candidates with short term training certifications/Recognition of Prior Learning	
Hire fresh ITI Graduates	
Re-skill & Up-skill existing workers	
Hire experienced skilled workers from market	

F6. Identify top 5 job roles at your organisation where there is current/anticipated demand over the next 12-24 months?

_____

_____

_____

_____

F7. Is there a general positive momentum over the last 3-5 years due to '*Make in India*' initiative in terms of improved domestic/export orders? (If yes, please tick the appropriate option)

5- 10%	
10-20%	
20-30%	
30-50%	
Above 50%	

F8. What is the anticipated external (export) demand post COVID-19 pandemic after the initial loss in first 3-4 months? (Please tick the appropriate option)

Significantly lower (>10% decline in export demand)	
More or less the same (90-110% of pre-COVID demand)	
Significant improvement (>10% increase in demand)	