White Paper – Footwear Industry in India

Technology Cluster Manager (TCM)

Technology Centre System Program (TCSP)

Office of DC MSME, Ministry of MSME

October 2020

KPMG

Disclaimer

This Report has been prepared on the basis set out in our [Engagement Letter addressed to / engagement contract reference 21/DCMSME/TCSP/CON/TCM/2016/TR with The Development Commissioner, MSME, Ministry of MSME dated 03rd December 2018 (the "Contract for Supplier Services")

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Abbreviations

AFMEC	Agra Footwear Manufacturers Exporters Chamber
ALT	Association of Leather Technologists
APEDA	Agricultural & Processed Food Products Export Development Authority
AR	Augmented Reality
ASMA	Agra Shoe Manufacturers Association
BCS	Basic Chrome Sulphate
BDS	Business Development Services
CAD/CAM	Computer Aided Design and Manufacturing
CAGR	Compounded Annual Growth Rate
CETP	Common Effluent Treatment Plants
CFTI	Central Footwear Training Institute
CLE	Council for Leather Exports
CLRI	Central Leather Research Institute
CPSC	Consumer Product Safety Commission
CTCP	Centro Tecnológico do Calçado de Portugal
DPIIT	Department for Promotion of Industry and Internal Trade
DIC	District Industries Centre
ERP	Enterprise Resource Planning
ESI	Employee State Insurance
EVA	Ethyl Vinyl Acetate
EPCG	Export Promotion Capital Goods
FDDI	Footwear Design & Development Institute
FDI	Foreign Direct Investment
FOB	Free on Board
HR	Human Resource
HRM	Human Resource Management
HS	Harmonized Commodity Description and Coding System
IDEMI	Institute for Design of Electrical Measuring Instruments
IGTR	Indo German Tool Room
ILDP	Indian Leather Development Programme
INR	Indian Rupee
ISF	Indian Shoe Federation
ITPO	India Trade Promotion Organization
JV	Joint Venture
MLC	Mega Leather Clusters
MSME-DI	Micro, Small and Medium Enterprises-Development Institute
MSME	Micro, Small and Medium Enterprises
NBFC	Non-Banking Financial Companies
NSIC	National Small Industries Corporation
PU	Polyurethane
REACH	Registration, Evaluation, Authorization and Restriction of Chemicals
SIDBI	Small Industrial Development Bank of India
TC	Technology Centre
TCM	Technology Cluster Manager
TCSP	Technology Centre Systems Programme
UNIDO	United Nations Industrial Development Organization
USD	United States Dollar
VR	Virtual Reality

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1. Objective of the White Paper

Technology Centre Systems Programme (TCSP) is a national programme undertaken by the Ministry of Micro, Small and Medium Enterprises with the assistance of the World Bank. The programme seeks to enhance the technological and skill base of MSMEs in certain manufacturing sectors to improve the competitiveness of MSMEs, via upgraded and new Technology Centers (TCs).

The objective of the programme is to enhance the productivity of selected MSME clusters by improving their access to manufacturing technology, establishing strong focus in providing business & technical advisory services and improving availability & employability of skilled workforce through TCs[1]. As part of the programme, KPMG has been appointed as the Technology Cluster Manager (TCM) to support TCs and undertake technology and cluster development activities.

The objective of TCM is to increase business opportunities for MSMEs through market linkages, enhance competitiveness of the cluster business environment, increase the number of MSMEs utilizing the services of TCs, develop a financially self-sustainable business model for cluster related services provided by TCs, identify technologies (Industry 4.0) of selected sector for TCs, evaluate existing training programs & develop new training programs for roll out at TCs, conduct gap analysis of TCs, strengthen the capabilities of TCs to provide technical advises to their clients, increase awareness amongst stakeholders on Environmental, Health, and Safety (EHS) requirements[2].

Central Footwear Training Institute (CFTI), Agra is one of the TCs selected under the TCM project. CFTI, Agra was established to support the leather footwear and allied industries. CFTI aims at developing human resources for the leather footwear industry through various tailor-made training programs, introduction of modern technology in footwear designing & manufacturing and provide consultancy & job work services to the enterprises in the sector.

As part of the project, White Papers in different sectors are being prepared to help identify the future roadmap for the TCs. This White Papers focuses on the footwear sector. This Paper aims to showcase the current scenario in the footwear sector, highlight the degree of alignment of the current services of the TC with the market needs, and recommend a future course of action for the TC to be better able to serve the sector in synergy with the ongoing trends.

[1] http://www.dcmsme.gov.in/tcsp/TCSP%20-%20Concept%20Note.pdf
[2] http://www.dcmsme.gov.in/tcsp/Program%20Overview/Technology_cluster_man.html

2. Leather Market

2.1. Global scenario

The global leather goods market size is expected to reach USD 629.65 billion, expanding at a CAGR of 5.4%, by 2025[3]. The market growth is mainly driven by growing disposable income, improved living standards, changing fashion trends, and growing domestic and international tourism. Rising demand for comfortable, trendy, and fancy footwear along with growing brand awareness is expected to have a positive impact on the footwear market. Moreover, it is an employment intensive sector, providing jobs to about 4.42 million people (with 30% women), mostly from the weaker sections of the society.

Global leather exports are led by China (36%), followed by Italy (12%), Vietnam (11%), France (4%) and Indonesia (3%). However, between 2010 and 2016, China's market share fell from 45% to 36% and by 11% within the leather footwear sector[4].

2.2. Indian scenario

Leather is one of the most important industries in India with Indian leather totaling up to 13% of the global production of skin and around 10% of world's footwear production coming from India. Leather exports from India comprise of raw-hide skins, finished leather, leather goods, leather garments (2nd largest), leather footwear component, saddlery & harness (3rd largest).

Leather production is spread across 10 states with southern region having the major share of production (Figure 1). Tamil Nadu cluster leads the sector closely followed by West Bengal from a volume perspective.

Figure 1: Major leather production centers in India

Central region – 20% of leather exports
- Madhya Pradesh (Dewas)

Eastern region – 15%
- West Bengal (Kolkata)

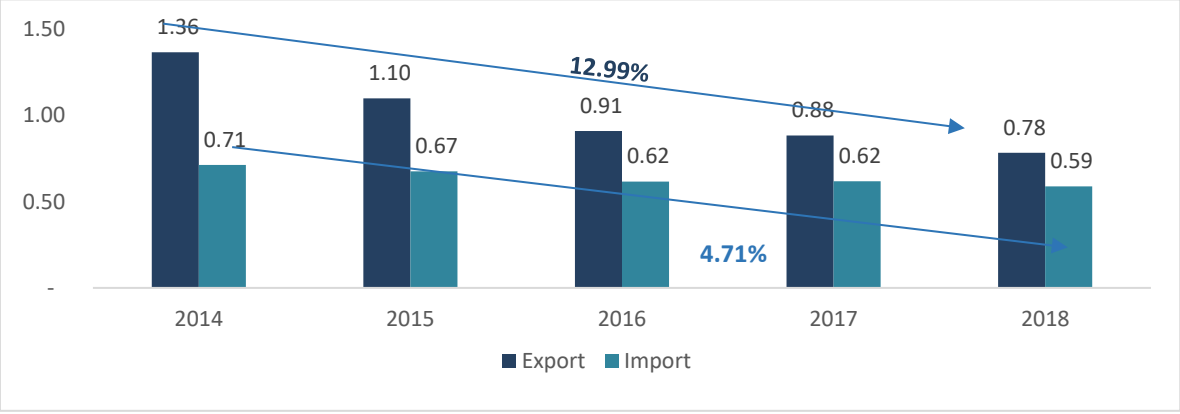
Northern region – 24%
- UP (Kanpur, Agra, Noida, Saharanpur)
- Punjab (Jallandhar, Moga, Patiala)
- Haryana (Gurgaon, Bahadurgarh, Karnal & Faridabad)

Southern region – 36%
- Tamil Nadu (Chennai, Ambur, Ranipet, Vaniyambadi, Vellore, Pernambut, Trichy, Dindigul and Erode)
- Karnataka (Bangalore)
- Telangana (Hyderabad)
- Kerala (Calicut and Ernakulam / Cochin)

Western region – 5%
- Maharashtra (Mumbai)

The demand drivers for leather sector are fashion, footwear (55%), furniture & automotive (20%), clothing (15%) & other industries (10%).[5] Moreover, more than 50% of bovine hides and around 40% of sheep and goat skins are processed into footwear, while the remaining is used for the production of garments, furniture and travel goods.[11] It is interesting to note that in India, between 2014 and 2018, there has been a steady decline in especially the export of raw hides and skins, as can be seen in the Figure 2.

Figure 2: India's export and import value (USD Billion)
HS Code 41 - Raw Hides and Skins (other than furskins) and Leather



[3] https://www.grandviewresearch.com/industry-analysis/leather-goods-market
[4] https://conseilnationalducuir.org/en/press/releases/2018-01-24
[5] https://www.ibef.org/blogs/leather-exports-from-india-going-strong

3. Footwear industry

3.1. Footwear industry – Global

Footwear products can be classified into two categories i.e. Open-ended footwear & Close ended footwear. From a material standpoint, they can be divided into leather and non-leather footwear. The footwear industry is expected to grow at 3% between 2019 to 2027 and increase from USD 235 billion to USD 308 billion during the period, with non-athletic footwear segment dominating the global footwear market at 64% share in 2016.[6] In terms of material, leather footwear currently occupies a larger market share compared to non-leather footwear.[7]

Historically, the footwear market has been driven by growth in developed countries, however, the trend is changing with growth in developing countries and increasing penetration of global footwear designers and producers in new upcoming markets. This can be witnessed in the Asia-Pacific region where the footwear market dominated in both consumption and production in 2018.

Moreover, with improvement in living standards across the globe resulting in wealth generation and increased purchasing power, the demand for fashion and products made from natural materials including leather has increased, leading to high trade volumes, better revenues and increased employment opportunities.

3.1.1. Footwear production centers globally

China is the top exporter in the footwear industry with 60% global market share. It not only manufactures the most coveted shoes in the world, the Balenciaga Triple S but is also a hub for Burberry, Armani, Visvim and Prada, etc. Spread within four major clusters - Guangdong, Zhejiang footwear industry base, Chengdu and Chongqing and Quanzhou and Jinjiang in Fujian, China has ~40,000 skilled technical worker per cluster with wages doubling over the past decade. This workforce availability helps the industry in adjusting the labor cost as per quality requirements.

Italy is another top exporter and is known for its craftsmanship, creativity and comfort. The industry highlights some major clusters like Riviera del Brenta, Verona and Montebelluna in Veneto; Fermano in the Marches; Barletta and Salento in Puglia. The Riviera del Brenta and Fermano clusters trade majorly within Europe, particularly Germany, France and, Great Britain. Within the industry, Montebelluna specializes in sports shoes and ski boots but the prime Italian trade rests in luxury leather footwear and the luxury brands that promote it. As top companies settle in Brenta, the industry shares their rent in order to acquire production skills and workforce. Within Italy, the manufacturing machinery and technical skilled labor are backed with intensive research that keeps it ahead of its competitors.

While Vietnam lacks brand value, it's market overlaps with that of the Italian industry and extends to the United States, Latin America and Asia. With the launch of the new Italy-Vietnam footwear technology center in Binh Duong, Vietnam is equipped with modern machinery and equipment imported from European countries, allowing SMEs and local companies to approach, research and develop new products. This production includes sports, canvas and leather shoes made by a workforce of 930,000 labor. Vietnam currently has more than 65% population in the working age which makes availability of human resource easy and cheap, making it a primary production hub for many companies.

However, since Ethiopia's shift from agriculture to footwear, the East African nation threatens many existing competitors with its labor costs. It not only provides a labor pool three times cheaper than China but also has abundant raw material, low electricity cost, shorter lead times to the US market, heavy investments in infrastructure and factory capabilities and duty-free pricing. While it targets the African,

[6] Transparency Market Research
[7] Allied Market Research

European and American markets, its economic zone is creating employment for around 100,000 people. The strategy is to widen the skills of the locals from Sheep and oat skin to cow-skin and make them future managers. Ethiopia has collaborations with Chinese firms who recruit graduates from southern Ethiopia and train them in their facilities.

3.1.2. Key Trends

- The overall production of hides and skin is expected to grow at a slow rate with developed countries witnessing slow or negative growth due to declining meat consumption and stringent environmental standards while developing countries experiencing expansion to meet the domestic demand for meat.[11]
- While leading companies such as Nike, Adidas, Bata, Puma, Aldo, etc. have significant market share, they are expected to face stiff competition in the coming years. Therefore, mergers & acquisitions and joint ventures with local players to expand product portfolios have gained prominence. Moreover, local producers in developing countries are focusing on reducing their cost of production and increasing profitability for sustainability.[6]
- Due to the flexibility offered by plastics and synthetic products, especially in satisfying requirements of warmth, support, waterproofing, and recyclability, they are increasingly replacing leather products, especially when it comes to women's footwear and athletic or sports footwear.
- Knitted uppers, due to their comfort, light weight and ease of manufacturing; have become increasingly prominent over the years with all major brand using knitted uppers for their latest collections.
- Men's shoes are generally not subject to rapid fashion changes; however, this is not the case with women footwear which gets discarded before being worn out. With one of the key features of leather being durability, women footwear, therefore, may not be required to be made of leather. As a result, footwear made of other materials is expected to gain more prominence, especially in the Indian context, where the percentage of market captured by women footwear has constantly been increasing over the years.
- While there has been a growing concern over wastage over the years, it seems unlikely this will translate into something substantial.
- Since synthetic materials are not biodegradable, the ultimate disposal of footwear and garment made from such materials is a bigger challenge than leather products. However, this may not be the case soon as legislations for recycling become more stringent, diminishing the advantage leather recycling currently has.
- Depending on the structure of the raw skin, technology of chemicals and products used, and methods of application, there can be lack of uniformity in leather products from batch to batch. This gives an advantage to other materials which offer consistency and therefore are easy to produce and offer economies of scale. With more people being lifted out of poverty every year, especially in Africa, the demand for such products is expected to increase.
- However, the uniformity and similarity of synthetic products limit the individuals' need to express individuality, which is offered by leather products. This essentially puts a further premium on leather products. With the Indian luxury market, estimated at USD 6.25 billion, witnessing CAGR of 18% between 2012 and 2017 and expecting to grow at 10-15% till 2022, it offers a large market for such leather products[8].
- From a manufacturing technology perspective, seamless integration of functional analysis/biomechanics, material science and comfort related parameters in CAD/CAM software is expected. In addition, augmentation of AR/VR to provide a better customer experience is already underway.

[8] ETBrandEquity.com. (2020). Luxury product market in India to grow 10-15% in next three years - ET BrandEquity. [online] Available at: https://brandequity.economictimes.indiatimes.com/news/business-of-brands/luxury-product-market-in-india-to-grow-10-15-in-next-three-years/67957572 [Accessed 3 Mar. 2020].

- There has also been an increased focus on smart and tech-enabled footwear. This has led to an increase in development of new materials and processes that are allowing production of the next generation of footwear with functional behavior resulting in development of innovative materials and processes to enable this. This along with increased awareness through new multimedia channels has opened a number of options for consumers compelling manufacturers to focus on design and development of footwear which are not only comfortable and trendy but also sustainable and equipped with modern technologies.

The focus on innovation in the shoe sector has evolved in a slow but efficient way, driven by the changing demands of the customers at retail. This has acted as a trigger for more creative innovations of materials and methods of construction to meet the appropriate demands. A recent example of this evolution in market demand for segmentation is the development of shoes, labelled by the public, as "Sports" footwear. These were originally dominated by big multinational brands, whose success was based on new styling linked to material and process innovation linked to product performance in the market.

Interestingly this category of footwear has also moved from purely footwear to be worn for sport to a fashion item of footwear linked to similarly innovative clothing covering all age groups. This demand has released opportunity for new brands to appear to satisfy global demand. 25 years ago, this segment of the "Sports Shoes" market was dominated by the "big 3" – NIKE, ADIDAS, PUMA. Now this segment has attracted at least a further 20 established brands with global presence and billion-dollar sales. India has developed its own clusters making "sports shoes" using some of the processes developed by the big international brands.

Figure 3: Major innovations by key players

Existing players –

- Adidas - focusing on foot biomechanics
- Puma (with MIT Design Lab) - developing biologically active shoes which adapt to the wearer
- Apple - products that can detect damage to feet

Emerging player –

- Xiaomi (primarily a smartphone maker) with its MiJia smart shoes that capture speed, distance, weight, etc.
- Digitsole offering personalized feedback to analyze health, fatigue, posture, etc.
- Zhor tech's shoes - shoes for construction workers which count steps, detect fatigue and evaluate posture, alert supervisors in case of accidents, etc.
- Lechal footwear - designed for visually impaired.

This category is further evolving with the ever-increasing focus on health and fitness. Shoemakers are innovating constantly by incorporating means to measure athletic performance to evaluating health parameters and are starting to provide personalized feedback to users. This has led to a shift in focus of well-established players as well as proliferation of many new players into the smart shoe market as seen in Figure 3. This market is at a nascent stage and is expected to grow at a CAGR of around 23% during the period 2018-2022[9]. Moreover, there seems to be an increased focus on individualized products and customization. 3D printing and smart shoes offer the individualized experience through at-home printing or for printing at a local store and personalized feedback, respectively.

The footwear sector is undergoing a transformative phase wherein in addition to design and comfort, features on aspects related to functionality are also gaining prominence in the minds of the consumer. We believe this to be an important element which will redefine the industry in the coming years the same way smartphones and especially smartwatches have done.

[9] Technavio

3.1.3. Leading global research/training institutes

In order to explore advance technology, knowledge and innovation that can be transferred to MSMEs through CFTI Agra, details of leading research/training institutes involved in leather/non-leather and orthopedic footwear have been highlighted in Table 1 with possible areas of collaboration with TCs:

Table 1: Leading global research/training institutions

Institution	Dealing with type of footwear	Major Services offered	Potential Areas of Collaboration with TC
CTCP, Portugal	Leather/Non-Leather footwear	• Education and customized training for footwear companies • Industry support (Consultancy) for productivity improvement, quality, environment, social responsibility, innovation, OSH, Energy Management • Testing & Design • R&D&I for creation of new technologies, process, products, materials	• Research & Development & Innovation (R&D&I) in sustainable materials/components for footwear • Customized joint training programs for footwear industry
INESCOP, Spain	Leather/Non-Leather footwear	• Training programs • Software for footwear (Icad3D solutions) • Adhesive research • R&D in digital manufacturing, additive manufacturing, nanotechnology, leather and textiles, chemical substances in footwear	• Jointly exhibiting Industry 4.0 for the footwear sector • Training program on customized footwear
International Shoe Competence Center (ISC), Pirmasens, Germany	Orthopedic footwear	• Education and Customized training • Supplier of footwear testing machines • R&D in model and process optimization, Biomechanics/optimized fit/wearing comfort • Biomechanical laboratory	• Customized training programs in Orthopedic footwear
Southern Cross University, Lismore, Australia	Orthopedic footwear	• Training courses (Bachelor of Pedorthics, Bachelor of Podiatry)	• Joint training programs on Pedorthics

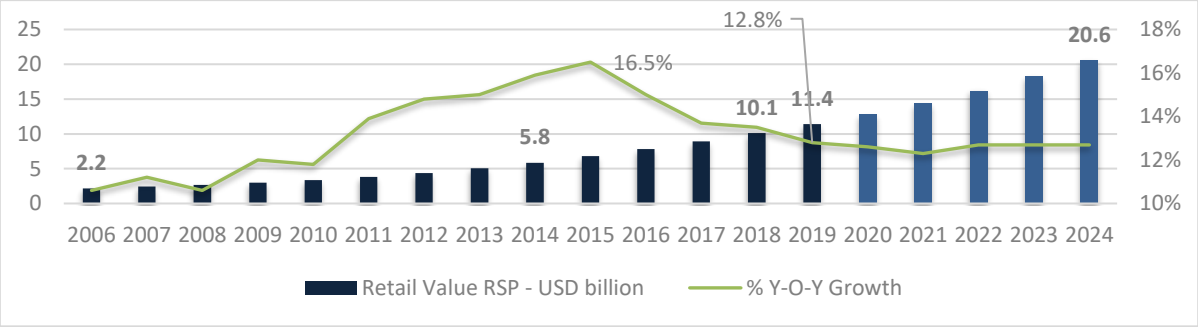
3.2. Footwear industry – India

India is the 2nd largest producer of footwear (after China) and leather garments in the world.[10] The export of footwear, leather and leather products from India reached a value of US$ 5.74 billion during 2017-18. As per different sources, the annual production of footwear in India is around 2 billion pairs with 95% being sold in the domestic market. Footwear (leather and non-leather) export accounts for about 43.5% share in India's total leather & leather products export.[10]

Although riddled with raw material related challenges, with 20% of world cattle & buffalo and 11% of world goat & sheep population, India has an abundance of raw materials. India is expected to witness increased milk and milk products consumption leading to rising contribution of animal products to diets till 2030, essentially increasing the supply of raw material.[11]

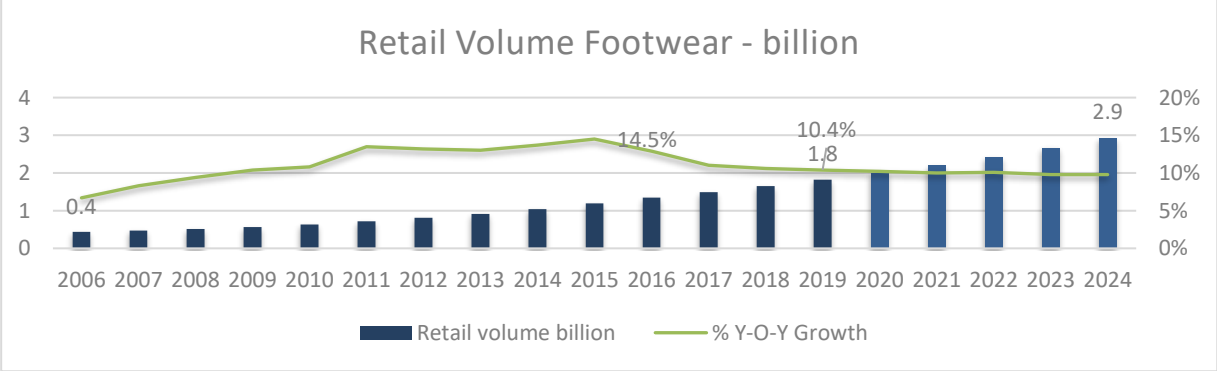
The retail value of footwear sector is estimated at USD 11.4 billion in 2019 and is expected to increase to USD 20.6 billion by 2024 with an impressive growth rate of 12.6% as seen in Figure 4.

Figure 4: Retail Value of Footwear industry in India – USD Billion



In terms of volume, India produced 1.8 billion units and is expected to product almost 3 billion units by 2024 growing at more than 10% annually as shown in Figure 5.

Figure 5: Retail Volume of Footwear in India – Billion



[10] Council for Leather Exports
[11] Food and Agriculture Organization of the United Nations (FAO)

3.2.1. Footwear Clusters in India

The Indian footwear industry is highly fragmented and unorganized with over 15,000 small and medium enterprises and caters primarily to the domestic demand. The small organized sector targets the export market.[12]

3.2.1.1. Agra leather footwear cluster

Agra leather footwear cluster has a rich tradition of leather footwear manufacturing dating back to the Mughal era. Over the years the sector in Agra has evolved and has emerged as an important source of employment generation in northern India. With an estimated 5,500 – 6,500 leather footwear manufacturing units providing employment to more than 100,000 people, the Agra footwear industry is concentrated in 16 areas across the city. These units operate at around 60-70% efficiency and produce close to 1.5 lakh to 2 lakh pairs per day[13]. Most of the footwear units in Agra are involved in leather footwear or leather-like footwear manufacturing with a very small percentage of units involved in non-leather footwear. Agra meets 65% of domestic requirements & has 28% share in the total footwear exports from the country.[14] The footwear industrial units in the region can be broadly divided into 3 major categories:

Household units: Mostly run by family members of the unit owners using basic machines like heat chambers and mostly rely on hand tools (stitching, cutting, lasting tools) to make shoes. The number of employees in these units range from 3-10 and most of them are hired on a contractual basis depending upon orders and requirements. It is estimated that close to 50-60% of the total footwear manufacturing units in Agra belong to this category.

Workshop units: Workshop units (also termed as Karkhana) form 30-40% of the total industrial units in Agra and have total manpower ranging from 20 to 40 contractual employees per unit. These units use stamping machines, stitching machines, air compressor and heat chamber for manufacturing of shoes and outsource some job work like upper stitching to household units. Most of the workshop units majorly cater to domestic markets with very few dealing in exports through merchant exporters.

Semi-mechanized units: Only 10-20% units come under the category of semi-mechanized units. These units majorly cater to domestic and exports markets and have a workforce of around 40 to 100 workers per unit. These units cater to both national and international clients like Bugati, S. Oliver, Bata, Liberty, Khadims and Relaxo among others. As these units need to maintain the compliance standards for international clientele, these units use modern machines like flat, post & cylinder bed stitching machines, stamping & embossing machine, skiving machine, counter molding machine, punching & eyeleting machine, toe puff & toe lasting machine, upper setting machine, heat setter, wrinkle chasing machine, pounding machine, roughening machine, heat activator, sole press machine, heal nailing machine, de-lasting machine and finishing machine. As per Council of Leather Exports, there are 275 export-oriented units, Free on Board (FOB) value of which in the year 2018-19 for leather footwear exports was INR 3,242.09 Crores (USD 450 million)[15].

Table 2: Types of footwear units in Agra

Particulars	Household Units	Workshop Units	Semi Mechanized Units
Approx. range of no. of employees	3-10	20-40	40-100

[12] There are more than 1000 leather exporting companies in India. Some of the prominent players are Prara Leathers Private Limited, Rahman Industries Limited, Farida Prome Tannery Private Limited, Tata International Limited, Super Tannery Limited and Blue Diamond Leaders. (IBEF)

[13] Data gathered from interaction with Industry Associations

[14] Agra Footwear Manufacturers & Exporters Chamber

[15] Council for Leather Exports Report 2019

			200-500 (International export houses)
Daily production per unit	24 -48 pairs	100-500 pairs	200-1000 pairs 2000-3000 pairs (International export houses)
Price range	INR 120 – 300	INR 300 – 900	INR 400 – 1000 INR 700-1500 (International export houses)
Material used for production	Rexin, synthetic micro or foam	Leather and synthetic	Leather and synthetic

Table 3: Snapshot of machines used in Agra

Household Units	Workshop Units	Semi Mechanized units	Export Houses
• Manual cutting & Stitching machine • Locally manufactured grinder • Locally manufactured heat activator box • 2 Pad Manual pressing machine • Wooden Last • Manual Finishing	• Manual Cutting & Power operated stitching machine • Roughing with dust collector • Heat Activator Box • Stuck on press • Polyvinyl Chloride (PVC)/Wooden Last • Spray Gun for finishing	• Power Operated Stitching machine with flat bed and post bed • Roughing with dust collector • Heat Setter • Stuck on Press • PVC/ Wooden Last • Spray Gun for finishing • Hydraulic clicking press • Skiving machine • Stamping machine	• Imported stitching machine and cutting by Hydraulic (Trolley Type/ Arm type) • Roughing with dust collector • Heat Setter • Imported Stuck on press • PVC Last • Imported Spray gun • Automatic stamping machine • Shape forming machine • Chiller & Conveyor System

3.2.1.2. Chennai leather footwear cluster

Historically, one of the most important trading centers, Chennai primarily dealt with export of raw hides & skin. In 1973, to promote export of finished products of leather, Govt. of India banned export of raw hides & skin resulting in opening of manufacturing units of footwear & allied products in Chennai. With developed countries no longer keen on operating tanneries & footwear manufacturing due to tightening environmental legislations, Chennai attracted the tanning industry and footwear & allied product manufacturing, accelerating the growth of leather industry. Foreign footwear manufacturers brought their techniques, quality systems, machinery, knowledge of international compliances & competitiveness to manufacture internationally competitive footwear. Coupled with availability of quality finished leather in and around Chennai, excellent sea-port and airport connectivity, disciplined workforce and presence of supporting institutions like Central Leather Research Institute (CLRI), Council for Leather Exports (CLE) and Central Footwear Training Institute (CFTI), Chennai became a major hub of leather footwear export.

As per Indian Shoe Federation (ISF), the Chennai footwear industry comprises of household units, workshop-based units and around 50 export-oriented units. There are four large integrated manufacturing firms. There are around 15 component manufacturers. It is to be noted that many of the export-oriented

and workshop-based units are also involved in tanning. Due to the rapid development of Chennai city, land prices skyrocketed resulting in an increase in the operational and manufacturing cost of footwear. This led to shifting of most footwear units to other districts (Ranipet, Ambur, Vaniyambadi) of Tamil Nadu.

The turnover of Chennai leather footwear cluster is approximately INR. 3993 Crores (USD 500 million) with leather footwear comprising of 23% of the share. About 60% of the output is accounted by finished leather, footwear and its components15. Rest of the output is contributed by leather garments, gloves, goods and non-leather footwear.

3.2.1.3. Other Major Footwear Clusters

Footwear clusters in India were evolved traditionally like Kanpur, Kolhapur, Kolkata, Jaipur, etc. and some clusters are being developed by Govt. of India by providing infrastructure and other facilities.

Traditional footwear clusters - India is traditionally known for ethnic footwear like Kolhapuri chappal, Jutti etc. and footwear completely made by hand with using minimal tools. Such products are designed and produced in certain footwear clusters of India (Kolhapuri Chappal in Kolhapur footwear cluster, Maharashtra; Jutti in Punjab, Jodhpuri in Rajasthan).

The traditional footwear clusters are artisan-based cluster consisting of majorly household based units (cottage industries). Raw material like leather, threads, adhesives, footwear components are available locally along with hand tools such as knife, hammer, etc. These footwears are prepared with the use of leather/velvet upper with embroidery work done on the upper which is stitched on to the sole which can of leather as well. Such footwears are generally without laces so that it can be worn and removed easily.

Local artisans manufacture the footwear and generally, a middleman is an interface between them and the retailer/buyer/customer. Footwear is then sold in the local market and nearby states. Training institutions like CFTI, FDDI, and other Skilling agencies provide need-based training to these artisans to make them competitive.

Modern footwear clusters - Modern footwear clusters are new and are mostly promoted and supported by Govt. of India in the form of Leather/Footwear parks such as in Bahadurgarh-Delhi, Ambur, Ranipet-Karnataka, etc.

The footwear units in such clusters are primarily semi-mechanized and export-oriented units. The manufacturing of footwear in such units is manpower intensive providing employment to skilled and unskilled youth. Units in the cluster manufacture for reputed national & international brands such as Liberty, Relaxo, Action, Today, Columbus, Aeroback, Lancer, Welcome, etc. With modern machineries and equipments for production of footwear such as hydraulic clicking machine, upper edge skiving machine, Flat bed & post bed stitching machine, Toe lasting machine, Roughening machine, Heat setter, stuck on press machine, stamping & embossing machine, sole press machine, finishing machine etc., the clusters produce footwear such as casuals, formals for men, women and children.

Major markets include Saudi Arabia, Oman, UK, USA, UAE, Bhutan, Nepal, Malaysian, Ethiopia, Seychelles, Kuwait, Mauritius, Nigeria, Australia, Qatar, Hong Kong, Mexico, etc. Leather is generally available within the cluster through tanneries, but leathers can also be imported on the basis of client's demand. Rest of the raw materials such as last, soles, shoe components are also readily available within the clusters. At a country level, the complete footwear market is extremely fragmented with top 5 firms accounting for less than 17% of the retail value Table 4. It is interesting to note that the growth of very small players is outpacing the growth of almost all major players.

Table 4: Retail Sales Performance by Company - 2013-2018

Company	Sales (INR million)	% CAGR Growth
Bata India	32,888	**6.6**
Relaxo Footwears	26,781	**14.2**

Company	Sales (INR million)	% CAGR Growth
Paragon Group	23,429	**10.5**
Veekesy Rubber Industries	22,071	**15.2**
Adidas India Marketing	14,533	**12.6**
Metro Shoes	9,973	**11.5**
Puma Sports India	9,972	**17.6**
Khadim India	9,749	**10.6**
Aero Group	7,493	**11**
Others	559,842	**16.4**

3.2.2. Challenges in Footwear Industry

Footwear units of different categories face different types of challenges. Household and workshop units normally face issues related to market, finance & raw material procurement. These categories come under the unorganized sector and the major focus is on short term survival goal. Export-oriented and semi-mechanized units are bit organized sectors and their challenges and issues are bit different in terms of intensity and requirement. The challenges of all categories in terms of intensity scale (low, medium, high) are mentioned below:

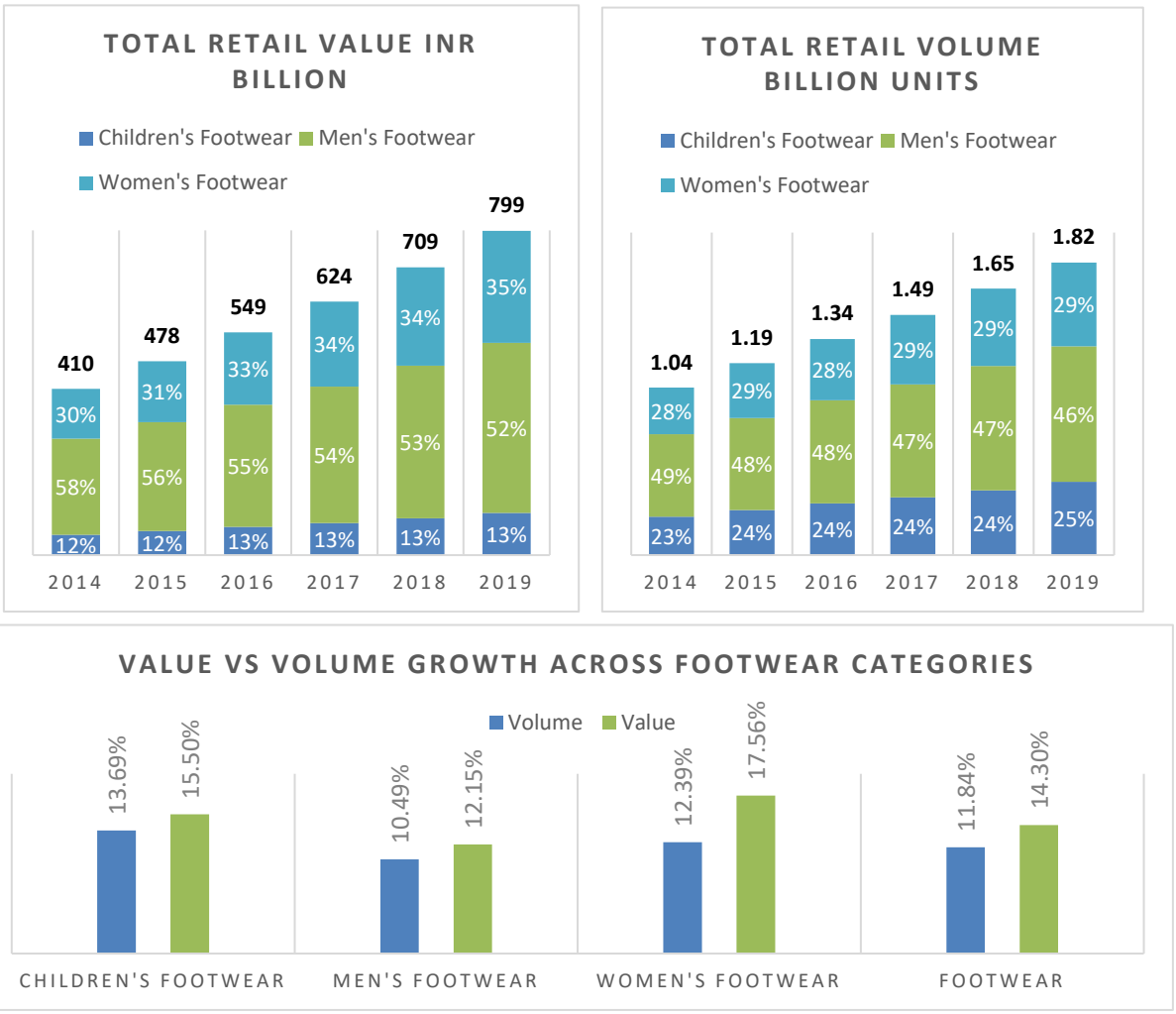
Table 5:Challenges in footwear industry

Challenge	Description of the Challenge	Household Units	Workshop Units	Semi Mechanized & Export oriented units
Low Registration of MSMEs	• Low level of UAM registration in Household and Workshop units	High	High	Low
Outdated Production Technology	• No access to latest manufacturing technologies (high cost of machinery) • High wastage of raw materials due to outdated technology	High	High	Medium
Poor quality of products	• No quality standardization of finished products	High	High	Low
Supply Side Challenges – Raw Material Procurement	• High cost of raw material procurement due to presence of middle men.	High	High	High
	• Limited access to good quality raw material • Non availability of Raw Material Bank	High	High	Medium
Demand Side Challenges – Sale of Products	• No fixed job work contracting and dependence on middle men for day to day work. • Limited fixed pricing for final products.	High	High	Low

Challenge	Description of the Challenge	Household Units	Workshop Units	Semi Mechanized & Export oriented units
Limited Access to market	• Dependence on wholesalers for reaching new markets • High competition due to low level of product differentiation.	High	High	Medium
Up-skilling of Workforce	• Up-skilling of workforce. • Lack of training on productivity and total quality management. • Limited availability of managerial / trainers trainings	High	High	High
Poor Occupational Health and Safety	• As most of the enterprises operate out of their homes so there is no space for expansion • Limited space for stocking of raw material, finished products or installing machinery • Unhealthy working conditions	High	High	Low
Congested Workplaces		High	High	Low
Access to Finance	• Inability to meet working capital requirements • Limited information about financial institutions and their schemes	High	High	Low
Weak Horizontal Linkages	• Highly competitive & secretive market with large perceived threat on design thefts	High	High	Low
Weak Vertical Linkages	• Dependence on middlemen and wholesalers for connecting with different players	High	High	Medium
Poor Access to Information	• Low awareness about government schemes and Incentives (concessions & facilities)	High	High	Low

3.2.3. Key trends – Indian Market

Figure 6: Footwear categories in India - Value and Volume trends



Although dominated by men's footwear, both in terms of value and volume, its share has been shrinking gradually with Children's footwear witnessing the fastest growth (13.69%) in terms of volume and women's footwear value growing at the fastest pace (17.56%). It is interesting to note that the per unit value for women has been increasing at three times the rate for per unit value for men or children's footwear. Per unit value for women's footwear category is now the highest in India Figure 6[16].

Footwear industry in India is very optimistic right now with growing awareness about the latest trends and consciousness among consumers. Western influence has also played a part with people bring inclined towards styles like Oxfords (Europe) and Brogues (Ireland). Unlike the past, people today require footwear as per the occasion. However, shoes per capita for India (1.9) is still much lower than US (7.2) and UK (7.4), presenting a large opportunity.[17]

The consumers have become more technology savvy, extensively prone to digital marketing and practices, fashion conscious, demanding the latest trends and contemporary styles and fashionable in a certain manner. The growing footwear segment along with the budding working-class population,

[16] KPMG analysis
[17] https://www.statista.com/statistics/1077289/country-ranking-by-per-capita-shoe-consumption/

increasing brand consciousness, rising discretionary income, has led to an enormous growth in footwear consumption. Moreover, due to increased internet penetration and subsequent evolution of e-commerce ecosystem, the last decade has been exceptional for the industry.

Leather footwear market is closely aligned with consumer spending on fashion accessories. Rapid growth in the spending on fashion accessories due to growing influence of social media is driving the market. Recent changes in consumer shopping trends and increasing propensity toward buying high-end and designer shoes are estimated to trigger the growth.

There has been a drastic change in India's import basket within HS code 64 as can be seen in Figure 7. From just over 2.5% in 2010, 3 HS code categories now constituted over 62%.[19] These categories consist of non-leather footwear and are primarily plastic or textile footwear components, highlighting the change in consumer preferences over the years towards non-leather footwear products.

Figure 7: Share of imports of footwear (HS code 64)

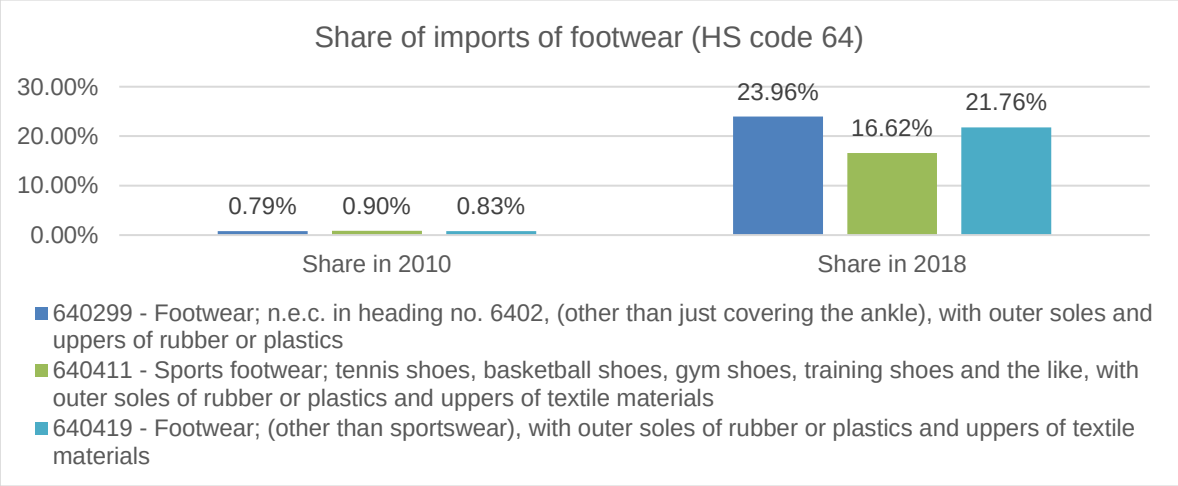


Figure 8: Existing Government initiatives for the sector

a. The entire leather product sector is de-licensed, facilitating expansion on modern lines with state-of-the-art machinery and equipment
b. The Government of India allows 100% FDI under the automatic route
c. On footwear sector, customs duty has been hiked from 25% to 35% and on parts utilized to make footwear customs duty has been hiked from 15% to 20%.
d. Capital goods (machinery) required by the industry can be imported without import duty under the Export Promotion Capital Goods (EPCG) Scheme of Foreign Trade Policy, subject to meeting the export obligation of six times the duty saved in six years
e. The Integrated Development of Leather Sector (IDLS) sub-scheme implemented as part of the Indian Leather Development Programme (ILDP) has significantly contributed to capacity modernization and technological up gradation of the leather sector
f. Under leather technology, innovation and environment issues, a sub-scheme of the ILDP, assistance is provided for technology benchmarking and environment management for the up gradation of Common Effluent Treatment Plants (CETPs), for Solid Waste Management and for holding environmental workshops.
g. National Manufacturing Policy identifies leather as a special focus sector for growth and employment generation
h. DPIIT has notified the Mega Leather Clusters (MLCs) sub-scheme. Its objective is to create new production centers for the leather industry with all the required infrastructure
i. Duty free import of raw hides and skin, wet blue chrome tanned leather, crust leather and finished leather of all kinds including splits and sides thereof for those exporters who are registered members with the CLE.
j. The Indian Leather Development Programme (ILDP) has been developed with several components including integrated development of leather sector for providing technical upgradation/ modernization of leather units with a maximum assistance of Rs 2 crore for each product line.
k. Under a sub-scheme of ILDP, there are provisions to provide infrastructure support by establishing of Mega Leather Cluster. The minimum land area required for Mega Leather Cluster is 25 acres to be set up without tanneries and 40 acres with tanneries. Assistance up to 50% of the project cost is provided by the Govt. under the scheme, excluding cost of land and with maximum assistance limited to Rs. 125 crore.
l. Under the 'Make in India' programme, the Govt. of India has created separate cell(s) to guide and facilitate investors and individual firms on their FDI and JV proposals. Further, the Govt. has designated CLE to identify potential and prospective non-resident investors including well known foreign companies who could be invited by the Govt. to invest in the leather and leather products manufacturing in India.

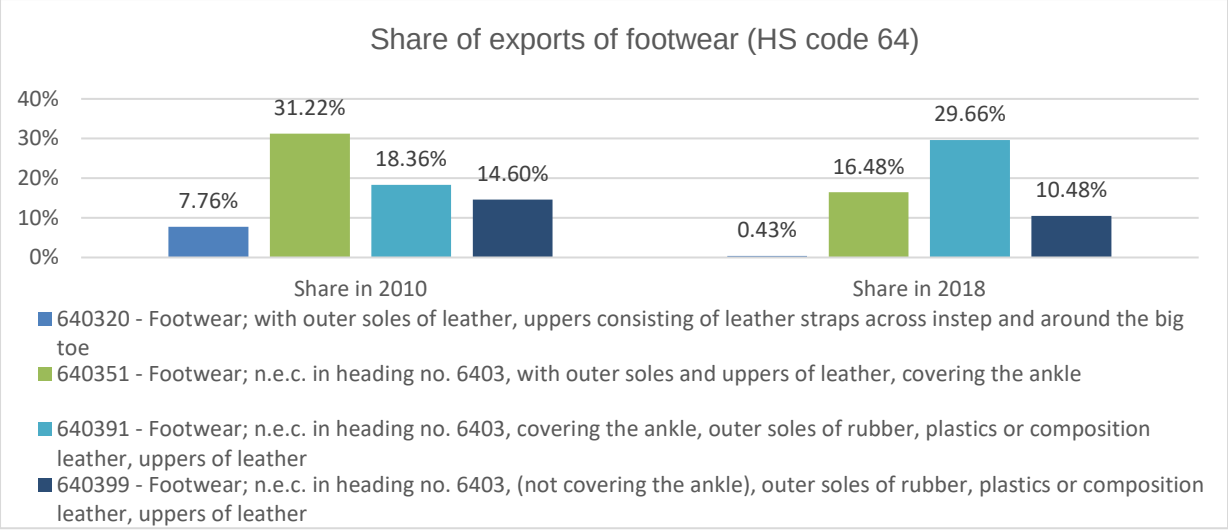
Moreover, there also has been a focus on skill development in the sector -

a. Under the National Skill Certification and Monetary Reward Scheme of the National Skill Development Corporation, financial assistance is given for the training and certification of both the existing workforce and new workers in the leather industry.
b. The Human Resources Development sub-scheme under ILDP implemented by DPIIT, aims to provide skill development training to the unemployed for placement in the leather industry while

Similarly, on the export side, under HS code 64, 4 sub codes accounted for almost 72% of all exports in 2010 but just over 57% in 2018 as shown in Figure 9. One of the fastest growing sub codes for exports has been 640411[18] which has experienced CAGR of 36% between 2000 and 2018.[19]

[18] Sports footwear; tennis shoes, basketball shoes, gym shoes, training shoes and the like, with outer soles of rubber or plastics and uppers of textile materials

Figure 9: Share of exports of footwear (HS code 64)



The Indian footwear sector is primarily raw material oriented and not necessarily product oriented. While this is ideal from a supply perspective, this does not align effectively with the demand side. A look at the footwear trade to and from India over the past few years shows an interesting trend. Value of Indian import and export of raw hides and skin has dropped sharply between 2014 and 2018 at a CAGR of 4.71% and -12.99% respectively[19]. However, the number of footwears produced in India has grown at the rate of 14.87% during the same period. Although leather footwear constitutes around 50% of raw hides and skin, it can be inferred that the share of leather footwear has reduced over the years while the market for non-leather shoes has expanded. However, with a raw material-oriented approach, India seems to be missing the area with increasing demand – non-leather footwear. Moreover, with the increasing share of women's footwear, in terms of volume and especially in terms of value coupled with the categories' need for relatively less durable products (due to changing fashion), we believe that women's non leather footwear has the opportunity to add greater value to the sector.

3.3. Indian Footwear Sector post COVID-19

Robust infrastructure, qualified scalable workforce and significant cost arbitrage gives a competitive advantage to any economy over other economies. As the footwear industry is emerging from the post COVID scenario, a major change in demand and supply of footwear products from India and other exporting countries is expected.

Foreign buyers will place smaller order quantities to reduce stock build up as buyers will be more interested in managing reduced inventories of finished goods. This will lead to more frequent changes in models both in the design and also the last and sole development. There will be more focus on use of sustainable non leather upper materials as an alternative to leather, the tanning sector is facing increased criticism as being one of the big polluters of the world despite ongoing attempts to clean up the processes. Orders will be smaller and more frequent meaning faster development schedules will be required. Companies will have to adjust to this "new normal" on the international scene. There will be a decline in the purchasing power of consumers and pressure to buy cheaper shoes. This will affect the bottom line of all the footwear companies. There will be a reluctance to buy new technology but hang on to the older systems until confidence returns to the world markets.

There will be a demand on footwear manufacturers to use their resources more efficiently. TC is charged with introducing innovative machinery and process technology and move towards increased use of latest mechanization in all sections of the factory. It should focus on non-leather-based technology which will

[19] Comtrade, KPMG analysis

help local industry by attracting demand for job work round the clock on some processes. This should gradually have the effect of moving from labor-intensive to a more technology driven sector provided that the companies can accept the need for such changes.

Footwear machinery manufacturers are moving their developments towards the use of digital technology. The latest machines are embedded with 3D CAD systems that can be used for last digitization and modeling, sole and insole designing and manufacturing. Growth in the Indian shoe sector will be driven by processes that focus on more fashionable but cheaper footwear which require less labour and more machine efficiency.

There is a need to train demonstrators and operators as per the changing demands of technology with improving productivity and quality parameters by upskilling or reskilling themselves. As some of the footwear buyers are looking for alternate cheaper products that may be in smaller quantities and different markets it could be a great opportunity for the Indian footwear Industry to invite foreign investments in such technologies through joint ventures and partnerships.

3.4. Technology Center – CFTI overview

Central Footwear Training Institute, Agra (CFTI) was established under Ministry of MSME in 1963 to support footwear industry in India. It was modernized with the assistance of the National Leather Development Programme of UNDP and equipped with state of art infrastructure in early 1990s. It was then tied up with international Textile Institute, U.K, a world-renowned institute in Footwear Technology for conducting a diploma course in “Footwear Manufacture and Design” during the year 1994-95. It further converted into a Govt. of India society for better autonomy and smooth functioning in the year 1996.

CFTI provides technological services to the MSMEs within its campus and Outreach Training Programmes (ORP) across the country. The Institution also serves as a tool room and is a self-sustaining autonomous body.

CFTI has three verticals to deliver host of services to the footwear industry in Agra. As a part of its different verticals, TC offers different services related to job work, short term and long terms trainings, outreach programs and consultancy services. Serviced through different internal departments, each vertical has a set of machines that are used for training as well as job work related services.

CFTI has designed various long and short term training programs ranging from 1 month (out-reach training programs) to 2 years. Minimum qualification for these different programs ranges from 8th pass to graduate depending upon the eligibility criteria of the respective courses. It has 3 workshops (clicking, closing and bottom) cum training halls having a capacity to cater to 60 plus trainees.

CFTI also provides job work services to support local footwear industry. Most of the footwear manufacturing units in Agra are either household units using hand tools and minimal machines for footwear manufacturing or semi mechanized units having some basic machines required for day to day operations of footwear manufacturing. Sustainable source of revenue is a major challenge for the tool room facility with high dependency on PU Pouring and CNC machines for generating revenue over the last three years. Through cluster visits it has been identified that there is immense potential to improve the job-work revenue by promoting job work facility.

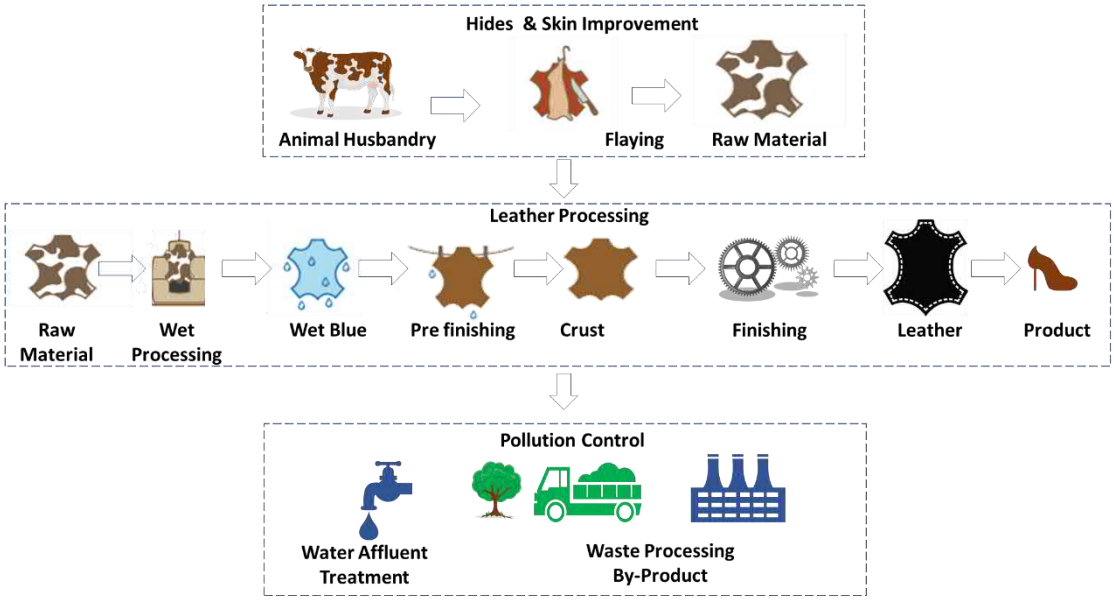
Design and Consultancy division of CFTI is currently providing limited consultancy services to MSMEs in Agra. This provides TC an opportunity to tap the large consultancy and support services market in Agra footwear industry which is marred with challenges like professionalism of the work force and undefined system operations.

Apart from this, CFTI also has a testing lab that is only being used to provide hands on training on testing equipment. The lab offers only physical testing and is not NABL certified hence, MSMEs are unable to utilize the testing services.

4. Footwear industry value chain

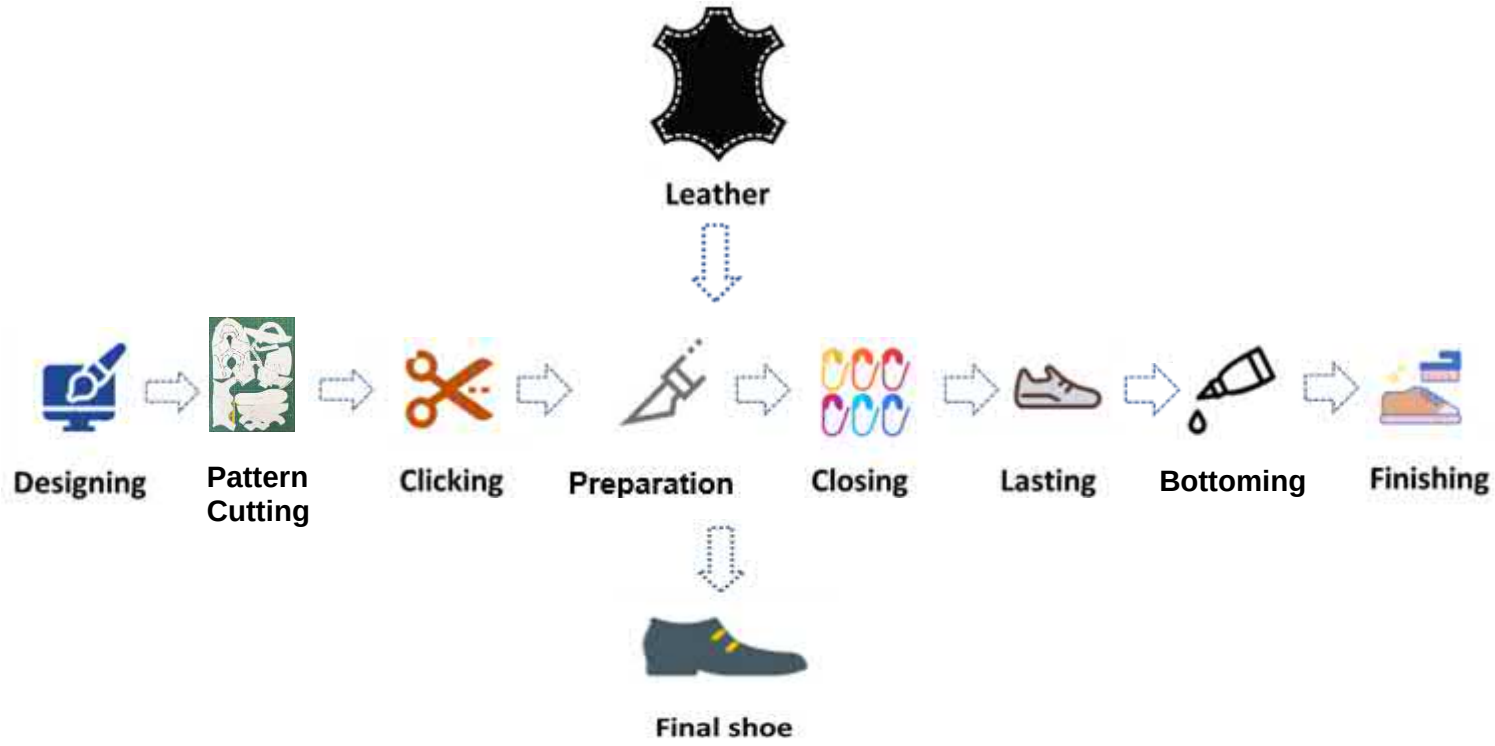
The leather value chain starts with the recovery of hides and skins from slaughtered animals followed by their treatment in tanneries which requires substantial investment. This is followed by the manufacturing of leathers products in small labour intensive workshops which require very limited investment or in large capital-intensive factories, post which the product is ready to be marketed.

Figure 10: Leather manufacturing value chain



The footwear manufacturing process begins once the leather has been treated in the tanneries and generally follows the following steps –

Figure 11: Leather footwear manufacturing value chain



Footwear manufacturing is generally carried out using two processes-

- Cemented construction-machine made
- Cemented construction-handmade

Designing

The preliminary step before working towards creating a design is to consider the guidelines of the client, the market where the product or service is to be launched and based on these to create parameters for the design. Designing process involves meeting with the client, research, mood board preparation, development of range plan, development of kit (shoe last, outsole, heel etc.), CAD review post agreement on the preliminary idea by the client, creation of specification sheet, creation of patterns and lastly development of a final sample.

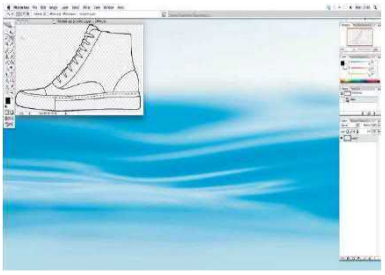


Figure 12: Designing process

Pattern Cutting

Pattern cutting is the process of creating a model of the various parts of the shoe upper so that these can be cut from leather or any other material and then joined to form the desired three-dimensional design. The pattern cutter will take the three-dimensional design and convert it into a series of two-dimensional shapes, initially in one size, and is referred to as sample size. These patterns will then be graded (i.e. made bigger or smaller) to cover the entire size range envisaged for production. Grading is the term applied to the proportional enlargement or reduction of a last or patterns to accommodate the different sizes in a range (such as UK size 5-12 for men). Grading can be carried out by hand, by machine or by a CAD-CAM software system.

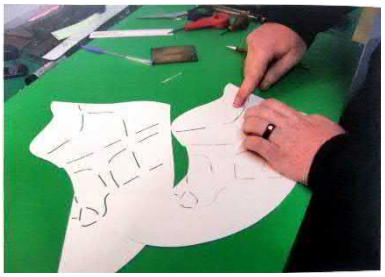


Figure 13: Pattern cutting process

Clicking

The clicking is also known as cutting. The clicking process is one of the most critical operations in footwear manufacturing. This step involves cutting of upper, bottom and lining components for the shoes. All upper and bottom parts including insole, toe puff, etc. are cut in the clicking section. If the components are not cut correctly then it will have an adverse effect on the finished product. Clicking is the only operation where significant material savings can be made.

Figure 14: Clicking process

Preparation

This process is followed by identification marking (ID marking) of the components to aid production and maintain the quality. Stitchmarking is part of the process of preparing components for sewing. Visible marks are applied to the upper components (outers and linings) so that when they are sewn together, they can be positioned accurately followed by the skiving process. Skiving is the operation used to reduce the substance (thickness) of the cut edge of an upper or lining material normally before stitching. Skiving operation is conducted i) to improve the appearance of the finished upper, ii) to reduce a seam's bulk to avoid discomfort in wear and, iii) to aid subsequent operations such as folding and stitching. Backing an upper material with a lining or interlining is done to improve the appearance of the inside of the shoe (linings) and to make the inside of

Figure 15: Preparation

the shoe more aesthetically pleasing. The number of different steps included in this step may vary as per the requirement.

Figure 16: Closing process

Closing

Upper closing is one of the most skilled operations within the shoe manufacturing process. Closing is basically joining pieces together. Different machines are used to form the stitch formation for operations such as lockstitch, chainstitch and overlock. There are many different types of stitching machines such as multipurpose machines (flat bed machines and post bed stitching machines) and, special purpose machines (cylinder arm machines, zigzag machines, heavy stitching machines, over-seaming machines for insole attaching, and automatic machines).

Figure 17: Lasting process

Lasting

Lasting is the process to convert the unshaped or partially shaped upper into the upper found in the finished shoe. It is to be noted that there are a number of ways in which footwear can be made and each different method consists of a particular sequence of lasting operations which is allied to a specific way of attaching the sole. Different types of lasting are flat lasting, slip lasting, string lasting and ripped lasting (Goodyear welted).

Bottoming

The preparation process for lasted upper for the follow-up process of bottoming depends upon the type of upper materials (i.e. leather, PVC-coated fabrics, Synthetic suedes, PU-coated fabrics, poromeric, textiles). In general, the bottom of the lasted upper is roughed or scoured to modify the surface in order to make it compatible with adhesive material. Mechanical or chemical treatment (the choice of treatment is dependent on the type of adhesive to be used) is also given to the soling material to modify the surface or to remove the contaminants which might interfere with adhesion for the pasting. In the bottoming, the sole is attached to the lasted upper. The process of bottoming maybe through simple sole cementing and bonding, Goodyear welted sole attaching, machine sewn or direct moulding.

Figure 18: Bottom process

Finishing

Finishing operations vary enormously between styles, materials and shoe rooming of different footwear factories. Typically, a finishing process involves cleaning of shoes (by mild, medium or strong cleaner), top dressing by wax or cream to provide the required gloss or luster to the shoe, spraying with clean compressed air with the help of a spray gun or nozzle, removing stitchmarks, hot blasting, steaming and ironing to clear the wrinkles from the upper by the use of hot air and labeling of the shoe is done for product branding.

Figure 19: Finishing process

Other industries feed-in to the leather industry at different stages of production. For example, tanning requires substantial inputs from the chemical industry. At the higher end of the value chain, design and marketing are essential to compete in domestic, regional and global markets. However, these activities tend to be controlled by lead firms in the chain, meaning that tanners and leather producers in developing countries have a high degree of dependency and only limited prospects for upgrading. Quantity and

quality-related problems dominate the first production stage, whereas management and design skills dominate the higher value-added stages.[3]

5. Challenges in value chain

Despite the footwear industries strong performance in India, the sector is riddled with challenges while offering several new opportunities. The following figure gives a high-level SWOT analysis of the sector followed by a detailing of the challenges faced.

Figure 20: SWOT Analysis

5.1. Leather footwear production and manufacturing process

5.1.1. Primarily unorganized sector leading to hinderance in scalability

The Indian footwear industry is highly fragmented with manufacturing being dependent on sub-contracting/Job work. Unorganized segment dominates the market in sales volumes due to its presence majorly in the low-cost rubber/ plastic footwear. Given the fragmented nature, the footwear products end up catering to lower end of the demand. The products are usually cheaper due to involvement of cheap household labor, lax implementation of tax and labor laws and limited investment in assets.

Most of the job working units here are household or micro level units which operate from their residence with no separate workspace. Footwear manufacturing SMEs in Agra especially the workshop units expose themselves to fumes and chemicals during finishing processes. Moreover, operating in congested areas also makes it difficult for the units to comply with regulatory requirements such as fire license, pollution control clearances, labour law related compliances. Most overseas buyers and brands insist on such declaration and compliance.

5.1.2. Lack of investment in process and technology thus limiting quality of product

Two key processes of footwear manufacturing which define quality and help move it to next level of value is (a) design and pattern grading (b) closing of shoe upper on last and pasting on sole. While design and pattern grading are not a major component from a cost perspective, it decides the quality of shoes. Similarly, the issue of closing of shoes upper on last and pasting on sole contributes close to 55% of the value chain of the shoe manufacturing process. Also, upper making is a major bottleneck of production in leather footwear and therefore, is generally outsourced for faster turnaround time. Generally, a job work mentality is followed, and manual approach is undertaken in these stages. Moreover, most of this work is undertaken by part time workers which limits the inclination of manufacturers to spend on capacity building and training. As a result of these factors there is increased lead time in sample creation, mistakes, fit and comfort issues, low quality finish and high rejection rates, etc. placing it at a lower value chain.

This is a well-recognized problem and there are machines available (costing between INR 50,000 to INR 200,000) which automate the entire process and take the entire product suite to the next level. Based on interaction with some of the prominent brands, it was revealed that they did identify some of the better small manufacturer and equip them with training and such machinery on easy terms. However, given its job work nature, the small manufacturers once equipped with the know-how and machinery, start producing for other manufacturers and de-prioritize the orders of their anchor units, primarily, because the initial part of the remuneration paid for the first few months is deducted to recover the cost of these investment, which is avoidable if the small manufacturer takes up work for other anchor units.

In addition, an increased number of buyers from across the country demand a particular quality specification for products. With no testing labs in some of the regions (especially Agra), quality samples have to be sent to different locations which increases costs as well as leads to delays.

In some cases, under-utilized machinery remains idle for long periods due to insufficient orders to reach the minimum scale of production. For example, installation of a lasting line conveyor where they quickly become a dirt and rubbish collector as the units do not have sufficient production to fully use their capacity. Moreover, inadequate assessment before installation of a particular machinery is another challenge faced. For example, installing dieless cutting machinery into an SME whose production level does not match the capacity of the dieless cutter is an example of the wastage of an expensive asset. This is an area where the TC's can have major impact on SME's by enabling them to avail of the benefits of the technology without the needs for big investments.

Many enterprises employ basic machinery for production, the main reason for this is lack of knowledge of latest manufacturing techniques, high price of machinery, limited space for expansion and technical knowhow of operating such machinery. This results in low production capacity of enterprises which is a deterrent in taking up large scale orders. Majority of the operations are carried out manually leading to low standardization of products and wastage of raw materials.

5.1.3. Essential components of footwear supply chain missing in one geographical area

Generally, the complete supply chain is not present in one particular area. In Agra, depending on the type of unit, sourcing of raw material takes place via different means. Household and workshop units procure from Hing Ki Mandi (footwear component wholesale market) which in turn procures it from middlemen in Delhi who source it from Kolkata, Kanpur, Chennai. However, export and semi mechanized units, due to their larger requirements, source it directly from these locations. As a result, the smaller, unorganized sector procures its raw material at a higher cost. With leather accounting for 40% of the cost of final product, this has a significant impact on the competitiveness of these players. Moreover, raw material like adhesives, eyelet, buckles, laces are all procured from Delhi. Shoe lasts and soles are, however, available in Agra.

5.1.4. Conventional designs, lack of awareness on global trends, 'replicate' not 'create'

Generally, manufacturers process the order based on sample design provided by buyers (importer of leather goods). The recent trend has been to copy design instead of formulating new designs which leads to a loss of competitive edge in the market. Although, there are certain organizations for e.g. CLE, India Trade Promotion Organization (ITPO) etc. which aid in improving overseas market access, there are inadequate number of specialized service providers in the area of design and product creation.

The complete value chain within the sector is geared towards low value add manufacturing. A very small number of units engage in creating new designs with most working on designs shared by foreign clients. Freelance designers are available in the cluster and provide 2D CAD/CAM designs to the footwear manufacturing units. On average, there is 1 designer for every 25-30 enterprises in the cluster. However, the designs are generally not elaborate and are used by players serving the domestic market.

5.1.5. Non-availability/dysfunctional integrated Infrastructure

Capacity to invest in infrastructure is largely governed by the scale and nature of industries present in any geography. An overwhelming majority of units are MSMEs and therefore do not have the capacity to provide for essential industrial infrastructure.

5.1.6. Lack of formal training

Many artisans and labour have learned the skills of footwear manufacturing from their family members without any formal training. This has limited their exposure to latest technology in footwear manufacturing. Also, the general level of education of people engaged in footwear manufacturing is low with limited knowledge of business processes, government schemes and procedures.

Moreover, the training offered by training institutes such as CFTI, Agra is largely at a supervisory level. With no formal job work training, the supply of skilled artisan labour is expected to fall, which is essentially the strength of the Agra cluster.

5.1.7. TC services aligned with raw material supply as opposed to demand side

CFTI Agra primarily offers services related to leather footwear and the current infrastructure is not aligned to support the market needs of the non-leather sector. Moreover, the needs of the leather footwear sector are easily met by the local service providers which offer similar services in proximity of the cluster.

The TC is primarily viewed as a training institute with many enterprises not aware of other services being provided. Also, CFTI is located around 10-15 km away from all the major manufacturing locations. This increases the logistic cost for manufacturers and limits the uptake of the services.

5.2. Marketing and distribution

5.2.1. Fractured supply chain resulting in inefficiencies and delays

Despite the emergence of organized players over the last decade, the Leather sector in India has been highly fragmented and unorganized in nature and is known for the plurality of family-owned operations. This adds approximately 6% to the due to transportation across the value chain since the units are operating in a distributed manner (e.g. Tanneries, sole, accessories, chemical, all these units are distributed). This leads to higher costs structures due to units operating in distributed manner and limited scope and availability of industrial infrastructure and common facilities center – both for the design, production process and administrative requirement. Moreover, most of the supply chain in the marketing and distribution is informal with multiple touch points resulting in delays in supplying finished leather because of raw material sourcing and in-efficient processing of the tanneries.

5.2.2. Organized retail not leading to organized back end

With people becoming brand conscious and the rising need to leverage economies of scale, the organized sector has witnessed growth in last two decades. Major export houses have come up and there has been growth in the organized retail. However, the retail chains have not changed the back-end ecosystem and changes have been limited only to the retailing part. Also, there is limited involvement of Business Development services for the leather market linkage. The industry operates at the lower end of the value chain. To maintain sustained growth, the scale of productions must keep on increasing because of tiny margins – which may not always be possible.

5.2.3. The marketing and presentation of the products has gaps

Despite being a major player in leather footwear, India does not have a significant digital presence. Agra, which is the hub for leather footwear, hardly has any online presence. There are very limited websites that showcase Agra's leather footwear and the ones that exist require significant support in product cataloging and presentation. They have very limited presence on platforms such as Amazon, Instagram,

etc. Moreover, the websites that do offer exciting products, although based in Agra, tend to target exports and are seemingly branded to distance themselves from their origins.

5.2.4. Changing consumer taste and preferences

With India's domestic market driving the sector, the sector will need to keep up with the changing taste and preferences of the Indian consumer. The changing trend in the footwear industry is not just limited to cities and is now penetrating the smaller Indian towns and cities. Awareness and aspirations for the latest global trends have increased with increased urbanization. The growth of integrated shopping malls, retail chains and multi-brand outlets are drawing more customers to shopping centers due to an overall improvement in space, ambience and convenience. However, smaller firms are not able to target this market due their low quality and obsolete designs.

In addition, some of the generic challenges faced by traditional footwear clusters include -

- Competition from established footwear brands which have set standards and quality benchmarks
- Lack of availability of finance to run the business as credit system is prevalent
- Marketing of footwears produced as low price is obtained for selling the footwear in the local market
- Raw material availability
- Low awareness about government schemes
- Occupational Safety & Health concerns as working conditions are below international standards

Some of the major challenges faced by modern footwear clusters are –

- Competition from international footwear clusters in Vietnam, China, Germany, Portugal
- Lack of access to latest technologies as compared to that of in international footwear clusters
- Lack of R&D in various aspects of footwear manufacturing
- ICT promotion is an area that lags behind
- Tariff rates and trade barriers are a negative impact
- Low protection of intellectual property

Based on the above challenges, we believe there is a requirement for interventions across many areas and therefore, we have identified 4 major areas which require support from a technology and overall infrastructure standpoint.

- ***Leveraging the latest technological advances in the manufacturing value chain*** *- Treatment of raw material for leather products in tanning operations - There are challenges across the value chain and treatment of the raw material in tanning operations leads to sub optimal quality and usage of processes detrimental to the environment. We believe this is a critical area to address since it not only impacts the footwear sector but the overall leather sector.*
- ***Encourage upward movement within the leather footwear value chain*** *- Within the leather footwear sector, there is considerable infrastructure, although elementary at the cluster level, to support it. However, self-design, production, branding and distribution account for a very small part of Indian leather footwear sector and need to be increased.*
- ***Create supporting infrastructure for non-leather footwear products manufacturing*** *- Despite the growing demand for non-leather footwear (estimated at ~30% of total footwear production in Agra[20]), there is limited infrastructure to support it, leaving the cluster unprepared to deal with future trends. Also, the sector needs to be geared towards the rising demand for women's footwear (highlighted above)*
- ***Incorporating technology within the footwear itself (Smart shoes)*** *- As highlighted earlier, the market for smart shoes is expected to expand significantly, however, the Indian footwear sector is currently not ideally positioned to participate in the growth.*

[20] As per discussions with stakeholders in Agra

6. Skilled Manpower requirements in the footwear sector

Footwear sector holds a very important place in the Indian economy on account of its potential for creation of employment opportunities, substantial export earnings and favourable conditions for its sustained growth. There is a huge potential to enhance the domestic production and in turn exports which necessitates infusion of manpower as well as upgradation of skills of existing employees in the footwear sector. Though the need for appropriately trained and skilled manpower is felt across all levels, the shortage is most acutely felt at the lower level of semi-skilled workforce. The distribution of workforce across major functions in the footwear sector is mentioned in Table 6.

Table 6: Distribution of workforce across major functions in the footwear sector[21]

Function	Percentage of Workforce
Manufacturing/Production	80-85 Percent
Designing and Sampling	2-3 Percent
Sales	3-5 Percent
Other Support Functions (Includes HR, Finance and Administration)	10-15 Percent
Total	**100 Percent**

As can be seen from above table, majority of the workforce in the footwear sector is involved in manufacturing/production process. The distribution of the human resource across the manufacturing/production process in the footwear sector is mentioned in Table 7.

Table 7: Distribution of human resource across various manufacturing process in footwear sector[21]

Function	Percentage of Workforce
Cutting/Clicking	10-12 Percent
Closing	60-65 Percent
Lasting	10-12 Percent
Finishing (Includes Quality Control and Packaging)	10-12 Percent
Total	**100 Percent**

6.1. Incremental Human Resource Requirement (2020-2025 & 2025-2030) in footwear sector

Table 8: Human resource requirement in footwear sector (2020-2025 & 2025-2030)[22]

	Employment (in million)			Employment Growth (2020-2025)	Employment Growth (2025-2030)
	2020	2025	2030	in million	in million
Footwear	1.27	1.82	2.57	0.55	0.75

The period 2025-2030 will see a marginally higher growth in employment w.r.t 2020-2025 with the footwear industry not expected to witness a significant change in operations through automation resulting in steady employment elasticity factors over the period of 10 years.

[21] National Skill Development Corporation-Human Resource and Skill Requirements in the Leather & Leather Goods Sector (2022)

[22] KPMG Analysis

Table 9: Human resource requirement in footwear production and associated job roles[23]

Function-Job Role	Employment (in million)		
	2020	2025	2030
Cutting/Clicking-Operator	0.13	0.19	0.26
Closing-Operator	0.69	0.99	1.40
Lasting-Operator	0.13	0.19	0.26
Finishing-Operator	0.13	0.19	0.26
Designing & Sampling - Designer	0.03	0.04	0.05
Sales-Merchandiser	0.04	0.05	0.08
Other Support Functions-Store Manager, Production Manager, Line Manager HR, Finance, Administration etc.	0.13	0.18	0.26
Total	**1.27**	**1.82**	**2.57**

As 80-85 percent of the human resource in footwear production is associated with closing operation there will be immense scope for the human resource skilled in closing operation in the footwear sector.

Footwear industry in India along with the world's middle-income countries faces a common challenge of either maintaining or upgrading the entire value and supply chain in order to remain competitive in the global market. Historical transformation of the high-income countries in the footwear sector is a lesson for the future, with thousands of enterprises may be forced to close with contraction of employment in millions of jobs. To avoid such a scenario, it is necessary to invest in skills development and training, research, infrastructure and new technologies to upgrade the footwear industry[24]. Future of footwear industry lies with adoption of technologies for not only enhancing the productivity but also comply with environmental regulations and reducing carbon footprint of the industry; ensuring compliance with animal rights and protection through new technologies. Adoption of technologies wont necessary will mean reduction in workforce but upskilling of the workforce for greater skill sets. The workforce of the future in the footwear industry will be cross trained in all or many operations. Some of the new-age skills sets required in the footwear sector is mentioned below-

- Engineers and technicians will be required who can operate, service and maintain the new age technologies.
- Qualified personnel will be required for adherence to labour and environmental norms.
- Skilled workers knowledgeable with computer softwares will be required to operate modern technologies such as automated cutting and CAD.
- Skilled personnel having experience in electronics, material science and medical science will be in demand as future workforce for footwear industry.
- Supply chain managers with effective production planning and inventory management skills for smart inventory management.

[23] KPMG Analysis
[24] International Labour Organization (ILO)-The future of work in textiles, clothing, leather and footwear 2019

7. Recommendations

In cognizance of the identified challenges, the following interventions are proposed to prepare the Indian footwear sector for future challenges -

- Incorporating technology within footwear
- Encourage upward movement within the leather footwear value chain
- Recommended technologies in footwear manufacturing
- Create supporting infrastructure for non-leather footwear products manufacturing
- Leveraging the latest technological advances in the manufacturing value chain
- Indian leather & footwear sector- to enhance its competitiveness
- TC as an enabler for innovation
- Skill development for small unorganized sector
- Improvement on performance testing and compliance testing facilities

7.1. Incorporating Technology within footwear

From a strategic point of view and taking a 5 year horizon, the Indian footwear sector must augment significantly to play a major role in the global scenario. With the advent of new technologies and the proliferation of electronics within footwear, this presents an opportunity for the existing stakeholders to enhance their offering and create a separate product line to be able to focus on product augmentation. The TC should, therefore, look towards introducing such new technologies in the cluster and promote such augmentation.

Figure 21: Callaghan– Differentiation through technology

Callaghan is a Spanish footwear company which boast of adopting technology to create its own niche market in footwear industry. To differentiate its casual shoes from its competitors, Callaghan designed and developed a casual shoe with an integrated electronic device that records physical activity and is connected to a web based personal trainer.

7.1.1. Smart shoes

As highlighted earlier, the smart shoe market is expected to expand, driven in parts by existing players but also by startups. India, with the world's second largest startup ecosystem, has seen several technology based companies rise over the past few years across industries. Such companies, identified through the Startup India initiative, can be explored from a smart shoe technology perspective.

The TC can play a role of a facilitator and establish linkages between the right players. From the above value chain, export oriented units and semi mechanized units to some extent, would have the infrastructure and the capacity to invest in smart shoes.[25] Alternatively, lead firms who have already developed smart products would be exploring the possibility of outsourcing manufacturing operations, similar to what is prevalent in the leather footwear sector.

Some of the recent technological innovations with the industry include smart shoes with soft sensor networks[26]; functionalities such as GPS, heating, pedometers, musical or massage functions and automated fastenings, nerve stimulation; biologically interactive materials that release or contract based on heat generated within the foot, etc.

7.1.2. Inter TC collaboration to bring together multiple disciplines

With technologies like additive manufacturing, AR/VR, internet of things penetrating the footwear industry, it offers opportunities for inter TC collaboration especially with the Institute for Design of Electrical Measuring Instruments (IDEMI), Mumbai, and Indo German Tool Room (IGTR), Aurangabad, etc.

[25] A list of almost 350 footwear manufacturing units across the country is available with the TC

[26] Circuits of flexible sensors that are embedded in the upper and/or (in) sole and are programmed to measure specific data, which is then sent to an external device, such as a watch or a mobile phone

Projects in collaboration add value to the service offerings of all TCs while also offer an appealing feature to the target market.

Export-oriented units can look at AR/VR technologies to better connect with their foreign lead firms while domestic firms can create product prototypes through additive manufacturing/3D printing. Examples of recent global innovations using the 3D printing technology include Adidas's Future craft 4D & Alpha edge 4D- Digital Light Synthesis (DLS) Technology, Reebok's-The Liquid Floatride Run, its latest 3D shoes, ECCO- 3D QUANT-U project, Nike- 3D-Printed Uppers.

While it is understood a mere introduction to such technologies will not be enough to promote adoption and drive innovation, specific programs that explain the amalgamation of these aspects with existing footwear processes can prove to be useful. With the TCs having the foremost experts in the area of footwear and electronics, they can prove to be breeding grounds for creating a multidisciplinary approach towards upgrading traditional industries.

7.1.3. Bringing customization to the customer using technology

As established earlier, the need for customization and individualization has picked up significantly over the years. With new technologies, it is gradually becoming easy to customize products during manufacturing and also during the purchase process.

From an overall sector perspective, there are certain changes in the landscape which need to be considered in the near future.

- The key areas that must be reinforced by the institutional bodies and industry giants on priority include demonstration of new age technologies, product and process engineering & research and development, hands on training, design development. This has been discussed in detail above.

Figure 22: Sacha London – Customization through INESCOP iShoe

Sacha London is a footwear company that specializes in women's shoes. All the footwear is designed in Spain. Sacha London wanted to add value to the point of sale, and to increase mass media impact of the brand. In collaboration INESCOP a technology solution was developed to offer a chance to the customer to customize all the footwear collection, using a tablet and web based online customization system (iShoe), and offered the possibility to test the model in a Virtual Mirror (iMirror).

- With fashion changing more frequently than ever, to compete, the approach should be to minimize the process of new product development and prototyping to launch the product in the market earlier than the competition and enjoy a longer lifecycle of the product.

- The continued footwear product safety is a top issue for the entire footwear industry. There are many different global chemical and physical testing standards depending on the country and footwear product (age, use, etc.). Companies must be aware of these laws and ensure their compliance standards meet or exceed standards from Consumer Product Safety Commission (CPSC) to Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) requirements and other laws. It is essential to understand and become accustomed to the changing landscape of product safety standards and regulations that impact the footwear industry.

7.2. Encourage upward movement within the leather footwear value chain

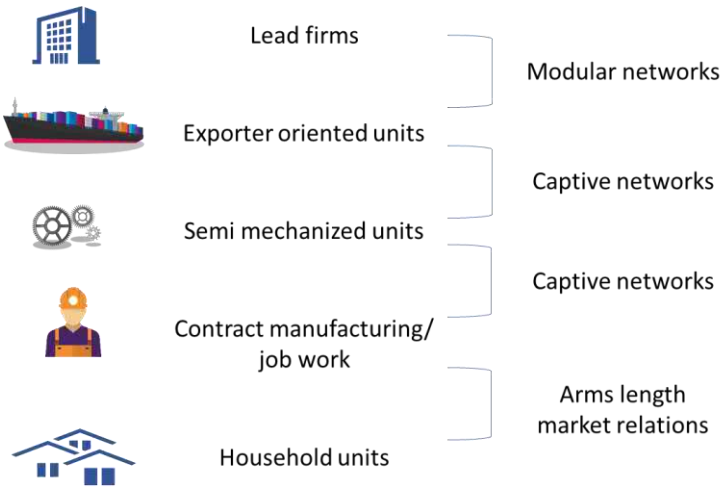
7.2.1. Targeted interventions for firms in value chain

There are various aspects from sourcing to market development that have to come together for the footwear industry to move up the value chain. Due to the technological know-how and capabilities of the existing stakeholders within the sector, there is an opportunity for them to move vertically up in the value chain. The stakeholders within the footwear value chain can be seen in the figure below. Each stakeholder shares a different type of relationship with the other and can be categorized as follows[27] –

[27] Learning and Earning in Global Garment and Footwear Chains, Hubert Schmitz

- **Arm's-length market relations** – Replaceable suppliers with standard work and limited to no value addition.
- **Modular networks** – Distribution of activities based on competencies between buyer and supplier with high level of trust between them. In the Indian context, international buyers or lead firms provide the design and product specification while export oriented units produce the products as per the requirements.
- **Captive networks** – Very high levels of monitoring and high degree of control over suppliers. In such relationships, buyers define product characteristics, production process and continuously inspect the activities. This is an example of moving down the value chain wherein buyers take control of the inputs.
- **Hierarchy** - The lead firm takes direct ownership of some operations in the chain. The case of the intra-firm trade between a trans-national company and its subsidiaries falls into this category.

Figure 23:Types of firms and their relationships



The Indian footwear sector witnesses these relations across the value chain. The current value chain has gaps across multiple stages especially in areas such as self-design, branding and distribution. Addressing these would involve targeted interventions at firms at each stage.

Figure 24: Farida - Success story of moving up the value chain

Factories in Chennai are exploring new business models for technology upgradation, increasing supply chain efficiency, reducing lead time for export orders. As a result, lead time of 90 days from the day of an order confirmation has reduced to 60 days, in some cases, 45 days.

Farida, one of the biggest footwear manufacturing group with 35,000 workforces has successfully adopted a business model suitable for buyer's lead time requirements and sample development. Farida has established a Design studio in China with a staff of ~50 people to speed up prototype making and sample development activities. Most of the sample development, prototype development, and pre-production activities are carried out at design studio in China. Once the pre-production samples are approved then bulk production orders are transferred to Indian factories, resulting in lead time reduction. The activity such as developing sole molds and pattern cutting which takes approx. fortnight in India is done comfortably within 3-5 days in China. This has also led to them having their own portfolio, which is of a great help to the prospective buyers in finalizing the order.

Export oriented units – As established earlier, with almost 95% of footwear consumption catering to domestic needs, export-oriented units, with support in terms of original design, branding and distribution, can develop their own products and target the domestic luxury market. The TC, by engaging external designers and establishing a design studio in line with FREYA for international/contemporary design, can provide design services catering to the domestic market and such units can leverage the distribution networks of their domestic partners. The EMERGE programme of National Stock Exchange for developing a design culture can also be replicated in this regard. This would enable export-oriented units to become the lead firm and thereby move up in the value chain.

Semi mechanized units – By leveraging the recommendations in the previous sections, semi mechanized units can increase their productivity and competitiveness and provide higher quality products. More mechanization through introduction of new technologies would also help in changing their relationship from captive network to modular network. The TC can provide consulting

services in this regard and devise a roadmap for each such unit post conducting an assessment. Post development of a roadmap, support in terms of finance facilitation through financial institutions and existing schemes (IDLS) can also be provided to the units

Interventions on the design side can also be leveraged by such units given there is limited innovation at this stage. From a distribution standpoint, the proliferation of ecommerce has been significant which can be leveraged, however, without branding standing out on an ecommerce platform can be difficult. With the growth in online market places, only the major firms in the organized sector have found a gateway to tier II, tier III and rural areas of the country. Smaller firms have not yet been able to leverage ecommerce. Therefore, associations such as Agra Footwear Manufacturers & Exports Chamber, Indian Leather Products Association, Indian Footwear Components Manufacturers Association, Indian Shoe Federation, Indian Leather Technologist's Association, etc. could be leveraged to help build a brand.

Contract manufacturing/job work – Such work largely tends to be manual and mundane in nature lacking quality and standardization. Moreover, with limited value addition, such suppliers tend to be replaceable leading to irregular cashflows and uncertainty in terms of orders. For such units to move up the value chain, their quality requires significant augmentation and therefore, an integrated model of practical training/skill enhancement and co-working is suggested. The skill enhancement program would include 1-3 months of skill development training followed by 3 months of practical training/co-working space.

- Skill enhancement: Training in particular on manufacturing of leather footwear and customized based on the industry requirements and skill set of the participants. These programs will be classroom based to upgrade the existing skill of candidates. The TC already has extensive experience in this regard.
- Practical Training Program: After successful completion of the training program, candidates will be given an opportunity to manufacture/ develop products using manufacturing techniques learned during the training, at the TC premises under the guidance of experts. During this time, the candidates may procure the raw material and produce the finish goods and sell in respective markets, which will provide livelihood support to them. Raw material assistance and market linkage support shall be provided by the TC enabling them to understand the complete value chain while helping them develop relevant linkages.

Since a significant part of the operations tend to happen within the respective households, this model of co working space for such artisans and workers is suggested. This approach is expected to result in a collective approach leading to more bargaining power for the artisans and ability to fulfill larger orders. In addition, it will result in a better and healthier working environment. Factors such as these are expected to attract more artisans.

Also, as highlighter earlier, the current trend is to replicate the design either provided by the anchor unit or copy the latest available design. Evidence suggests that brands with in-house design (that are manufactured for Rs. 400) sells for Rs. 800 to 1000 (medium brands) or for Rs 1,500 to Rs 2,000 (top brands). Therefore, the value add due to design can be significant. Thus, setting up common design facilities where the smaller players can have access to designs (by paying for them) will help them move up the value chain.

Figure 25: Tempe Inditex Group– Hyper-realistic virtual prototypes

Tempe Inditex Group is a multinational footwear company which sells footwear and accessories by brands name such as Zara, Massimo Dutti, Pull & Bear etc. Tempe's challenge was its complex and multifactorial operational environment, with multiple conditional factors. The solution was to use INESCOP's integrated CAD/CAM solutions, starting from the shoe design phase. The solution helped in exchange of information using compatible data files between design and production centres: components (lasts, heels, soles) and whole footwear. This resulted in creation of hyper-realistic virtual prototypes.

From an EHS perspective, especially for household and workshop units, a simple spray booth with vacuum and water circulation will help address the challenge of exposure to fumes and chemicals during finishing processes.

Figure 26: Spray booth in the Chennai Leather cluster

It may be noted that the TCs need to promote and deliver education in a raft of new technologies, materials, techniques and capture data on future developments through an internal information centre. TC's must not abandon the traditional education delivered to 16 – 18 year old students who dropout. The basic knowledge of shoemaking in India and globally will continue to be an essential starting point for all entrants to the TC programmes. Knowledge in new technology must be disseminated and included in these courses.

7.2.2. Leverage Business Development Services (BDS)

BDS providers generally offer services which address gaps across the value chain from sourcing, design, process, technology and market development, etc. Providing necessary linkages with BDS providers can help in this regard and also establish market linkage in the domestic and international market where the needs are more pronounced. Also, if the focus has to shift to product centricity, even the market development services will have to follow similar approach.

- Facilitating the creation of a brand
- Leveraging GI tagging
- Leveraging multiple MSME development programme run by leading ecommerce players such as Flipkart, Amazon and others to provide better access to the market.

7.3. Recommended technologies for footwear manufacturing

Within the footwear manufacturing process, the Agra cluster had several opportunities to upgrade. The Chennai cluster has already adopted a few of the below mentioned technologies. Pattern cutting and grading, clicking machine, shoe pasting on sole are some of the areas where mechanization has to be promoted. These stages add over 50% of the value addition and also determine the quality of the footwear. Many units get the pattern and grading done manually. The benefit of most of the technologies is better quality of product through standardization in addition to increased productivity. It may also be noted, that the IDLS scheme includes most of these machines, therefore, making it easy to procure them.

While the upgradation of technology is important, it is also imperative that a proper assessment be conducted before installing any machinery. The TC can play a significant role in this aspect by providing relevant consultancy services to accurately assess the requirement and provide recommendations

Table 10: Recommendations on new technologies

Process	Cemented Construction-Hand Made	Cemented Construction-Machine Made	Technology suggested	Skill Set Required	Training Suggested	Benefits
Designing & Pattern cutting	○ By hand (manual) ○ Grading on 2D & 3D CAD (Procam, Shoemaster)	○ By hand (manual) ○ Grading on 2D & 3D CAD (Procam, Shoemaster)	○ 3D CAD systems (Red 21 software)	○ Knowledge of shoe designing and pattern engineering ○ Good hand-eye co-ordination and judgement in positioning and cutting ○ Knowledge of basic estimation and numerical skills[28]	○ One-month training from RED 21 software engineer	3D CAD systems ○ Import of a wide range of formats (HOR, LST, STL, IGS, SEC, OBJ, etc) ○ Flattening of any last shape, including boots and ankle boots, in an accurate and reliable way. ○ Creates quickly and easily any type of sole (sports, platforms, wedges, etc.) and heels ○ Allows conversion of design directly into instructions for machinery
			○ Shoe last thermoforming machines ○ Leather area measuring machines			○ Shoe last thermoforming machine helps to easily make models of last. ○ Leather area measuring machines Support in measuring area of raw material
Clicking	○ By hand (manual)	○ Hydraulic clicking press ○ Trolley type clicking press	○ Dieless cutting machine (Knife cut, water jet, laser jet) & numerical control	○ Knowledge of material management (raw), interlocking	○ One-week training will be provided by the concerned supplier.	Dieless cutting ○ It is used for lay planning (layout) directly commanding the cutting operation without requiring any die.

[28] Leather Sector Skill Council-Qualification pack Cutter (Footwear)

Process	Cemented Construction- Hand Made	Cemented Construction- Machine Made	Technology suggested	Skill Set Required	Training Suggested	Benefits
			dieless cutting systems	analytics, prior experience of working with 2D CAD systems ○ Good hand-eye co-ordination and judgement in positioning and cutting ○ Knowledge of basic estimation and numerical skills[29]		○ Increased productivity & reduction in cost of using leather by more accurate layout of patterns on each skin (requires fewer workforce)
Preparation	○ Skiving machine	○ Upper edge skiving machine	○ Automatic upper edge skiving machine (3 step skiving machines, auto skiving machines)	○ Prior experience of working with similar machines in the footwear industry. ○ Must possess good hand-eye co-ordination, monitoring ability,	○ Machine suppliers generally provide initial training with necessary preventive maintenance measures.	Automatic upper edge skiving machine ○ Automatic upper edge skiving machine improves handling efficiency ○ Internal memory to recall the skiving specifications for future operations ○ Improved accuracy of skive on leathers with varying thickness due to auto adjustment Splitting machines

[29] Leather Sector Skill Council- Qualification Pack Helper Upper Making (Footwear)

Process	Cemented Construction- Hand Made	Cemented Construction- Machine Made	Technology suggested	Skill Set Required	Training Suggested	Benefits
				concentration, depth perception, vision, dexterity skills, estimation and numerical skills		Ensures consistent thickness
			○ Computerized skiving machine	○ Prior experience of working with similar machines in the footwear industry (minimum qualification ITI) ○ Must possess good hand-eye co-ordination, depth perception, concentration, monitoring ability, vision, dexterity skills, estimation and numerical skills	○ One-week training required which is provided by machine supplier's engineering team.	

Process	Cemented Construction- Hand Made	Cemented Construction- Machine Made	Technology suggested	Skill Set Required	Training Suggested	Benefits
Closing	○ Stitching machine ○ Eyeleting machine	○ Flat, post bed machine ○ Eyeleting machine	○ Auto Stitchers	○ Prior knowledge of basic CAD systems and well versed with the mechanism of servomotors. ○ Good hand-eye coordination skills, dexterity and good monitoring skills[30]	○ Two weeks training is required which will be provided by the machine supplier (Programming, tool room engineers) (Special tool room is required to make pallets as per the new upper designs every time.)	
			○ Flat bed, Post & cylindrical bed stitching machine (Servo motor) ○ Automatic lacing machine ○ Bartacking machine (semi-automatic) ○ Upper reinforcements applying machines			Flat bed, Post bed & cylindrical bed stitching machines ○ Fitted with servo motors requires less effort from worker for stitching thereby increasing productivity. Bar tacking machine ○ Used where the place on component in Footwear/ Garments is in high pressure zone or where more strength is required to support extra load Vamp crimping machine

[30] Leather Sector Skill Council-Stitching Operator (Footwear)

Process	Cemented Construction-Hand Made	Cemented Construction-Machine Made	Technology suggested	Skill Set Required	Training Suggested	Benefits
			○ Edge taping machines ○ Vamp crimping machines ○ Punching machines ○ Eyelets, rivets, hooks, rings attaching machine ○ Edge folding machines ○ Toe cap attaching machines ○ Toe Molding machine for shoe uppers and Vamps ○ Pleating machines ○ Lining-upper cementing machines ○ Upper lacing machines			○ Faster process and requires less effort from worker thereby increasing productivity Punching machine ○ Faster process and requires less effort from worker thereby increasing productivity

Process	Cemented Construction-Hand Made	Cemented Construction-Machine Made	Technology suggested	Skill Set Required	Training Suggested	Benefits
Lasting	○ By hand (manual)	○ Toe lasting machine	○ Semi-Automatic toe lasting machine	○ Minimum 10 years of experience working with the Toe Lasting machine operations. Knowledge of pneumatic and hydraulic functions ○ Good concentration, monitoring ability, hand-eye co-ordination, vision, depth perception, dexterity skills, basic estimation and numerical skills[31]	○ Two weeks training to be provided by the machine supplier.	

[31] Leather Sector Skill Council-Qualification Pack Laster

Process	Cemented Construction-Hand Made	Cemented Construction-Machine Made	Technology suggested	Skill Set Required	Training Suggested	Benefits
			○ Semi -Automatic side & seat lasting machine	○ Minimum 5 years of experience working with the Toe Lasting machine operations. ○ Knowledge of pneumatic and hydraulic functions. ○ Must possess good hand-eye co-ordination, depth perception, vision, dexterity skills, estimation and numerical skills[31]	○ Two weeks training to be provided by the machine supplier.	
			○ Auto roughening machine	○ Minimum 5 years of experience working with the Toe Lasting machine operations. Knowledge of	○ Two weeks training to be provided by the machine supplier.	○ Auto roughening machine is safe with improved quality productivity

Process	Cemented Construction- Hand Made	Cemented Construction- Machine Made	Technology suggested	Skill Set Required	Training Suggested	Benefits
				○ pneumatic and hydraulic functions. ○ Must possess good hand-eye co-ordination, depth perception, vision, dexterity skills, estimation and numerical skills[31]		
			○ Insole applying machines ○ Insole trimming machines ○ Toe upper forming machines ○ Machines for humidifying upper and/or its parts ○ Pulling-over and lasting machines ○ Heel seat lasting machines			○ Toe shape scanning, right & left odd adjustment, Auto wiper & insole rest adjustment, hot melt adhesive adjustment, auto pincer adjustment (automatic)

Process	Cemented Construction-Hand Made	Cemented Construction-Machine Made	Technology suggested	Skill Set Required	Training Suggested	Benefits
			○ Lasted shoe pounding machines ○ Ironing and stabilizing heat setters ○ Ironing machines with hot hair and roller ○ Lasted shoe roughing machines ○ Sole roughing machines ○ Lasted shoe-sole cementing systems ○ Multifunction machines for lasted shoe			
Pasting	○ Roughening machine ○ Sole press machine	○ Roughening machine ○ Heat setter ○ Stuck on press ○ Air compressor	○ Auto cementing machine	○ Two year of experience working in the footwear industry ○ Concentration skills	○ Two-day training to be provided by supplier.	○ Auto cementing machine is safe and helps in saving adhesives

Process	Cemented Construction-Hand Made	Cemented Construction-Machine Made	Technology suggested	Skill Set Required	Training Suggested	Benefits
		○ Stamping & embossing machine ○ Upper setting machine ○ Sole press machine	○ Sole attaching presses	○ Knowledge of pneumatic and hydraulic systems ○ Concentration skills[32]	○ One-week training to be provided by supplier.	
			○ Heel seat pounding machines ○ Brushing machines for glue removing along the edge last ○ Heel top piece attaching presses			
Finishing	○ By hand (manual) ○ Spray gun	○ Finishing machine ○ Spray gun	○ Ironing machines ○ Brushing machines ○ Stamping machines ○ Seam beating and ironing machines ○ Sock's cementing machines	○ Basic knowledge of footwear manufacturing (Shoe room) ○ Basic skills for crafting an intricate product, good hand-eye co-ordination,	○ Four weeks training to be provided by finishing material suppliers.	The technologies ensure better cleaning and polishing of the shoes

[32] Leather Sector Skill Council-Qualification Pack Pre-Assembly Operator

Process	Cemented Construction-Hand Made	Cemented Construction-Machine Made	Technology suggested	Skill Set Required	Training Suggested	Benefits
				dexterity skills, monitoring skills along with inclination towards maintaining quality and adhering to timelines[33]		

[33] Leather Sector Skill Council-Qualification Pack Helper Finishing (Footwear)

Around 2.5 million people are employed by the Leather sector in India and less than 5% of them go through a formal training. With the proposed technologies, there shall be a requirement of a workforce that is able to operate such machines. Although CFTI Agra has some of the above-mentioned machines but latest version with updated technology will give an edge to the learning of trainees. Therefore, the following initiatives can help in addressing this aspect -

- Setting up an extension unit or branch of CLRI. This will have a far-reaching impact on the overall skill requirement of the leather industry and small need-based tools can be developed as per the requirement of the footwear industry.

- Modifications are required in Solvent Extraction System used for adhesive application area/table to suck the adhesive fumes restricting to emit into the atmosphere. CLRI along with CFTI can help in materializing this technology.

Figure 27: OPT-SHOES – Designing with comfort parameters

OPT-SHOES is a cost-effective and accurate Computer Aided Design and Engineering (CAD/CAE) design support tool for supporting the design of footwear with desired comfort characteristics. It uses sole models and a realistic foot biomodel. This technology focuses on the issue of comfortableness and functionality of the footwear produced. OPT-SHOES helps in generation of algorithms for 3D foot biomechanics data processing and modeling; generation of 3D foot models and the complete solution as a service can be availed in cloud computing environment.

- Promotion of Volatile Organic compound (VOC) detector to test emission of gases due to adhesives. CLRI can test this technology along with CFTI Agra and share the result with stakeholders. Post its success it can be implemented at all footwear manufacturing units. The success of above two technologies can help in changing the category of leather footwear from Green to White at Agra.

- The labour available in the state are adept in operating traditional machines (mostly stitching machines). There is a lack of skill in operating modern machinery that are required for other portions of the manufacturing cycle. Short courses by TCs can be rolled out in collaboration with machine manufacturers and suppliers in the identified areas for the workforce (e.g. Stitching , Lasting, PU pouring etc,) and a program can be designed to get the associations and units to employ at least 75% of the successfully trained candidates.

Figure 28: LLOYD– Reducing returns through technology

LLOYD, Germany is one of the oldest footwear brands in Germany. To reduce the return rate and increase the revenue with better customer experience LLOYD adopted the Size Advisor®. It is an Artificially intelligent technology, built exclusively for the footwear sector, that understands the sizing of 97% of all shoe models worldwide. The data are structured, homogenized and leveraged data across footwear brands, retailers and manufacturers.

The self-learning technology improves its algorithm with every purchase registered. Result was reduction in return rates by -16%. Extra revenue per shopper was > €9 and conversion rate using size advise was >7%

While it is difficult to estimate the total impact, the above interventions will make, because of scale of adoption and at what stage, most of the above process at an aggregate level seem to contribute close to 30-50% of value addition. A 10% - 15% improvement in this process through technology up gradation and mechanization can add another 5-7% in cost optimization, thus adding another INR 2,000-3,000 crore. This is excluding the impact that will result due to better realization of end product due to increased quality and freeing up of additional capacity thereby by enhancing productivity.

7.4. Create supporting infrastructure for non-leather footwear manufacturing

India comes from a position of strength with respect to leather footwear sector and has evolved over the years, however, the same cannot be said about the non-leather footwear sector. Considering the trend over the past few years and the rising demand for non-leather footwear (50% of all footwear[10]), there is a need for TCs to provide support in this area. Currently, the infrastructure at the TC does not cater to this growing market.

To address this issue, the integrated model of practical training/skill enhancement and co-working mentioned above is suggested with an aim to build skills within this area and also develop the overall ecosystem.

On the technology front, technologies such as the following can be a good starting point for the limited semi-mechanized units within the non-leather footwear sector to upgrade their manufacturing processes and product high quality non-leather products -

- Direct Injection Process (DIP) soling system for PVC or TPR
- Seamless Upper Knitting machine
- EVA (ethyl vinyl acetate) injection machine
- Injected sole automatic trimming
- PU soles washing
- Sole Scanner

Figure 29: Success stories from TC

M/S Rana Overseas – Capt. Rana, Founder, is an alumnus of CFTI Agra and operates the firm which has an annual turnover of INR 23 crores. The firm supplies to major brands internationally and employees 475 workers. Capt. Rana is also the Governing Council Member of CFTI, Agra

M/S Leather Luxury - Specialized in good year welted shoes and industrial comfort shoes required where the work demands long hours of standing and walking, the firm has customers like Escorts, Telbross, Thomson printing press and ISG. They were also the first firm to launch specialty shoes for pregnant ladies, executive shoes for hospitality industry. Shri Ranjeev Kochher, Founder, was also on the Governing Council of CFTI, Agra.

Gautam Stylish Scarpe - Meera Sanadhya Gautam, only female from the 2011 batch started her business in 2013 and now produces 200-300 pairs per day .

Figure 30: Knitted footwear

A one-piece upper design is produced by a CNC knitting machine then assembled with the tongue, lining materials, and reinforcements. This knitting technology once found only on expensive shoes is rapidly expanding to lower-priced shoes. Running shoes made by Nike™, Tubular X Knit Soccer shoes, Hyper Boost™ from Adidas™, and even Chinese local market casual shoes are now being made with 4D knitting.

In addition, Seamless Upper knitting machine are developed from the circular sock knitting technology which produces seamless tubular socks and this technology is instrumental in saving raw material wastage. Raw material consumes about sixty percent cost of footwear and is a considerable expense in the shoe manufacturing process. Every upper is knitted individually and requires no trimming or cutting or sewing post-production.so it saves around 60% in material wastage. Two options either Single cylinder or double cylinder are available in seamless circular knitting machines. The knitted upper of either single or double cylinder is drafted on the last and then placed in an oven at 200° for one minute, to activate the Thermo glue and transferred into a vacuum pressure bladder that removes the air thereby allowing the upper shape to be fixed. Research is further going on for 4D knitting solutions in which lace punching holes can be created while knitting process and fusions of more sustainable materials in spaces to create mesh and other 3D effects is possible.

Outsole TPR & Midsole EVA are a perfect combination with knitted uppers. Nike, Reebok, Adidas, Puma etc. are manufacturing such types of sports shoes. This technology is also new to the Agra footwear cluster. Footwear units can use this machine in preparing soles of non-leather footwear. It will be a complete package for the footwear manufacturers, and they can make complete shoes by using machines along with knitted uppers. The TC can train operators for these machines thereby helping the sector.

However, expansion of non-leather manufacturing will require a large anchor unit to create enough demand for such products. While the large anchor firms may not be interested, approaching some of the relatively smaller firms may be a step forward. Agra has quite a few success stories of candidates completing their training from the TC and starting their own businesses. Such enterprises could be targeted to ignite the non-leather footwear manufacturing ecosystem. In addition, women footwear, as identified earlier, provides a larger opportunity in terms of value per unit. Therefore, awareness regarding this opportunity needs to be created and existing courses at the TC should have a focused session on women footwear manufacturing processes.

Alternative leathers are also gradually coming up with fish leather being considered sustainable since fish Skin is considered waste of the fishing industry. However, their fragility is a challenge. Other sources include derivative of the plant-based family with earthy options of fruit, palm, mushroom, pineapple, etc. Another kind includes 'insect wood' which is made from sericin (natural glue produced by silkworms). However, many of the plant-based leathers are not always very suitable for footwear since they tear easily and require backing.

Figure 31: BioLeather - Alternative material – Chrome free leather

BioLeather (Chrome free leather) is tanned with tannin extracted from trees like Acacia, Mimosa, Quebracho among others and with polymeric resins. This leather material contains only traces of copper, iron, lead, zinc, nickel, cadmium, pesticides, cobalt and chromium elements. This material is commercialized by a Portuguese tannery, Curtumes Aveneda, LDA.

7.5. Leveraging the latest technological advances in the manufacturing value chain

7.5.1. Upgrading the tanning process

National manufacturing Competitiveness Council in its report on Leather and Leather products sector dated July 2010 has rightly pointed out that there is need for a paradigm shift in the adoption of technology in the leather industry in the country. Missing on technology up gradation can lead to inefficiencies and lost opportunities. There are key areas of manufacturing value chain where mechanization and automation are more critical due to the significance of value addition these steps add to end product.

Figure 32: SHOEBAT- Awareness building regarding sustainable practices

SHOEBAT is a project (country partner-INESCOP-Spain, C.G.S. di Coluccia Michele & C. sas-Italy, INSTYTUT PRZEMYSLU SKORZANEGO - Poland) which aims to increase the knowledge and application of the most environmentally friendly techniques within the footwear and tanning industries.

Chemical consumption, raw hide to wet blue and Wet Blue to Crust felt (wet finished) are the areas which add maximum cost and value addition to the process – over 60%. Lot of these processes are performed manually. Machinery such as automatic stamping, Pneumatic wet blue sorting table and others can increase the efficiency of the tanneries and improve the quality of the finished leather. The processes and technologies identified in the section have been recommended by Central Pollution Control Board with an aim to address the environmental concerns of the leather tanning industry.

- Use of clean technologies[34]
- Water minimization measures in the tanning process[34]
- Chromium recovery[35] - Installation of Chromium recovery plant either individually or collectively with reuse of recovered chromium in the tanning process or in other areas such as production of stainless steel; automobile accessories like hubcaps, trim; blast furnaces, etc.
- Solid waste management[34]

[34] Guidelines for Environmental Improvement in Leather Tannery Sector, Central Pollution Control Board

[35] Report of Working Group on Leather & Leather Products Twelfth Five Year Plan Period (2012-17), DPIIT

7.6. Indian leather & Footwear Sector: To enhance its Competitiveness

To increase the competitiveness of footwear manufacturers, supply chain challenges should focus on reducing the lead time and increase the local manufacturing of components and parts locally to international standards. That means suppliers should be looking to upgrade their equipment by investing in better technology to match foreign quality and price.

Factors responsible for materials procurement should be dealt with utmost care. Cluster-based artisans of household and workshop units face major challenges as their major source of material procurement are the cheaper street markets through local traders or distributors. Fluctuating prices makes costing variations and sales price stability a real headache. Future demand for components will be reduced so prices should remain more constant. If the industry adopts the new process technologies using non-leather upper and other sustainable materials, incentive schemes could be introduced in terms of tax rebate or duty drawback for usage of sustainable non leather raw materials. Incubator units should be made available to encourage a younger generation of entrepreneurs to enter the industry. They will bring new fresh ideas to inspire buyers. These incubators should be well connected to big fashion houses and reputed brands to bring fashion faster to the footwear industry. Mentoring support should be available from all prominent stakeholders like designers, leather suppliers, and chemical companies.

7.6.1. Efficiency in Supply Chain

Apart from materials, changes in processes are necessary to reposition India in the global footwear market. HS codes 6402 and 6404 point the direction India should pursue to replace lost export sales on leather footwear and take advantage of the popularity and demand for shoes made to these HS codes. The export footwear industry in Agra and South has been built on expertise in making leather shoes to international standards. Changes in market demand will force through a new set of skills which India must adopt to restore its rightful place as a dominant player in non-leather footwear. This means the industry will transform into a technology-oriented sector rather than a labor-oriented sector. An example is the introduction of knitted upper which has eliminated the cutting and stitching operations from footwear manufacturing, which are known as major bottlenecks in production.

7.6.2. Market Interventions

India is the second largest producer of footwear in the world simply due to the size of its population and the domestic market for shoes. The image of the “Make in India” brand championed by the Prime Minister is to attract buyers and inward investors to consider India is open to do business. The problem in this promotion is that India must be able to show its ability to supply shoes that buyers are looking for, Recent history shows that it is not Leather shoes but fashionable younger footwear at lower cost using non leather upper materials and technology driven equipment. HS6404 products attract at least 10 of the top selling brands of footwear globally by volume and value.

Of course, to make this move into alternative product and construction there must be a supply chain to support it. This is where India is fortunate to have such a well-developed huge textile producing sector. Most of those brands use textile uppers. The standardization of materials and availability at competitive prices will provide an edge to Indian manufacturers to meet international competition. It will provide a boost to semi-mechanized and workshop units to try and join the next band of exporters.

Effective marketing of “Make in India” cannot be driven by CLE alone. Their mandate is the promotion of Leather and leather products to the world. CLE is organizing Buyer-Seller meets and facilitating visits to international fairs, etc. but driven by leather as the prime material. Change will be necessary in marketing this non leather sector and to understand and target alternative materials which are not necessarily unique to India but are available here and form a huge part of India’s industrial power base in the global textile business. Soling materials will be varied between Rubber, which India can produce in its temperate regions or synthetic materials like Thermo Plastic Rubber which can be produced locally. The supply

chain can remain in India. Obviously, there is a need to build synergies with international marketing agencies to promote the "Make in India" brand.

Domestic footwear manufacturers should have access to the information related to changing styles and processes and handling the increased demand so that they can plan their forthcoming collections accordingly. A survey may be required on a pan India basis to collect data on footwear sizes in India and to establish the National Footwear Sizing System to ensure suitably fitted lasts and well-fitted footwear for comfortable wearing as per the requirement of the Indian population. The one factor to study is the market drivers are going to be the youth of the world. There anatomy is different due to massive changes in lifestyle. Indian feet are more like other countries among its male population. Any survey would need to separate into gender. Kids should be included because the very young are target audience for such products

7.6.3. Design Interventions

Designing must be seen as an essential engine of economic and industrial growth. Most of the industrial sectors do maximize value addition in terms of design. The footwear sector has been treated as a thrust sector for its inclusive growth. Traditionally the footwear market has been driven by growth in developed countries, however, the trend is changing with growth in developing countries and increasing penetration of global footwear designer and footwear producers in the new upcoming markets. Although India is very strong in producing high-quality leather footwear both for domestic use as well as for the export market, with many of the leading international brands sourcing from India but export units are still playing a role as "resourcing partner" with good skills in interpreting overseas design teams product design requirements. They are linked digitally to communicate fast and clearly.

This seems frustrating for local designers to be copying rather than creating but it will continue to be the case as export buyers take their directives on what to buy from internal design departments that are working with marketing/ resourcing/ sustainability personnel who combine points of view to achieve the desired collection. It is a collective effort. Outside influencers are rarely used unless it is a contracted consultancy This explains why footwear designing in the export footwear field is still in a very nascent stage. Indian factories must depend upon countries like Italy, France, US, UK for design inputs, since these are the top buying / importing nations.

To resolve the issue of lack of opportunity for Indian based designers, the domestic scene in India will play a much bigger part in future. The buying population of the future will be primarily the younger generations who are both trend and market savvy and have individual taste in their choice. Indian based Design Studios should be established in conjunction with the larger buying groups in India as well as feeding into the boutique business which is large in the metro cities. There is far more variety of products available in the Indian fashion market than abroad.

Design studios should be able to provide complete solutions on building complete collections along with essential support items like tech packs confirmed samples, SoP for each style, and patterns suitable for upper, bottom stock and last.

A standard design studio will be equipped with the preferred choice of integrated 3D and 2D Cad systems linked to a sample size dieless cutting machine to cut upper and bottom components with a facility to introduce marking lines, punch holes, perforations and gimped edges. The system can also produce graded sets of cutting patterns through a linked board cutter.

CAD packages are appearing with an in-built sole and heel design package linked to CNC machining. Also, the newer systems are more user friendly as a lot of digital technology development has been focused on the design function to professionalize and achieve faster response driven by customer demand

The design scene in India looks to be exciting and ready to develop further like the RMG clothing sector.TC's and/or local footwear associations, where export and domestic buyers will often be entertained, should provide incubation opportunities for young designers to enable them to establish themselves nationally. These incubator units will bring new fresh ideas to inspire both domestic and export buyers. They should have links to big fashion houses and reputed brands to bring fashion faster to the footwear industry. Mentoring support should be available from all prominent stakeholders like designers, leather suppliers, and chemical companies.

7.6.4. Industry 4.0 In the footwear sector

COVID-19 has challenged the footwear sector to review the way it designs, makes, and sells its products. There is a dire need to work upon the below factors:

- Reduce cost - by using reliable fast data on real costs of prime materials and labor
- Reduce time - by speeding up the development of new products
- Reduce waste - by recycling, reduce inefficient operations to produce more effectively in all sections
- Reduce stock levels - by finding alternative ways to reach markets and customers through digital channels

These are all strong challenges and industry 4.0 can provide solutions to the above challenges. Smart factories with robotic systems are solutions for increasing efficiency and eliminating wastes.

Digital Factories

Sports shoes are regarded as some of the most labor-intensive products to manufacture. Sports shoe manufacturing presents almost a perfect storm for automation, but it still requires a lot of manual labor. The overall challenge in making shoes is that the tolerances, the product size ranges, and the breadth of natural and man-made materials are quite different from those in technical products. Companies are dedicating a few production lines in factories for custom products to satisfy customer demand for customized footwear in a shorter lead time. Manufacturers are using computerized stitching, which enables them to place materials on a pallet and deliver them to sewing machines along a digital path. Usage of 3D printing for accessories, prototype development, product development, product aesthetics, and functionality all are part of digital factories. 3D printing is especially valuable for making parts of customized footwear, such as plates—the molded part at the bottom of an athletic shoe that may have cleats or spikes—and cushioning materials, such as midsoles etc.

The automated embroidery selection programs on custom product lines allow manufacturers to quickly change thread colors. Other technologies help to automate the steps of attaching the molded bottom portion of a shoe to the soft upper portion. Companies are using a digitized system for tracking defects on the production line. Big brands are also using 3D foot scanning at some of their exclusive global retail locations to give their customers an enhanced fit experience.

The current limits to 3D are seen in finalizing a set of fully capable footwear materials and putting the technology into action on a production line. Transforming the upper part of the shoe from 2D to 3D is a complex challenge that will require some new thinking on product construction and automation. 3D is not high-speed manufacturing. There will always be some handcrafted parts. Also, full palette of different materials that can work with 3D is not available, though there have been tremendous advances. Another priority is to reduce material waste in 3D printing.

To get better productivity, quality and to manage an expanded product range footwear industry should adopt sensor-based robotic conveyor systems for material movement at workstations. The robotic systems at smart factories give control over critical operations to improve consistency and performance. They assist associates who are doing repetitive motions and make the work environment safer. Robotic arms can do operations like roughing around 'bite line' and other areas to eliminate inconsistencies in

product quality. Software-driven tunnels with Infrared lamps and hot air with automatic temperature control systems for fast drying and reactivation of glue eliminates the requirement of temperature setting manually. Moreover, due to auto control temperature tunnels, heat accumulations at last does not take place and subsequently do power saving in the chiller. Managing inventories of raw material like soles, insoles, and tools like last is a big challenge for footwear manufactures, storage structures fitted with smart conveyor systems with movement flexibility in horizontal and vertical spaces provide solutions for managing inventories and using spaces efficiently.

To increase productivity and quality improvement in the footwear industry, technology centers can guide footwear manufacturers on adequate and inadequate loading of workstations to ensure line balancing and proper workflow. Moreover, TC can play an active role in promoting quality concepts like Six Sigma among industry members. Shop floors digitization is the new development, all paper forms have been replaced with manufacturing app that runs on tablets or other touch screen devices. Operators don't need information technology expertise to use this system. They call up an image of the shoe style they are working on and note where the defects are. These app provide connect to production equipment and correlate machine and human data using the built-in analytics engine. All these technological advancements are improving productivity and quality standards in footwear manufacturing.

7.7. TC as an enabler for Innovation

Central Footwear Training Institute, Agra has a history of over five decades in providing training and education in footwear technology and practice. The steps to enabling Innovation starts with the Institute adding innovative machinery/processes/materials in its own premises. It must accompany some innovation with sectoral experts and mentors who will be trained in the knowledge transfer and then makes it possible to disseminate this knowledge through the innovation. The Knowledge transfer process will take a long time to embed into TC structure and mode of operation. Once this step has been achieved and trial events conducted satisfactorily the TC can start reaching out to its customers to create interest in the innovation. This will involve a lot of demonstrations over a long period, with delays through time constraints.

There is a huge scope for innovation activities in the footwear industry. There are few R&D centres which have institute status. As this is a new challenge it will be necessary for TC staff to visit centres which are marked as Centre of Excellence in footwear research and technology transfer like INESCOP, Spain and CTCP, Portugal. Both these centres are in shoemaking hubs and disseminate innovation through their own trained staff reaching out to customers in the area. Their work has been focused across material research to reduce reliance on leather and on CAD systems impacting the design process.

To boost Footwear and Fashion Cluster, CTCP has launched the FAMEST Mobilizer project: Footwear, Advanced Materials, Equipment and Software Technologies. This is an ambitious project that promises to drive the Cluster of Footwear and Fashion and encompasses research throughout the production process and product life cycle. The Footwear and Fashion Cluster at Portugal has evolved from manufacturing and labor-led activities to market-led and knowledge-based activities, taking advantage of design and fashion and preserving production capacity in Portugal. This is a similar scenario to Agra. CFTI can adopt these technologies and can bring a massive change at Footwear cluster at Agra. In order to remain competitive, Cluster has to invest in creativity, dominate the entire production process and the product life cycle, adding value in each phase and embracing society challenges post COVID, trends and opportunities, market, technology, industry 4.0 and circular economy.

In order to ensure this positioning in the international market, the best will inevitably have to focus on differentiation, flexibility, speed of response, quality of products in order to become competitive and superior to those of the competition. It is in this context that the FAMEST project arises to study and develop, in accordance with the strategic plan defined for the Cluster of Footwear and Fashion, the following areas of action:

- Innovate at the level of design and products, materials and components, capital goods and processes, business models, digital economy and sustainable and responsible development.

- Train and upgrade skills and knowledge in human resources, companies and institutions to strengthen the Cluster's competencies in product creation, promotion and management.
- Internationalize and communicate through the domain of the Cluster, raising it to more demanding standards.

Similar approach could be adopted by CFTI, Agra and consortium of companies from cluster across value chain i.e. leather, insoles, soles, chemicals, softwares, equipment, logistic and footwear manufacturers. Industry leaders could be formed that ensure the development of innovative results and their economic valuation by the promoters in the national and international markets.TC can adopt and promote latest 3D CAD systems to do costs reduction in human resources and materials and to design any type of footwear.

At International Shoe Competence Centre (ISC) - Piransens Germany- BOOST4 SHOES programme in conjunction with EN initiative Erasmus promote the use of E-Commerce as a digital market driven tool GENIE. ISC Germany's services comprise professional training, further education, R&D as well as consulting, primarily in the areas of quality, product and process improvement.

CFTI, Agra can customize training programs focusing on the technical aspects of industrial shoe production aiming to increase quality and efficiency and imparts product competence for purchasing and sales staff. Further education programme can emphasize on problem solving for the international footwear industry and also made-to- measure seminars tailored to the individual requirements of each customer can be arranged in collaboration with other technical and management institutes. The main areas of intervention could be practice-oriented specialist knowledge in footwear engineering, manufacturing expertise, product development, product and process optimization, innovation, quality assurance, materials science for fit & comfort.

Another area of innovation for Technology Centre could be a state-of- the-art production line equipped to produce prototypes and pilot runs of all makes, where students can put their freshly acquired theoretical knowledge straightforward into practice. The leather and shoe industry are constantly searching for well-trained specialists and skilled workers. Besides training, R&D could be another core field of TC activities. Various projects and activities like method development and improvement as well as studies on open questions in the footwear sector could be addressed by TC. Technical aspects of production are of great importance for the footwear manufacturing industry. Contract research in the field of biomechanics, orthopedics and comfort could be addressed by TC in the long run.

7.8. Skill Development for small unorganized sector

CFTI Agra is surrounded by micro and small businesses which feed into the larger organizations around Agra. These feeder units are mainly unregistered groups of skilled workers normally set up in family premises and having learned their skills through exposure at young age to watch and copy their seniors, followed by continuous practice. They share machinery, equipments and can fix most problems by themselves arising in their machinery. Typically, the equipments are very old with basic clutch motor and no other attachments to assist the operator. Power supply is intermittent in these areas so working hours are determined by availability of power and spare time away from other family chores. The contracted work is normally collected from the feeder factory on completion and return of previous batch of work.

Despite the unorganized nature of this practice, these small teams provide an essential lifeline to the feeder units who generally depend on this service for the flow of their shoe uppers. The feeder unit only have minimal Upper makers in house, who mainly fix quality issues with the contracted work.

TC has been charged to reach out to these isolated communities to provide skills training at basic short-term level. It has mobilized teams of instructors to visit and deliver the training. The training is very short term and basic as the products are mainly Chappals. This is not enough to replace the much higher and complex skills needed to service feeder units with their work. The solution must lie with TC to change its approach along with the social changes which are emerging. They must provide longer term training on more complex styles to produce complete shoe uppers to factory standards.

Primary focus must start with upgrading the quality of the trainers and the training they provide. A modular training plan should be followed to raise the trainee skills step by step though a series of exercises which are designed to train the necessary hand/eye/foot skills to achieve more complex stitching patterns

required in shoe uppers. Past experience and practice in such a training modular approach shows a new starter with no previous experience of a sewing machine will need 2 months inside this modular programme to enable them to reach factory standards of speed and quality as their benchmarks.

The machinery used on these training programmes will start on basic flat bed machine then move to post bed machinery. This introduces the concept of multi skilling. The motors used to power the machinery should be vario-control type with in-built PC unit to enable the stitching movements. The old-style clutch motors being used at present are more of an obstacle to training. The operator gets confused with pedal movement. The target should be minimal hand wheel movement as the machine replaces the need for this habit. The machinery should be provided with the basic functions of auto back stitching, edge distance guides for improved control and quality. This applies to flat bed and post bed machines. These recommendations are being practiced in a lot of the contractor and factory training units in South of India.

7.9. Improvement on performance testing and compliance testing facilities

In the export market scenario, there are specific requirements buyers are demanding before placing orders. They are not only concerned about final quality of products in line and conformance to specification. They are also concerned about the quality of materials and shoes or likely performance levels in wear of the major materials/components being used in their products. The most accepted method for assessing one supplier's products against another is for the buyer to establish a list of performance tests and accepted norms for the results of testing on the footwear. Most of these tests are physical tests conducted on the finished or full shoes. In certain cases, physical tests are performed on raw materials where it is not feasible or possible to conduct the tests on components in finished shoes like insoles, threads, eyelets.

The buyer's specification for test parameters is taken from testing houses, who advise buyers on the performance of a range of tests, based on historical records. Results are often categorized into 3 levels of performance:

- Pass – High level
- Pass - Medium level
- Fail - Below lowest level

Buyers expect companies to have their samples tested in an accredited testing house at the factories expense. Alternatively, buyers accept company test results as part of their self-measurement. The purpose of testing is to predict the likely performance of the shoes and components in wear conditions. Worn returns are an expensive quality cost for buyers and often kill the chance of repeat business from clients, who experience poor performance. This translates into a drop in the buyer's supplier rating. High returns can damage company brand image also.

The other testing demanded by export buyers is Compliance testing. It is a test of supplier's standard of operation measured against a set of international norms. It covers areas such as:

- Design and development – specifications and records
- Purchasing procedures based on specifications and inwards inspection and/or specific testing
- Record keeping to enable traceability of materials through external suppliers and internal consumption in production
- Measuring quality performance of shoes in process through records of damages/process faults/repairs procedures
- Procedures adopted for corrective action on faulty products
- Disposal of faulty materials/products in process through quarantining
- Regular independent visit by auditors to assess actual performance against standards set by company through their quality manual.

The other area of buyer's concern is to understand the company practices impact on the environment and CSR activities. This aspect of compliance is increasingly important with export buyers. TC should have testing laboratory to support smaller companies with their testing. Charges should be nominal as part of support services along with this consultancy to workshop and domestic units can be provided on compliance requirement and certifications required by different buyers.

8. India as Footwear Hub

India has always been seen as one of the top ten footwear production centres in the world. It gained this classification due to its volume / value of exports under group HS6403 – Leather uppers plus synthetic soles. In the past 3 years, this status has been under threat due to static export value figures. Other developing nations have arrived in this period to threaten India's position as one of the leading footwear hubs for leather footwear. The prime causes for this decline are:

1) Leather shoe export volumes have remained static globally at 35% of total footwear sales by value. This translates into lower volumes as average price of leather shoes per pair has risen to $17.00.
2) Alternative categories of footwear have grown in volume such as HS6402 Footwear with upper and soles of synthetic plastics or rubber and synthetic soles and HS6404 (Footwear with uppers from textiles and soles from rubber or synthetics) The combined value of these 2 categories account for over 50% of the export value of all footwear. This figure measured by volume translates to the largest categories as the export value per pair is between average of $5.00 (HS6402) and $9.00 per pair average HS6404.
3) Market changes across the world are dominated by younger generations as the primary purchase groups. This age group have lower disposable income so purchase cheaper non leather products.
4) Leather as upper material is increasingly seen as a non-sustainable material, causing threats to the global eco-system from the tanning processes.
5) Post COVID trends will be a stronger move away from leather and into non-leather footwear groups.
6) COVID has witnessed a massive change in market trend which is driving customers away from family visits to retail outlets to purchasing footwear by shopping online from E-Commerce sites globally.

The consequences of above-mentioned changes in the footwear sectors globally have caused companies to address and adjust to these trends. India is in danger of dropping further down the global manufacturing hub league if it fails to respond to the change in market trend. These changes are equally relevant to the domestic market. Reduced purchasing power post COVID will have two knock-on effects in the domestic market:

- Less shoes bought per year
- Increased pressure to buy cheaper shoes
- Maintain good designing following popular fashion
- Increase in non-leather footwear
- Buy more shoes online as compared to counter sales

Indian (Agra) Factories must react to these market movements quickly. If there will be demand and supply gap it will be filled by imports, which will definitely have negative impact on Indian footwear manufacturers. Technology Centres must provide the support initiatives to achieve these objectives.

- Provide alternative materials and processes to make cheaper fashionable footwear
- Create online service through commercial site
- Introduce new processes to enable making shoes suited to category HS6404
- Provide design leadership
- Provide technical training in the new processes to both students and local manufacturers
- Engage material suppliers to use TC as a knowledge centre for their products/processes
- Develop CAD driven data management packages to introduce competitive costing
- In every successful footwear hub/cluster across the world, there is always a Design and Development centre pioneering in innovative solutions to support the cluster

9. Conclusion

Despite its much-stated advantages of large source of raw material, plentiful labour supply at low cost, heavy Govt support in promotion, the Indian footwear industry has not been able to realize its potential. UNIDO highlighted India as the only country with the size, population, raw material supply and a meaningful existing footwear industry that could challenge China's dominance.

However, the Indian footwear industry, although large, is mostly unorganized and has not been able to effectively respond to seize this chance to take a larger share in global footwear consumption, largely led by China's exponential growth followed by Vietnam, especially in the footwear sector. This compares with Italy maintaining its position as the 2nd largest producer of leather shoes globally, despite the rising costs of production in Italy. Italy has achieved this position by essentially developing new technologies to improve their productivity and quality in a very traditional industry. They have embraced the necessary changes to compete and India must follow this example.

The world of commerce is already facing a "new normal" in how to do business post COVID-19, due to the rapidly changing needs of the sector in both the global and domestic markets and the introduction of emerging new opportunities. Indian footwear sector must be capable to supply its own large domestic market with cheaper but younger, fashionable shoes in higher volumes. India's knowledge and expertise in the domestic footwear sector has developed a narrow vision due to its dependence on "traditional" leather shoes. It now needs the opportunity to target and introduce other technologies using non leather materials, coupled with the advantage of seeing rising labour costs in other competing International manufacturing hubs like China. This puts India in a strong position to increase its share firstly in its own domestic footwear market. Once it has cemented these changes as standard practice, it can then exploit these new technologies to overseas buyers.

The Agra footwear cluster has long targeted the domestic market, due to its current size in terms of value and volume along with its current level of mechanization. It continues to be the ideal cluster to witness a step change. We believe our recommendations across various technology areas would be ideal to move Agra along the value chain to enable supply of alternative products previously supplied by imports.

The export market buyers will change their strategy post COVID. They will buy smaller volumes, across more products with faster lead times, and lower prices. This recipe will suit Agra exporting companies who are set up to meet such demand. The restraint issues on growth in Agra are low productivity, especially in cutting and sewing rooms, slow prototyping, dependence on leather as prime upper material, low processing technology, limitations of alternative technologies for production and reduced costs, limited experience in e-tailing.

Our recommendations target following weaknesses in the Agra supply chain:

- Low productivity in sewing rooms - Introduce smart sewing lines using added technology attachments to enable faster and improved quality at lower cost. This will enable new employees to train faster and more efficiently in future.
- Low productivity in Cutting rooms – Introduction of Dieless cutting system to handle short runs of multiple styles without the need for slow expensive tooling costs.
- Slow prototyping – Use of 3D /2D CAD systems linked to design/product development process and cutting and sewing machinery.
- Dependence on leather as prime material - Introduce alternate technologies which target non leather materials as their prime material. Examples are knitted uppers, DIP process for lasting and sole injection, Dieless or beam cutting in multiple layers,
- Low processing technology - Present equipment in CFTI Agra only copies traditional processing methods using the cemented-on construction, highly popular in Agra. It cannot demonstrate or offer job work on new technologies using non leather materials.

- Limitation to offer alternative technologies beyond the traditional leather shoes - The. introduction of non leather processing technology such as DIP, will enable factories to offer greater variety of footwear across domestic and ultimately export markets targeting the more popular higher quantities and lower cost shoe categories as reflected in HS 6404. This means the footwear will be more popular, sporty and younger designs/constructions at a lower price to match local demand for lower cost but fashionable shoes due to drop in income post COVID.
- Limited experience in E-Retailing or Online selling - This market has exploded during COVID and will continue to grow as population reduces its travel and shops from home for more products. CFTI Agra will develop its own online site, operated as a commercial enterprise, enabling SME's to supply into its ranges of footwear, developed on its CAD design systems using its fast prototyping to enable factories to enter market quickly with small trial volumes and repeating orders based on sales figures.

Technology centers must act as catalyst in bringing paradigm shift in the supply chain of their respective clusters or industries and act as a mentor in building and raising awareness about the standards of future manufacturing.

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