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TECHNOLOGY VISION FOR INDIAN MSMEs – 2020

भारतीय लघु उद्योग विकास बैंक
SMALL INDUSTRIES DEVELOPMENT BANK OF INDIA

Addressing gaps in MSME eco-system

Technology Vision For Indian MSMEs – 2020

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FOREWORD

MSME sector, comprising more than 3 crore units, contributes over 40% of the total exports, 45% of manufacturing production and forms the second largest source of employment after agriculture by employing more than 7 crore people. Over the years, MSME sector has emerged as an important vehicle for attaining inclusive growth in the country. While technology is one of the most critical inputs for the growth of the MSME sector, it has been a major challenge for MSMEs, particularly for those at the lower level of the value chain. Increasingly, at the policy level, emphasis is being brought forth on ideation, innovation and speedy implementation. It is also considered as one of the major thrust areas identified by Government of India for making MSMEs competitive.

Small Industries Development Bank of India (SIDBI), being the Principal Financial Institution for the MSME sector, has been taking various initiatives to enhance the sector's competitiveness, including concerted efforts to improve technology gaps. In order to push the technology frontier in the MSME space, SIDBI has come out with a policy paper on **"Technology Vision for Indian MSMEs – 2020".** The study addresses various issues at a cluster level and also proposes a focused Science & Technology Policy for infusion of latest technologies in the MSME space. The highlights of the report includes creating a baseline of existing level of technology adoption across 10 selected focus sectors along with identification of key issues / constraints faced by MSMEs in technology acquisition / technology commercialization / ministries to access impact of implementation. It also addresses issues in terms of adopting globally vetted approaches on technologies relating to pollution reduction, going green and adopting clean technologies, etc.

S. Muhnot
CMD

PREFACE

Technology has emerged as an important dimension of means of production. Leveraging technology has helped manufacturing process overcome major manufacturing problems and increased efficiency. It works as a catalyst in the manufacturing process. I recall the words of Arthur C Clarke that **"Any sufficiently advanced technology is indistinguishable from magic."** Definitely technology is precious fifth factor of production. For the MSME sector, which contributes around 45 percent of the manufacturing output and 40 percent of total exports of the country leveraging technology, has become an imperative in the competitive environment.

SIDBI, being the principal financial institution for MSMEs, is responsible for the development and promotion of the MSMEs in India. It has, in the past been, and continues to function as a nodal agency of various technology modernization schemes of different Ministries of the Government of India. SIDBI is also implementing a World Bank led multi-partner, multi-activity MSME Financing and Development Project (MSMEFDP) in 25 industrial clusters for the holistic development of MSMEs in these clusters. During the diagnostic surveys and project implementation in these clusters, it was found that issues related to technological change surface regularly as a major challenge for MSMEs. The clusters vary widely in their technology information & technology adoption levels with some units having state-of-the-art technology to units with limited or virtually no technology usage. The clusters also validated the premise that technology has the potential to be a strong growth driver for MSMEs.

In order to sensitise various stakeholders in the MSME segment on the need for addressing the technology gap, SIDBI is publishing a policy paper titled "Technology Vision for Indian MSMEs – 2020". This is an endeavor to attend to the expectations of MSMEs, policy makers and other diverse stakeholders. It also brings out discussion points, case studies under MSMEFDP which evolved as role models on technological upgradation theme and also the benefits arising out of technological adaptation.

Being closely involved in steering this innovative project, I sincerely believe that this study would be useful for all the stakeholders and shall facilitate the MSMEs to understand and emulate the best technological practices. This will enable them to become even more vibrant and globally competitive.

N. K. Maini
DMD

MESSAGE

The Micro Small and Medium Enterprise (MSME) sector plays an important role in Indian as well as global economy. The sector plays a catalytic role in making an economy innovative, vibrant and resilient. Globally, technology has been a key differentiator to the competitiveness of an economy, more importantly the MSMEs. Among the major challenges faced by the MSMEs in India involving access to financial and non financial services, technology takes a higher slot. Lack of access to trusted information on updated/upgraded technologies as also non-availability of affordable, appropriate and updated technology hinders their growth. These impacts the ability of MSMEs to compete in markets not only at local or national level but also globally.

It has been endeavor of SIDBI to promote, finance and develop the sector through various financial instruments, information dissemination and policy advocacy measures. We have been bringing out a series of knowledge booklets, policy series as also toolkits.

I am happy that SIDBI is laying before the policy makers another thought provoking policy paper. I am sure the Technology Vision 2020 intent to contribute to removing of information asymmetry on technology issues by enlisting expectations of MSME domain on technology front will succeed. I am sure this will contribute to MSMEs next level of growth as also act as a change agent steering the wheels of MSMEs prosperity by ensuring match making of supply of business services to the demand of MSMEs thus easing the way they do business.

T R Bajalia
DMD

About MSME- FDP

A brief about MSME- FDP

SIDBI is the Implementing Agency for the "MSME Financing and Development Project (MSME - FDP)" involving the World Bank, DFID, UK and KFW & GIZ, Germany as partners. The Department of Financial Services, Ministry of Finance, Government of India is the Nodal Agency for the Project. The Project attends to demand and supply side needs of MSMEs through judicious provision of financial and non-financial services. Project has adopted an innovative approach (caters to target population which spans across stakeholders of MSME domain) to attend to poverty alleviation through enterprise development in MSME domain. The grounding of enterprises and instilling competitiveness in them contributes to National development as also the Millennium Development Goals.

The Project objective was to "improve MSME access to finance (including term finance) and business development services, thereby fostering the MSME growth, competitiveness and employment creation". This was to be achieved by focusing on:

- ► Enabling the framework for MSME financing by banks.
- ► Helping banks to gain better access to longer term financing for lending to the MSME sector.
- ► Mitigating banks risks related to MSME lending and reducing transactions costs of such lending, while, at the same time, ensuring the banks enhance quality of their MSME loan portfolio.
- ► Strengthening Business Development Services (BDS) and market linkage programs for MSMEs.

Making Market Work for MSMEs (through BDS market development in 19 Indian clusters).

The Key innovative tools/ model used for BDS delivery are given below:-

Voucher Support - Subsidizing by the project towards initial payout by MSMEs to BDS on tapering basis through a tripartite arrangement between BDS, MSME and Facilitating Agency (FAs) - where FAs role has been to oversee successful transaction completion.

BDS Clinic - A one point solution and matchmaking platform bringing MSMEs/ BDS together for on the spot viable solutions.

BDS on Wheels - A vehicle carrying BDS to cater to MSMEs service requirements at the place of MSMEs (with thrust on MEs)

BDS Panel - Created Panel of > 450 empanelled BDS who have successfully rendered services to MSMEs thus giving the needed trust (it includes a pool of FAs - with more than 110 personnel in team), BDS Consortia (pooling BDS of different specialization under one umbrella to offer advantages of collaboration), nineteen virtual BDS (each cluster has a website which have acted as knowledge repository), benchmarking of costs leads to reduction in fee etc.

Value chain mapping - Every cluster underwent Diagnostic Study which mapped critical pressure points and were attended throughout project intervention. The emergent scenario post implementation was compared to pre-launch situation as mapped by diagnostic study.

Who-Does-Who-Pays (WDWP) Matrix - The tool has been adopted to map the availability of BDS and their existing users including paying pattern in the clusters. This was tracked for pre and post situation.

Cluster Coordination Committee - This instilled ownership among key cluster actors towards project initiatives right from inception (diagnostic) till exit (handing over to exit vehicles). It vetted, validated, monitored and guided the initiatives.

Cross Learning's & Exposure Visits - For learning's from successes and failures in other clusters, Project organized cross learning workshops on regular basis (at national / regional level which has evolved as an institutionalized learning mechanism). More than 16 such learning workshops upgraded the capacity of FAs.

Skill Development Models (with MFI, BMO led, Corporate Houses, Academia-Industry Partnership etc.) were tested and validated institutional BDS.

Knowledge Series / Policy Papers / Tool Kits - Several policy papers / publications (e.g. Factoring Global Best Banking Practices in MSME Financing and Development , MSME Report 2010, 2011 Toolkits (e.g. Walk-in-Kit for Corporatization of MSMEs - fostering corporatization so as to enable 95% non-corporate MSMEs to slowly adopt it for growth and rise up the value chain, web enabled MSME Kit etc.), Series on Risk Capital for MSMEs, etc. Under MSME- FDP, Technology Modernization were taken as a focused area forintervention and at least 7 clusters (out of 19) saw technological /production processes related interventions. Technology initiatives were related to:

- Technology upgradation
- Cleaner /greener production technologies
- Advanced technologies for processing
- Drudgery reduction technologies
- Product and design diversifications
- Information and Communication Technology (ICT)

Main achievements and lessons from technology initiatives are described in details below:

Technological Up-gradation: Improvisation of Tanning Drum in Chennai led to cost reduction. Upgradation of Coupla in Coimbatore cluster to maximize the use of coal resulted in an estimated saving of approximately ₹ 11.2 Million per annum. Similarly in Rourkela, 3 technology demonstration on latest technologies in automated CNC and welding machines were organized which led to adoption of the technology.

Cleaner/Greener Production Technologies: Common evaporating unit and treatment plant for hazardous waste and effluent was successfully done in Ahmedabad Dyes and Chemical cluster. Similarly pollution reduction equipment (Multiple Effective Evaporator with latest technology) was introduced in Hyderabad pharma cluster.

Advanced Technology for Processing: One of the major problem faced by the Panipat Floor Coverings Cluster is low productivity (as more than 90% of the tufting and composite manufacturing firms are using manual tufting guns for tufting operations). This is also resulting in diminishing repeated orders for small tufting and composite firms from exporters as they are unable to supply the goods on time and thereby affecting the entire supply chain. The problem identified was inability to utilize electrical tufting guns (ETGs) as in house mechanics were not properly trained in repairing and maintaining the guns leading to frequent break downs resulting in reluctance of the labour in using the guns; and thereby finally leading to low productivity. Introduction of new technology when accompanied by the necessary skill development measures is most successful as the case of Electrical Tufted Guns (ETGs) shows in the Panipat Cluster. The same was also tested successfully in Bhadoli Carpet Cluster. Similarly, in Ganjam, under Cashew processing, shifting from 'Roasting' technique to 'Boiling' technique decreases the wastage by 30% (which led to saving of approximately ` 99 Million per year for 36 firms).

Drudgery Reduction Technologies e.g. Semi-Automatic Spinning Ratt in Allepuzzha cluster wherein this shift to small mechanized interventions has provided enormous benefits. Introducing economical semi mechanized looms have proven to not only reduce human drudgery (for example the women had to walk 10-12 km but now can sit and do retting) but also enhance efficiency.

Design Diversification: Design innovations ensures sustainability of cluster firms e.g. in Shantiniketan cluster, 28 new designs (surface and patterns) and 12 mock ups designs were introduced through design workshop during the course of the project with a high response from the buyers. Similarly Designers' Club initiative in Tirupur has given rich dividends. Tirupur, the textile hub is also a hub of potential designers. But due to lack of knowledge, information, and adequate platform, the designers were unable to show their talent and needed a platform to hone their skills. Tirupur BDS Project identified this need and founded a Club for Designers in association with NIFT - TEA. The club is founded with the objective of promoting designers from the cluster and to build industrial linkages through the experts. Supporting agendas with inbuilt sustainability traits have been mainstays of project.

Product Diversification: Kolkata is known for industrial gloves. A formal network (M/s United Creations Pvt. Ltd.) of six industrial gloves manufacturers decided to make a move from industrial to fashion gloves. This was a new product meant for exports and there was a need for an international expert who understands the product as well as the market. The Project partially supported hiring the services of German trainer. He trained 27 workers. Later another 20 persons have been trained by some of the trainees. The typical leather required was being sourced from overseas and is now being sourced from two local producers. After over six months of trial and error with the support of the expert, two tanneries have reached the quality levels needed and the raw material is now being sourced from them. The initial German buyer of the product was also linked by the BDS provider. Later the network found a buyer each in Holland and Spain. An order worth ` 3 Million has already been completed. Sales are expected to cross over ` 20 Million by the year 2011-12. Clearly many product (fashion gloves in Kolkata cluster) and design diversification efforts (in Shantiniketan cluster) also benefitted the MSMEs enormously.

Information and Communication Technology: Given the criticality of adoption of ICT among Indian MSMEs, the phenomenon has been effectively leveraged by many discerning small enterprises as a tool for gaining competitive advantage for long term growth. However, adoption of ICT by 132 MSMEs poses unique challenges and constraints which can prevent full realization of potential. Under the project, initiatives were seen in the area of computer aided design and enterprise resource planning. Most of the ICT/IT adoption was witnessed in the engineering clusters. Use of ICT can promote enormous efficiencies and cost savings with current usage at very low levels. MSMEs that are using ERPs have learnt the benefits of integration of planning, production, inventory, quality control, financial, depts and enhancing the efficiency of inventory management, planning, procurement, etc.

Few Case studies on Technological Change

Issues related to technological change surfaced and succeeded in cases of strong business needs. However because of high level of uncertainty involved in such experimentation, these interventions did not witness serious lead from the stakeholders. As a result these were mostly supply side interventions, led by the facilitating agencies, only to be picked up by the stakeholders, once such intervention proved its economic sense. At times, lack of appropriate training also led to restricted use of appropriate technology. Accordingly, the various models of technological changes witnessed include exposure to improved technology in benchmark cluster (Ganjam), training by embedded service provider - machinery supplier (Panipat), introduction through private service provider (Kanpur and Alapuzzha), and identification of best practices by the strategic service provide (Coimbatore), etc.

1. Technological Change through Benchmarking in Ganjam

Ganjam and Gajapati is the home of 120 cashew processing units supplying cashew to the domestic market for more than three decades but remained untouched by the advanced methods of processing that can take the product to the international market. Raw cashew is processed to palatable cashew kernel through traditional method of roasting, shelling and peeling yielding low quality product with high wastages. The project took a series of initiatives

in order to make the cluster realize its potential. An exposure 38 entrepreneurs was organized to Mangalore and Kollam cluster to learn best practices and advanced technology for processing. Again with the help of strategic BDSPs, trial and demonstrations events were organized in the cluster to make entrepreneurs learn different modern techniques for better quality and productivity and at the same time could be environment friendly. The initiatives resulted in converting 42 units from traditional roasting method to processing via boiling method. With this, average production of a unit increased from 10-15 bags to about 25 bags and increased profitability by Rs 550 per bag. This technology intervention has brought tremendous change in the cluster. More than 20% cashew units are now using better technology for cutting, peeling, grading, etc. and started having 18 grades instead of 8 grades. The method of steam-boiling and hand-cum-pedal operated shelling combination has been found to be more cost-effective and better technique over the traditional methods. With this, the turnover of the cluster increased by Rs. 68 crore. Advantages of this steam boiling method amount to a saving of 29.66 per cent on labour costs and increased income from the sales of cashew nut shell liquid (CNSL) apart from improved productivity and reduced air pollution. In addition, over 840 new employment opportunities were created through production expansion, setting up of new units, etc.

Picture 1: Old Roasting Method

Picture 2: New Boiling Method

With the technology change and subsequent expansion, there was a well felt need for skilled manpower to operate and maintain the machines. To address this, project in collaboration with the cashew processors association and one Government ITI in the cluster designed a full time 3 month certificate course and got it approved by the State Council for Technical Education & Vocational Training (SCTE & VT). This course is now successfully run by the ITI through its well trained faculty staff.

Picture 3: Electronic Tufting Gun

2. Training Induced Technology Adoption in Panipat Floor Covering Cluster

Picture 3: Electronic Tufting Gun Nearly 132 (40%) units out of the total 331 units in the Panipat Floor Covering cluster are micro and small tufting and composite manufacturing units which act as sub-contractors to bigger exporters. While the bigger export manufacturers have adopted superior technologies, 90% of the subcontracting units predominantly use manual methods for production. Specifically the project identified that the manual tufting guns beings used by the smaller units reduced productivity leading to units inability to manufacture in larger scales.

In order to overcome this problem, Electronic Tufting Guns (ETGs) were introduced to the cluster by the project not only with an aim to improve productivity but also to reduce employees' fatigue. The better output that can be achieved was demonstrated in the cluster. 17 training programs were conducted in the cluster through which 508 workers from 60 units were provided training. Following this the units were made to interact with ETG suppliers. As a mass demand was created for the product, a bulk purchase of 1000 ETGs was made by 50 units. Further training of an in house mechanic in each of the units was also carried out to ensure smooth operations.

With the new ETGs the output of the units has gone up from 1.5 meters to 4 meters per day. This in turn has led to an average increase in wages from Rs.180 to Rs. 240 per day per worker. Furthermore the investment per ETG at Rs.7500 was recovered in a month's time making this low cost technological intervention sustainable and viable.

3. Energy Savings through Technology Improvement in Foundry in Coimbatore

60 per cent of the 250 odd foundries in Coimbatore are small scale proprietary concerns with an estimated average annual turnover of Rs. 5 million. Most of them are equipped with single blast cupola furnaces. About half of them are suppliers to the pumps/valves unit in the cluster. They operate with an average profitability of 10 per cent. Although stricter pollution control norms have led a top few to switch over to induction furnace, but unstable power supply and strict time limits on the usage of electricity have led most of the units to continue with the traditional coke-based melting technology. Scope exists for improving operations by shifting to divided blast cupola (DBC) to improve energy efficiency and venturi scrubber to reduce emissions. Due to more investment cost, entrepreneurs are inclined to go for change.

Meanwhile, a quick survey by a foundry expert in December 2009, suggested that uncontrolled flow of air into the cupola is burning excess coke and controlling air supply will help in reducing percentage of coke used per melt. The expert suggested that installation of a butterfly valve at the inlet pipe from where air flows into the cupola to burn the coke, will provide optimum air supply and reduce usage of coke. A manometer can be used to check the pressure of the cupola and the opening of the butterfly valve can thereafter be manually adjusted depending on the manometer reading. Such controlled flow will reduce percentage of coke usage by nearly 10%.

Picture 4: Butterfly Valve

One of the foundry units, M/s Coimbatore Engineering Corporation (CEC), implemented the suggestion. The butterfly valve is a custom made product, depending on the pipe size, and was fabricated by the consultancy cell of the local engineering college – PSG Institute of Technology. This led to an investment of about ₹ 10000. Few months into the operation, CEC is able to reduce

coke metal ratio, i.e. the ratio of weight of coke and metal used for burning from 1:9 to approximately 1:10, leading to reduced coke usage by approximately 10 per cent.

Each melting operation uses about 1 ton of coal valued at ₹ 25,000 and four such Castings are made on an average every month by an average foundry unit. Hence it is estimated that a unit can save up to ₹ 10,000 per month. Thus the investment can be recouped in a month and profitability is estimated to increase by ₹ 120,000 per year. The results were disseminated by conducting workshop and also interaction with the beneficiary.

Following the successful demonstration in one unit, the project facilitated the adoption if this technology in 25 more foundries resulting in low consumption of coke, reduction in pollution emissions levels and a total savings of approx. ₹ 25,00,000 per annum.

4. Productivity Improvement through Technology Modification in Alappuzha Coir Cluster

The coir industry in Alappuzha is more than a century old and the technology being used have barely been altered since then. Up until the past decade the idea of mechanization had not taken root in the industry. Even though a small amount of this has percolated itself into some parts of the value chain, like spinning, de-husking and de-fibreing, the weaving industry, which employs more than 1.5 lakh weavers, remains largely untouched by technology up-gradation. Statistics from the coir board state that more than 85% of the weaving looms in Kerala have not undergone any kind of mechanization. The project identified this need for increased mechanization and that it would directly result in helping SMEs produce mats at lower costs and higher volumes thus increase their competitiveness on the whole.

A Pilot initiative was launched in March 2010 to attempt such a change in the cluster. A BDS for lean manufacturing visited the looms and assessed the level of mechanization that will be required and also permissible in the given environment. As many of these looms were situated in the interior parts of the cluster where power shortage was a problem, it was decided that the changes that are to be suggested be non-electrical and will aim at improving the productivity at low cost. After the assessment a set of simple changes were suggested by the BDSP and five local loom manufacturers were given a basic training to implement the same.

The project supported 35 looms which have been upgraded. The various changes were specific to each unit depending on how old each loom was. However in almost all of the units the heavy wooden frames were replaced by G. I. pipes, ball bearing was introduced where there was manual pumping done with the legs to make the movement effortless, the final wooden cylindrical beam which rolled the finished mat was made iron with a gear arrangement and the frames were also optimally balanced. These changes, though minor, resulted in considerable increase in productivity. One of the owners of a beneficiary unit reported an increased output of 15m per day and resulting additional profit of ₹ 100 per day per loom.

The project has trained 20 loom manufacturers from various areas in the cluster so that their reach will be greater and that they will be able to provide services in the interior parts of the cluster as well. Not only are the changes suggested low-cost (approximately ranging from Rs.12,000-Rs.15,000 per loom), they are also not drastically different or new. While radical changes may be barriers in themselves, the small scale ones as, mentioned above are being incorporated without interfering with the traditional mind of the artisan in the cluster of Alappuzha.

Picture 5: Coir Loom (Before)

Picture 6: Coir Loom (After)

5. Production Improvement through Introduction of Automatic Spinning Ratt in Alappuzha

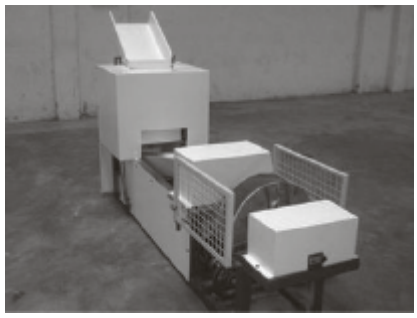
The spinning of coir yarn required to produce mats and other related coir products in Alappuzha is currently a very labor intensive process. The traditional spinning ratt required 3 women, one at the spinning wheel and two others to feed in the fiber while walking backwards. This method can yield 12-15 Kg per day. Though a number of units still use the above mentioned method of spinning the yarn, a slightly more mechanized version has also been introduced in the industry. The wheel which was previously hand-spun was attached to a motor hereby reducing the number of workers required from three to two. The yarn that is obtained through this method is in shorter fixed lengths. This results in another operation called spooling, where the yarns are made attached together manually and made into spools before the weaving operation can begin. This spooling operation is also a manual one. Also a shed space of approximately 50 ft, worth around ₹ 85,000 is required for this spinning operation.

With the project support a BDSP from Ahmedabad was introduced to the cluster. He developed 3 versions of a semi-automatic ratt that would use minimal space and effort. However a few hitches persisted due to which commercial production was not possible. Following this a coir machinery manufacturer based at Bangalore was brought in who introduced a fully automated design. This new design proved to be commercially viable with increased productivity and reduced the drudgery of workforce drastically. The machine also spins the yarn in to a spool eliminating manual spooling in the process.

This new model of the spinning ratt was launched in the cluster and demonstrated to the units. While the older model of ratt has a productivity of 8-12 kg per day, the newer model's output is 17 kg per day. The productivity per worker further increases as 2 machines require only one operator. Additionally, the investment cost is Rs.45,000 against Rs.85,000 required for setting up of a shed in the older model. The wages of a single worker increases by Rs.80 per day and an estimated increase in turnover by Rs. 20 crore is possible on 20% of the spinning units adopting the technology.

Picture 7: Traditional Spinning Ratt

Picture 8: New Automated Spinning Ratt



This spinning operation is performed predominantly by women workers and the level of manual labor involved is tremendous. The new spinning ratt will minimize this drudgery involved. Introducing this innovative design will revolutionize the industry and increase its potential by many folds.

SIDBI

भारतीय लघु उद्योग विकास बैंक

Small Industries Development Bank of India

- Set up on April 2, 1990 as subsidiary of IDBI, under an Act of Indian Parliament as an Apex Financial Institution for SSI (now MSME as per Government direction).
- Became autonomous in 2000 and now government ownership is held through public sector banks and insurance companies.
- Present authorized capital ₹ 1000 crore and paid-up capital ₹ 450 crore.
- Consistent profit making and dividend paying (since inception) (25% in the last two years).
- Balance Sheet size of ₹ 59,385 crore as on March 31, 2012.
- Cumulative disbursements of over ₹ 2,44,286 crore benefitting more than 325 lakh entrepreneurs as on March 31, 2012.
- Branch Offices at 85 locations across India covering all states and all major MSME clusters. Outreach widespread through associate/partner institutions
- Over 1,000 staff , mostly professionals, cut across multi-disciplinessuch as, Engineering, MBA, CA, etc.
- Wide range of financial and non-financial products and services for MSME directly as well through banks and other intermediaries.
- Preferred nodal agency for different ministerial schemes in sectoral areas such as textiles, food processing, leather, CLCSS etc.
- International Partnership- Leveraging association with lead international bi-lateral and multi-lateral institutions (World Bank , ADB, JICA, Japan; DFID, U.K; IFAD, Rome; KfW & GIZ, Germany, AFD, France, etc.) which includes imbibing global best practices , both financing and non financing, for Indian MSMEs Institutional solutions-
  - Set up its first associate in 1999 – SIDBI Venture Capital Ltd. (for providing venture capital) and SIDBI Foundation for Micro Credit.
  - Set up Credit Guarantee Fund Trust for Micro and Small Enterprises in 2000.
  - In 2004, started financing the Medium Sector Enterprises (with setting up of ` 10,000 crore SME Fund with SIDBI). Accordingly, now caters to the Micro, Small and Medium Enterprises.
  - In 2005 launched one of the world's largest MSME sector development project (MSMEFDP) in partnership with World Bank, DFID, UK; KfW and GIZ, Germany. Department of Financial Services, Ministry of Finance, Government of India is the Nodal Agency of the Project.
  - In 2005, set up SME Rating Agency Ltd. (India's first SME dedicated rating agency) and India SME Technology Services Limited to function as a technology bank for MSMEs in India.
  - In 2008, set up India SME Reconstruction Ltd. as the country's first MSME focused Asset Reconstruction Company.
- Designed, developed and disseminated several financing and non financing solutions especially products/services in nicheareas of risk capital, sustainable finance, skill development, technology upgradation, enterprise development, etc.

Table of Contents

1. Background

One of the key objectives of the MSME Financing and Development Project (MSMEFDP) is to promote development of MSMEs for ensuring that MSME lending becomes an attractive & viable financing option with increased access to credit for MSMEs. In this context, the project is providing requisite technical assistance including institutionalization of underlying policy, legal & regulatory framework for the non-financial development oriented services. One such development oriented initiative as part of MSMEFDP relates to adoption & absorption of latest technology by MSMEs in order to ensure their global competitiveness. With the adoption of a policy of liberalization and globalization by India, this assumes even greater significance in terms of ability of Indian MSMEs to tap the potential opportunities related to outsourcing, sub-contracting and ancillarization of products manufactured by large corporates and multinationals.

As part of this initiative, Small Industries Development Bank of India (SIDBI), in its role as the implementing agency of MSMEFDP, has mandated Deloitte Touche Tohmatsu India Private Limited (Deloitte) to develop a technology vision for Indian MSMEs considering a time horizon till 2020.

The current initiative would aim at building upon the past efforts of SIDBI focused on technology upgradation by Indian MSMEs in terms of adoption of 1999 as a "Techno Mission Year" along with publication of a report titled "Technology for Small Scale Industries – Current Status and Emerging Needs" which laid the technology vision roadmap for MSMEs till 2010 in terms of the following:-

- Assessment of existing technology status and technology gaps for key focal sectors
- Promoting modernization and technological upgradation road-map for Small Scale Industries (SSIs) with a vision till the year 2010, having the objective of enhancing the competitive strength of SSIs in the international markets; and
- Formulating inputs for policy formulation relating to technology adoption by SSIs

With the time horizon corresponding to the earlier study coming to an end and emergence of fresh issues & challenges impacting Indian MSMEs in terms of global competitiveness and need for technology upgradation, the current study envisages to address the following key issues:-

- Baselining the existing level of technology adoption in select focus sectors along with identification of key issues / constraints faced by MSMEs in technology acquisition / upgradation
- Mapping the various initiatives being taken by Government agencies / ministries to assess impact of implementation of the same along with identification of key issues & constraints in the policy framework and associated implementation
- Addressing the emerging issues in terms of adoption of environment friendly / pollution

reduction technologies, clean development mechanism, IPR protection etc. for accessing export markets, carbon credits, improving competitiveness etc.

- Benchmarking the science & technology related policy framework adopted in India with other countries to identify global best practices that should be replicated in India. Further, framework for customization of the same in the Indian context would also need to be developed

The expected outcome of the project is development of policy and institutional framework in form of a science & technology vision for MSMEs in India along with roles of associated stakeholders. This would serve as a reference point for the various stakeholders to take this initiative forward in terms of facilitating the implementation of recommended measures by putting in place the critical enablers to address the key issues & constraints.

1.1. Sector Selection Framework

Micro, small and medium scale enterprises (MSME) in India occupy a key strategic place in the economic growth & equitable development of the country in terms of contribution to innovation, employment generation, import-substitution, exports, etc. The impact of MSMEs can be gauged from their contribution to India's Gross Domestic Product (GDP), which is estimated at around 8%[1]. Highlights of the preliminary findings from the "Quick Estimates" of the 4th Census, post introduction of the MSME Development (MSMED) Act 2006 which laid down the revised definitions for purposes of categorization of an enterprise as an MSME in India, have been presented in the table below. This clearly highlights the role played by MSMEs in facilitating socio-economic development of the country.

Highlights of the 4th Census (2006-2007)	
Number of MSMEs	26.1 million
Number of manufacturing enterprises	7.3 million
Number of service enterprises	18.8 million
Per unit employment	6.24
Per unit gross output	₹ 4.6 million

Further it is observed that the Indian MSME sector is characterized by its diversity in terms of more than 8,000 product / service offerings, varying levels of technology adoption, focus on domestic vis-à-vis export markets, linkages with bigger corporates vis-à-vis operation on stand-alone basis, adoption of cluster vis-à-vis dispersed approach etc.

Given the diverse nature of the Indian MSMEs along with the need for development of a consolidated Technology Vision 2020 for the entire Indian MSME sector, it is critical to identify focal sectors which would optimally reflect the generic issues & constraints faced by Indian MSMEs with respect to technology adoption & absorption. In line with the scope of work requiring the detailed analysis to focus only on 10 focal sectors, the approach for selection of these focal sectors takes cognizance of the following key issues:-

- Identification of high-impact sectors in terms of contribution to output, employment, future growth potential, potential for adoption of clean / green technology etc.

[1] Report of The Working Group on "Science and Technology for SMEs" for 11th Five Year Plan (2007-2012)

It is envisaged that the key issues & constraints impacting these high-impact sectors is likely to be equally applicable for other relatively lower-impact sectors and a successful demonstration of benefits accruing from adoption of technology in these high-impact sectors is likely to serve as a role model for replication across the other sectors. Further, this approach of selection of high-impact sectors for implementation of technology adoption related measures would ensure devolution of maximum benefit to Indian MSME sector on a priority basis.

- Selection of focal sectors in the study titled "Technology for Small Scale Industries – Current Status and Emerging Needs" which was commissioned by SIDBI for formulation of technology vision for Indian MSMEs with a time horizon corresponding to 2010 for ensuring continuity in efforts at enhancing technology adoption levels in these sectors

Based on the above analysis and validations with the SIDBI MSMEFDP project coordinators, it was decided to focus the detailed study to the following 10 sectors.

Sl. No.	Name of Sector	Sl. No.	Name of Sector
1	Textiles	6	Plastics
2	Drugs & Pharmaceuticals	7	Paper
3	Food Processing	8	Engineering
4	Foundry	9	Electronics
5	Ceramics	10	Leather & leather products

1.2. Cluster selection and visits

In line with the scope of work agreed with SIDBI, it was decided to limit the primary interactions for understanding the current level of technology adoption and key issues & constraints being faced by the MSMEs with respect to technology upgradation to a single representative cluster for each of the ten focal sectors identified as above.

Preference was given to the clusters in which SIDBI had initiated Business Development Services (BDS) projects in order to leverage the relationships established by SIDBI appointed cluster facilitator agencies with the MSMEs and other key stakeholders associated with technology transfer & adoption in the respective cluster. This approach was adopted in order to facilitate the identification of the respective cluster participants to be met in order to fulfill the underlying objectives of the study along with serving as a basis for introduction to facilitate primary interactions with them. The cluster stakeholders included business member organizations / industry and cluster level associations, BDS providers, technology & equipment suppliers. In instances where SIDBI had not initiated any BDS related intervention for the focal sectors identified, contacts were made with the respective industry associations in the cluster to facilitate the primary interactions. This was supplemented with primary interactions with identified MSMEs who had availed of credit / financing support from the local SIDBI office based in the respective cluster.

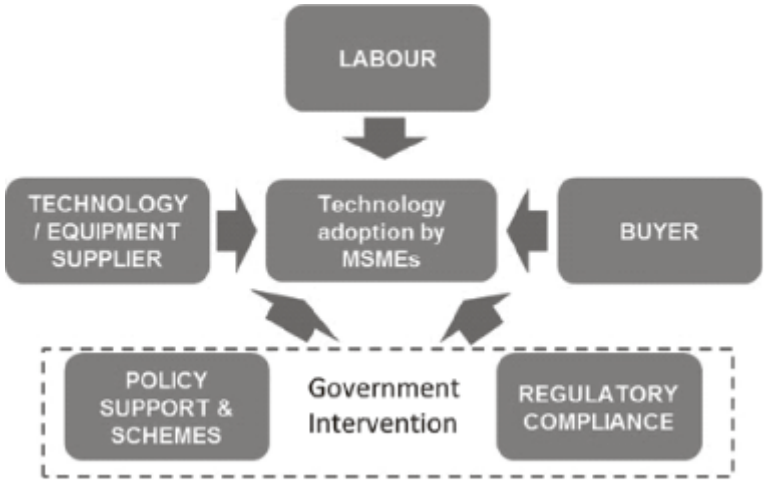
Based on the above, the following clusters were identified for purpose of primary interactions to ascertain the existing technology levels and issues & constraints faced by MSMEs related to technology upgradation for each of the identified focal sectors.

Sl. No.	Name of Sector	Cluster selected for primary interactions
1	Textiles	Tirupur
2	Drugs & Pharmaceuticals	Hyderabad
3	Food Processing	Pune
4	Foundry	Rajkot
5	Ceramics	Morbi
6	Plastics	Ahmedabad
7	Paper	Vapi
8	Engineering	Chandigarh – Panchkula – Mohali
9	Electronics	Chandigarh – Panchkula – Mohali
10	Leather & leather products	Kolkata & Chennai

Further, production facilities of the respective MSME and the relatively larger units within each cluster were also visited as part of sector-specific studies, wherever possible, in order to gain a first-hand experience of the comparative level of technology adoption of MSMEs vis-à-vis relatively larger players in the cluster.

2. Current Status of Technology Promotion in India

Considering the significant impact of MSMEs to the socio-economic development of any country, it is imperative for the respective national Governments to support the growth and development of MSMEs through all possible enabling mechanisms. Other than the well-established issue impacting MSMEs in terms of access to finance, markets & inputs; it is now being increasingly realized that lack of access and investments in technology also impacts the ability of MSMEs to compete in markets not only at local or national level but also globally. In this era of globalization, technology is increasingly becoming a key differentiator for developing economies like India in order to sustain growth rates, and especially to the MSME sector in order to ensure global competitiveness.



In line with the global trend, it has been observed that the Indian MSMEs face their own set of unique challenges related to technology adoption & absorption on account of their scale of operations, market linkages, access to "affordable" finance, policy & regulatory compliances etc. In spite of these issues impacting their ability to invest in technology upgradation / modernization, we understand from our primary interactions with the MSMEs during the course of cluster visits undertaken as part of this study that MSMEs are increasingly looking at investing in technology upgradation on account of select key drivers as depicted in the chart alongside and detailed below.

- Buyer requirement in line with changes in market trends and demand related to i) new product introduction, ii) modification to existing product, iii) quality upgradation etc. is one of the most important drivers for technology adoption / upgradation among the MSMEs. This can be attributed to the fact that failure to invest in technology adoption / upgradation in line with market demand / trends may result in loss of existing market and failure to access new markets
- Need for adherence to applicable regulatory norms & compliances which could relate to i) effluent discharge norms, ii) product quality certifications (domestic / exports) etc. is a key pre-requisite for MSMEs to ensure targeting / continue supplying to markets with stringent regulatory norms. On account of the above, it is observed that MSMEs are increasingly looking at investing in technologies facilitating regulatory compliance to ensure sustainability of their operations.

- Policy support and various schemes being implemented by the respective Government entities in facilitating technology upgradation among MSMEs have a positive impact on technology adoption among MSMEs. These could include i) hard interventions in form of technology transfer & commercialization and common infrastructure development for benefit of MSMEs, ii) soft interventions in form of support for development of technology awareness, skill development etc. However, it has been observed that the policy support and various schemes formulated by the respective Government entities primarily supports investment in technology upgradation, the demand for which emanates from other drivers like buyer requirements, need for regulatory compliances etc.
- Upgradation of technology provided by the equipment / technology provider along with withdrawal of maintenance support for existing technology may also force MSMEs to opt for technology upgradation. However, it is observed that this driver is usually applicable only in instances where the technology supplier has successfully demonstrated the productivity enhancement / cost reduction achieved through adoption of the applicable technology at some pilot / actual project site.
- Lack of availability of requisite level of skills among the labour force, even for relatively simple & routine jobs, is proving to be a key driver in MSMEs increasingly looking at investing in automation based technologies to substitute the level of manual intervention in the production process. Further, the need to conform to "social accountability" standards in order to cater to select export markets is also limiting the pool of labour available for deployment by MSMEs. However, one of the key issues impacting the adoption of these automation-based technologies could be the need for support in terms of capacity development of resources that can operate these new technologies.

2.1. Need for Technology Transfer to facilitate technology upgradation among MSMEs

Considering the above-mentioned drivers for technology upgradation, it becomes imperative for MSMEs to effectively connect their business strategy with the technology acquisition strategy to develop a sustainable competitive advantage. The technology acquisition strategy could involve development which can take place internally (inside the firm) or can be fostered through access to external sources, such as the transfer of technology from R&D agencies / multinational companies (MNCs), technical licensing / sale agreements etc.

Owing to the challenges in terms of lack of resources including, access to skilled resources & infrastructure etc. for investment in technology development, technology transfer from external sources is one of the key drivers impacting the ability of MSMEs to upgrade their technology. Technology transfer is seen as a process that aims at transferring technological know-how from a source like a university, a research center or R&D departments of firms to one or more recipients in form of firms which may either directly use or co-develop the technology. Traditionally, technology transfer has been a one-way process in which the recipient obtains new technology from the source through the stipulation of contracts, patents, license agreements, etc., and the technology is seen as hardware or a physical product. In spite of this

one-way process, the parties involved must actively communicate in order to establish a mutual understanding about the correct use of the technology which is new for the recipient. Therefore, the process of technology transfer should be seen as a knowledge communication process considering the fact that the economic value of technology is linked to the combination of general and specific knowledge. Given the above, technology transfer works the best when it involves a two-way communication process, with focus on i) assessment of the needs of potential users, ii) development of mechanism to apply the new technology to create value for the recipient; and iii) identification of the level of customization (from marginal to co-development) of technology required in order to develop specific applications.

2.1.1. Key Technology Transfer mechanisms

There are various channels through which technology may be transferred internationally or domestically. The key international technology transfer channels include i) foreign direct investment (FDI) through merger & acquisitions, ii) technical licensing agreements between foreign and local firms; iii) imports of intermediate and capital goods; iv) turnkey plants and project contracts, v) technical consultancies by foreign companies/consultancy firms etc. It should be noted that these international technology transfer mechanisms typically tend to impact only the urban-based relatively bigger medium sized enterprises. For purposes of technology transfer among the relatively smaller enterprises, effective mechanisms are needed for the domestic diffusion of technical knowledge from the first local recipient firms to other local firms, or from a local university as the first recipient to local firms. Domestic diffusion of the transferred or imported technology or knowledge can occur in various ways, including through subcontracting where buyers assist MSME suppliers to meet technical standards for inputs or establishment of long-term networks in form of i) strategic alliances through marketing output agreements, joint ventures, purchaser-supplier relationship etc. and ii) clusters with supporting ecosystem for technical development, management training as well as common facilities with state-of-art technologies which otherwise would be too costly for individual enterprises in dispersed locations. The key technology transfer mechanisms include the following:-

- Technology Licensing: License is a method of permit to execute, and a system wherein the holder of the technology rights gives permission to another party in relation to the execution rights of the relevant technology based on a contract. It means, the parties that give and take the execution & usage rights enter into a licensing contract, and on the premise of the specified conditions including payment of technical fees for a specified period etc., the permission for the execution & usage rights is given. After the period is over, execution and usage becomes invalid.
- Technology Sale: Technology transfer & acquisition is the transfer of rights in accordance with a contract as specified above, while the transfer of the same for a consideration is the called the sale of technology. By the sale of the relevant technology, comprehensive control and management is handed over to the buyer who pays the price (sales price). The key issues impacting this mode of transfer includes i) determination of sale / transfer price, ii) regulation of payment procedures and methods in terms of timing of payment and registration of the same in Intellectual Property Office etc.
- Technology Transfer with capital, management, know-how: In case of select highly advanced technologies, even if the technology is purchased or licensed, the success in

the commercialization of the relevant technology is not guaranteed, especially if the in-house utilization capability is insufficient. In these cases, technology transfer is usually accompanies with other management resources including capital, management know-how, equipment, core components etc. In this case, technical fees can be separately dealt with or transfer can be made including a part or the entire technical fee in relation to equipments, components etc.

- Technology Transfer using technical person as the medium includes invitation and deployment of technical personnel, resolution of technological issues through the employment of technical personnel etc. This can also be used to supplement the above-mentioned mechanisms.
- Technology Transfer involving sale of technology data such as plans, drawings etc. which is typically more relevant for small scale projects wherein the availability of such data can be used to formulate simple technology solutions.

2.1.2. Support required for Technology Transfer

As technology transfer takes place between different individuals / entities, the transmission of technological know-how from the source to a recipient may be distorted, as the efficiency of the transfer depends on in-depth understanding of the real needs of the recipient and minimization of language and cultural differences, which may hinder the flow of information from source to recipients. The management of the knowledge communication process may be very difficult for a MSME, and particularly for those firms not acquainted with the use of technology as a strategic asset. Given the complexity of the process, institutions — i.e., science parks, business innovation centers, public R&D agencies — acting as an interface between donors and recipients are essential for effective planning and implementation of the process itself. These institutions should be able to:

- Make firms aware of their technological needs and of the existence & potential benefits of new technologies
- Monitor the local, national and international technology markets, with the aim of identifying solutions to the technological needs of MSMEs. This task is critical given that MSMEs have limited resources available for independent gathering of information
- Facilitate the communication process between donors and recipients to facilitate information exchanges and knowledge generation
- Guide firms in minimizing difficulties when implementing the adopted technologies, including issues related to patenting, IPR etc.

Typical technology transfer service support required by MSMEs includes:

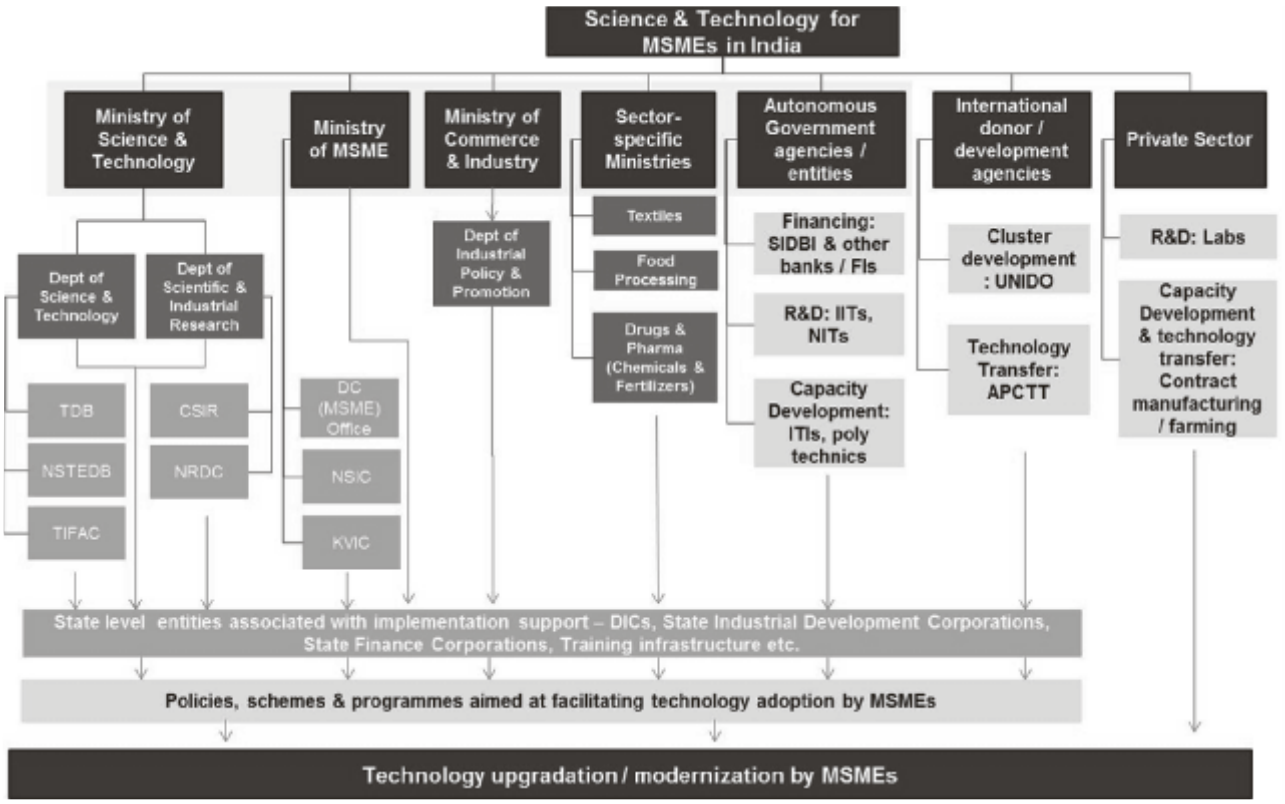
- Technology/business information
- Identification of technology partners
- Support in contracting, finance syndication and product marketing

In addition to the above, it requires Government intervention in terms of information dissemination on upgraded technologies available in the market, financing support for technology acquisition & adoption, incentivizing greater level of linkage of R&D eco-system with industry for technology indigenization & capacity development.

The existing policy and institutional level support available to MSMEs from various Government department / ministry / agencies for purposes of facilitating technology upgradation / modernization by MSMEs has been detailed subsequently in this report. This addresses the demand for technology upgradation among the MSMEs by either facilitating the technology transfer through development of requisite eco-system or through internal development.

2.2. Existing technology promotion related policy & institutional level support available to MSMEs

Interventions related to facilitating technology research, promotion and adoption for MSMEs in India has mostly been in the domain of the Government since Independence with a number of Ministries, Departments and agencies both at the Central and the State level, involved with various aspects of technology development and commercialization. In the recent past, a number of private organizations have also been working on technology adoption related interventions through establishment of captive research and development (R&D) centres specific to the respective sector. As per information available based on FICCI-sponsored study conducted in 2007, it is estimated that around 75-80% of R&D in India was undertaken by the Government agencies, 20-25% by private enterprises and around 3% by Universities[2]. Based on an assessment of the information available in the public domain and our past experience in assignments for the MSME sector, the existing institutional framework for facilitating technology transfer & adoption among MSMEs has been presented in the chart below.



[2] Source: Background paper by FICCI for conference on "Innovation- Advantage India" in December , 2007

The chart above highlights the key stakeholders associated with facilitating technology adoption among MSMEs through interventions including policy formulation, development of institutional framework for implementation, facilitating technology transfer & commercialization, information dissemination etc. The specific high-level role of the respective stakeholder has been detailed below.

2.2.1. Ministry of Science & Technology (MoST)

Ministry of Science & Technology (MoST) was established with the objective of promoting new areas of Science & Technology (S&T) and to play the role of a nodal ministry for organizing, coordinating and promoting S&T activities in the country, which also encompass those specific to the MSMEs across sectors. The key departments within this ministry include the following:-

- Department of Science & Technology (DST): Primarily entrusted with responsibility of formulation of S&T policies and their implementation, identification and promotion of thrust areas of research in different sectors of S&T; development of technology information databases; promotion of international collaboration for technology transfer and coordination of S&T related activities in the country. Select entities under the administrative control of DST which are associated with facilitating technology adoption, including those for MSMEs, through policy design and formulation along with implementation of respective schemes & programmes include the following:-
    - Technology Development Board (TDB): Offers financial assistance to the industrial concerns for the development and commercialization of indigenous technology
    - National Science & Technology Entrepreneurship Development Board (NSTEDB): Promotion of knowledge driven and technology intensive enterprises along with facilitating networking of support system, academic institutions and Research & Development (R&D) organizations to foster entrepreneurship and self-employment using S&T
    - Technology Information, Forecasting & Assessment Council (TIFAC): Generation of technology forecasting/technology assessment/ techno market survey documents, developing on-line nationally accessible information system, development of suitable mechanism for testing of technology and enabling technology transfer as well as commercialization
- Department of Scientific & Industrial Research (DSIR): Engaged in promotion of research in industry & institutions along with creation of enabling environment for development & deployment of innovative technologies. Select entities under the administrative control of DSIR which are associated with facilitating technology adoption, including those for MSMEs, through focus on promoting research & development in technology indigenization & commercialization include the following:-
    - Council for Scientific & Industrial Research (CSIR): National R&D organization providing scientific industrial research through a network of 40 labs and 80 field centres along with development of human resource associated with scientific research
    - National Research Development Corporation (NRDC): Objective of developing, promoting and transferring technologies emanating from various national R& D

institutions to the actual users along with development of technology database for ready reference

2.2.2. Ministry of Micro, Small & Medium Enterprises (MoMSME)

Ministry of Micro, Small and Medium Enterprises (MoMSME) has been involved in assisting the states in their effort to promote growth and development of MSMEs along with enhancement of their competitiveness in an increasingly market-led economy and generating additional employment opportunities. Further, MoMSME also attempts to address common concerns of these enterprises and undertakes advocacy on behalf of this sector. Select entities under the administrative control of MoMSME which are associated with facilitating technology adoption by MSMEs through policy design and formulation along with implementation of respective schemes & programmes include the following:-

- Development Commissioner (MSME): Nodal development agency associated with advocacy, hand holding and facilitation for the growth & development of Indian MSMEs through a network of pan-India offices and autonomous bodies like Tool Rooms, Training Institutions and Project-cum-Process Development centres
- National Small Industries Corporation (NSIC): Engaged in facilitating modernization, upgradation of technology, quality consciousness, strengthening linkages with large medium enterprises and enhancing exports for MSMEs
- Khadi & Village Industries Commission (KVIC): Planning, promotion, organization and implementation of programs for the development of Khadi and other village industries in the rural areas in coordination with other agencies engaged in rural development

2.2.3. Ministry of Commerce & Industry (MoCI)

Department of Industrial Policy & Promotion ("DIPP") under the Ministry of Commerce & Industry is associated with facilitating investment and technology flows to aid the process of industrial development, while providing avenues for inclusive growth for MSMEs. DIPP is associated with formulation and implementation of various Government schemes & programmes aimed at facilitating development / upgradation of technology-related infrastructure along with promotion of innovation in the Indian manufacturing sector, which also encompasses MSMEs.

2.2.4. Ministries focused on sector-specific interventions

Other than MoST and MoMSME, it is observed that there are select Government Ministries which are involved with policy formulation & implementation of technology transfer and adoption related interventions for MSMEs which are sector-specific. Representative examples include Ministry of Textiles for textile sector, Ministry of Food Processing Industries for the food processing sector, etc.

2.2.5. Autonomous Government agencies / entities

Autonomous Government agencies and entities which are not under the administrative control of any of the above-mentioned Government ministries but are associated with providing implementation support for facilitating various aspects of technology promotion among

MSMEs include the following:-

- Financing: SIDBI through Technology Development & Modernization Fund along with other public sector banks / Financial Institutions
- Technology development & indigenization : R&D labs in leading academic & research institutes like IITs, NITs, IISc, etc.
- Capacity development for skill upgradation : ITIs and polytechnics

2.2.6. International donor / development agencies

International development agencies also play a significant role in the design and roll out of technology adoption related programmes which include components of financial & technical support with interventions both at a central and state level. Further, the study projects conducted or supported by these International Agencies play a significant role in policy advocacy and provide inputs for policy formulation to facilitate greater levels of technology promotion among MSMEs. Select examples include:

- United Nations Industrial Development Organization (UNIDO): Promotion of cluster & network development programme aimed at building sustainable linkages between MSMEs, their larger scale business partners and support institutions
- Asian & Pacific Centre for Technology Transfer (APCTT): Facilitating the process of international flows of technologies across firms and national boundaries in the form of increased technological cooperation, strategic alliances, and partnerships along with advisory and support services for capacity building of MSMEs. Associated with Technology Bureau for Small Enterprises (TBSEi – now India SME technology Services Ltd.) and UNDP Technology Management Programme Support (TMPS).

2.2.7. Private sector

Private Sector players also playa key role in supporting the underlying institutional mechanism for implementation of respective schemes & programmes aimed at facilitating technology upgradation among MSMEs through their contribution in terms of i) capacity development & technology transfer support by entering into contract manufacturing with MSMEs and ii) R&D support through establishment of internal R&D divisions and labs which supports the MSMEs associated as suppliers to these players.

It is estimated that the country presently has around 1250 R&D divisions and labs[3] in the non-Government sector which supports various industries, including the MSMEs. However, it is observed that this support is concentrated in select sectors in which Indian companies have been the first movers in technology adoption such as automobiles and automobile ancillaries, biotechnology, pharmaceuticals, bio-informatics, ICT- software and hardware etc. Examples of large private sector companies in these sectors which have invested in R&D in India include Dr. Reddy's Laboratories, Ranbaxy Laboratories, Tata Motors, Mahindra & Mahindra, Cipla Ltd etc. One of the key focus areas of R&D for all these private sector companies has been facilitating vendor development, including MSMEs, through extension of R&D support to ensure better product development in terms of quality and cost competitiveness.

[3] Source: DSIR directory titled "Directory of Recognized in-House R&D units"

A number of MNCs like Toyota, Ford, Hyundai, Nokia etc. have also invested and setup operations in India since the liberalization of the economy and have either established in-house R&D facilities or outsourced R&D activities to India increasing the private R&D investments in India from $0.8 bn in 2002 to $4.1 bn by 2004. Besides, a number of private organizations also provide a wide range of business development services in form of consulting, technical assistance, capacity building and training services on technology related subjects such as lean manufacturing, six sigma, kaizen, etc. to MSMEs to support technology adoption and absorption by them.

2.2.8. State-level implementation support for technology adoption by MSMEs

For most of the technology-related interventions for MSMEs in respective states, support from the respective State Government agencies, entities and institutions like District Industrial Centres (DICs), state-level industrial development and financing corporations, academic & research institutes, industry associations etc. may be a pre-requisite for the successful delivery of the intended benefits. These state-level entities provide the "last-mile connectivity" for smooth implementation of schemes & programmes formulated by the above-mentioned stakeholders which is aimed at technology upgradation for MSMEs.

2.3. Specific role of Government in facilitating technology promotion among MSMEs

In this section, we will focus on detailing the policy & institutional level support available from the Government ministries, viz. Ministry of Science & Technology (MoST), Ministry of MSME (MoMSME) and Ministry of Commerce & Industry (MoCI) to the Indian MSMEs across multiple sectors. However, it should be noted that in addition to these there may be additional programmes & initiatives applicable for each of the 10 focal sectors identified for purposes of the study which are being undertaken by the sector-specific Ministries. These programme & initiatives would be detailed in each of the chapters on the specific sector along with linkages, if any, with these MoST, MoMSME and MoCI initiatives.

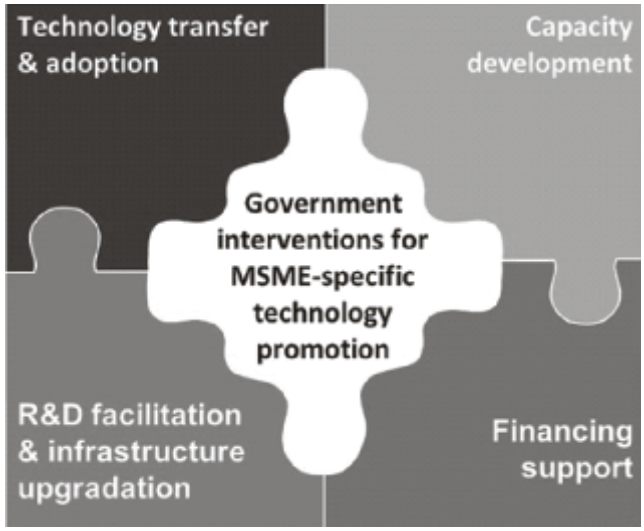
It should also be noted that MoST, MoMSME and MoCI are associated with policy design & formulation to ensure that the requisite interventions for the target MSME segments in high priority and focus areas are adequately addressed. In addition to their role in policy design & formulation, we have tried to categorize the technological promotion and adoption related initiatives of MoST, MoMSME and MoCI for MSMEs into the key support areas depicted in the chart alongside.

With the ultimate objective of supporting technology adoption among the MSMEs, it is observed that the interventions along the key support areas specified in the chart along side are either extended directly to MSMEs or routed through establishment / strengthening of intermediary entities like academic / R&D institutes, universities, incubation centres / parks etc. The specific sector-agnostic interventions by MoST, MoMSME and MoCI along these key support areas are specified below.

[4] Source: Background paper by FICCI for conference on "Innovation- Advantage India" in Dec, 2007

2.3.1. Technology transfer & adoption

Support for technology transfer & adoption relates to development of mechanism for technology procurement / import, indigenization, commercialization and patenting with requisite incentives for facilitating appropriate linkages with academic / research institutions and information dissemination on the same. The key initiatives undertaken to support technology transfer & adoption among the MSMEs include the following:-



Ministry / Department	Entity / Scheme focused on technology transfer & adoption	Highlights of intervention	Web link for reference
MoST – DST	Technology Information, Forecasting & Assessment Council (TIFAC)	• Facilitating availability of requisite technologies by minimizing time gap between technology import, development & utilization through close association with industry & academia	http://www.tifac.org.in/
	TIFAC – Technology Refinement & Marketing Programme (TREMAP)	• Establishment of network of Technology Commercialization Facilitators (TCFs) which provide assessment of innovative technologies by identifying market potential along with need for any refinement. Further, requisite marketing & operational support in terms of requisite linkages along with financial support is also provided for commercialization of viable technologies	http://www.tifac.org.in/index.php?option=com_content&view=article&id=223&Itemid=398
	National Science & technology Entrepreneurship Development Board (NSTEDB) – Technology Business Incubators (TBI)	• Facilitates transfer of technology & speedy commercialization of technology • Provides value-added services to SMEs in terms of conducting market surveys, marketing assistance, finance syndication, arranging IPR services along with provision for providing common infrastructure etc.	http://www.nstedb.com/institutional/tbi.htm
	State Science & Technology Programme	• Strengthening linkages between state-level S&T councils and central S&T agencies to ensure pooling of technologies promoted & generated for optimum deployment	http://www.dst.gov.in/scientific-programme/s-t_scst.htm
	National Council for Science & Technology Communication (NCSTC)	• Development of information dissemination mechanism leveraging various communication mediums about S&T related developments	http://www.dst.gov.in/scientific-programme/s-t_ncstc.htm

Ministry / Department	Entity / Scheme focused on technology transfer & adoption	Highlights of intervention	Web link for reference
MoST - DSIR	Technology Development & Demonstration Programme (TDDP)	• Strengthen the interface between industry, R&D establishments and academic institutions and provide support for development and demonstration of innovative product and process technologies, through entire value-chain encompassing proof of concept to laboratory stage to pilot stage, rendering them fit for commercialization. Also includes support for absorption and upgradation of imported technology	http://www.dsir.gov.in/tpdup/tddp/tddp.htm
MoMSME	Scheme for International Cooperation	• Information dissemination on technologies available for MSMEs through deputation as part of delegations participating in international exhibitions, trade fairs, buyer-seller meets etc.	http://msme.gov.in/guidelines_schemes.pdf
MoMSME – Office of Dev Comm (MSME)	National Manufacturing Competitiveness Programme (NMCP) – Support for entrepreneurial & managerial development through incubators	• Funding support to host organization to make available requisite laboratory / workshop facilities to SMEs which will aid in development of new technologies, processes & products which can subsequently be commercialized • Public private partnership model adopted with inclusion of private partner for providing funding & technical support	http://www.dcmsme.gov.in/schemes/Incubators10.pdf
	National Manufacturing Competitiveness Programme (NMCP) – Promotion of ICT	• Development of web-portal for clusters along with customized software solutions to improve productivity & reduce cost through interventions across production value chain	http://www.dcmsme.gov.in/schemes/ICTDetail.html
	Scheme for adoption of clean technologies	• Information dissemination about benefits/advantages of new techniques/technologies for achieving energy efficiency across multiple sectors in order to promote adoption of the same • Facilitating energy audits to identify areas of improvement in ensuring higher level of energy efficiency	http://envfor.nic.in/citizen/specinfo/cltsmall.html
MoCI – DIPP	National Productivity Council	• Information dissemination on importance of productivity improvement in manufacturing process and demonstration of the concepts and techniques of productivity in all sectors of the economy	http://www.npcindia.org/
	Quality Council of India	• Information dissemination on need for adoption and adherence to quality standards in manufacturing along with certifications / accreditations	http://www.qcin.org/

2.3.2. Technology related capacity development

Capacity development support relates to interventions aimed at ensuring development of requisite skills and competencies among MSMEs to optimally leverage the existing technology / adoption of new technology. The key initiatives undertaken to develop capacities related to technology adoption among MSMEs include the following:-

Ministry/ Department	Entity / Scheme focused on technology related capacity development	Highlights of intervention	Web link for reference
MoST – DST	National Science & technology Entrepreneurship Development Board (NSTEDB) - Technology based Entrepreneurship Development Programme (TEDP)	• Focused on training and development need of S&T entrepreneurs in specific technology areas across multiple sectors • Training in indigenous technologies developed by R&D institutions that are available for commercialization	http://www.nstedb.com/training/tedp.htm
MoMSME	Scheme for assistance to training institutions	• Assistance for establishment of new entrepreneurship development institutes (EDIs) and strengthening of infrastructure of existing EDIs in order to provide training to entrepreneurs and facilitate establishment of their units	http://msme.gov.in/EDI_Scheme_Guidelines.pdf
MoMSME – Office of Dev Comm (MSME)	Scheme for capacity building, strengthening of database and advocacy	• Support for facilitating capacity development related initiatives for MSMEs through industry associations	http://www.dcmsme.gov.in/faq/Capacity_Building.pdf
	Strengthening of training infrastructure of existing & new Entrepreneurship Development Institutions	• Assistance for establishment of new entrepreneurship development institutes (EDIs) and strengthening of infrastructure of existing EDIs in order to provide training to entrepreneurs and facilitate establishment of their units	http://dcmsme.gov.in/schemes/assedi.htm
	National Manufacturing Competitiveness Programme (NMCP) – Enhancing competitiveness through quality management standard (QMS) / quality technology tools (QTT)	• Development of course content in collaboration with ITIs / polytechnics with the objective of sensitizing & encouraging MSMEs to adopt latest QMS & QTT to improve competitiveness	http://www.dcmsme.gov.in/schemes/QmsQtt.htm
MoMSME – Office of Dev Comm (MSME)	National Manufacturing Competitiveness Programme (NMCP) – Design Clinic Scheme	• Establishment of Design clinic centres to provide subsidized solutions to design related issues like evaluation, analysis & improvement • Linkage of these centres in key clusters with engineering, design and management institutes in the geographic vicinity	http://www.dcmsme.gov.in/schemes/DesignClinic.htm
MoCI – DIPP	Centre for Energy Efficiency	• Capacity development in the areas related to adoption of energy efficient technologies along with information dissemination on the same	Not available

2.3.3. R&D facilitation and infrastructure upgradation

Interventions aimed at research & development facilitation and infrastructure development in terms of establishment of laboratories along with requisite equipments & instruments, setting up of common facility centres with requisite common infrastructure, etc. for the MSMEs include the following:-

Ministry/ Department	Entity / Scheme focused on R&D facilitation & infrastructure upgradation	Highlights of intervention	Web link for reference
MoST – DST	Sophisticated Analytical Instrument Facilities (SAIF)	• Development of facilities with sophisticated analytical instruments for utilization for purpose of R&D related activities along with information dissemination on the same	http://www.dst.gov.in/scientific-programme/ser-saif.htm
	Science of Equity Empowerment & Development (SEED)	• Facilitating utilization of existing national S&T infrastructure in order to provide facilities to scientists / field-level workers to take up R&D activities focused on socio-economic development, especially in rural areas	http://www.dst.gov.in/scientific-programme/s-t_ssp.htm
	Scientific & Engineering Research Council	• Project support to scientists / academic & research institutes engaged in pursuing research initiatives in various S&T related areas	http://www.serc-dst.org/
	TIFAC – Patent Facilitating Centre	• Information dissemination on patent information as a vital component of the R&D initiatives, with focus on the process for obtaining the same along with key challenges faced • Provision of patent related facilities	http://www.indianpatents.org.in/
	National Science & Technology MIS (NSTMIS)	• Collection, collation and information dissemination on resources devoted to S&T activities in the country to facilitate optimum investment in R&D	http://www.nstmis-dst.org/
	Science & Technology International Cooperation Division	• Negotiation and implementation of S&T cooperation agreements aimed at development of joint / collaborative R&D programmes along with exchange visits for professionals engaged in R&D for knowledge dissemination	http://www.stic-dst.org/
	National Science & technology Entrepreneurship Development Board (NSTEDB) - Science & Technology Entrepreneurs Park (STEP)	• Development of close linkage between universities, academic and R&D institutions on one hand and industry on the other to i) promote entrepreneurship among Science and Technology persons, ii) provide R&D support to the MSMEs and iii) support innovation based enterprises	http://www.nstedb.com/institutional/step.htm
MoST – DSIR	Council of Scientific & Industrial Research (CSIR)	• Establishment of linkage with academia, R&D organizations and industry to conduct scientific industrial R&D for the benefit of enterprises across multiple sectors like leather, chemicals, drugs & pharmaceuticals, food processing etc.	http://rdpp.csir.res.in/csir_acsir/Home.aspx
	Industrial R&D Promotion Programme (IRDPP)	• Strengthen R&D related infrastructure and promote R&D initiatives of industry and scientific & industrial research organizations (SIROs) through requisite monetary & fiscal benefits	http://www.dsir.gov.in/tpdup/irdpp/irdpp.htm
MoMSME	MSME Testing Centres	• Provision of testing facilities in order to ensure i) conformance to international quality standards, ii) testing of raw materials & finished products and iii) instrument calibration	http://www.dcmsme.gov.in/sido/ktdrtfts.htm

2.3.4. Financing support

Interventions related to financing support for investments in the acquisition / upgradation of technology and associated equipments and plant & machinery, working capital management for production etc. are usually bundled with other technology promotion related interventions aimed at technology transfer & commercialization, R&D facilitation and infrastructure upgradation. Select initiatives are detailed below.

Ministry/ Department	Entity / Scheme focused on financing support	Highlights of intervention	Web link for reference
MoMSME – Office of Dev Comm (MSME)	Credit Linked Capital Subsidy for Technology Upgradation	• 15% capital subsidy on institutional finance availed by MSMEs for induction of well-established and improved technology in approved sub-sectors/products. The admissible capital subsidy is calculated with reference to purchase price of Plant and Machinery • Nodal agency for implementation include: o Small Industries Development Bank of India(SIDBI) o National Bank for Agriculture and Rural Development (NABARD) o State Bank of India o Canara Bank o Bank of Baroda o Punjab National Bank o Bank of India o Andhra Bank o State Bank of Bikaner & Jaipur o Tamil Nadu Industrial Investment Corporation o The National Small Industries Corporation Ltd.	http://dcmsme.gov.in/schemes/sccredit.htm
	Credit Guarantee Fund Scheme	• Collateral-free credit, encompassing both term loans & working capital facility, through extension of partial guarantees to MSME-specific lending institutions through a trust named Credit Guarantee Fund Trust for Micro & Small Enterprises (CGTMSE) which facilitates on-lending to MSMEs. SIDBI is co-trustee of CGTMSE	http://www.cgtmse.com/
MoMSME – Office of Dev Comm (MSME)	Quality upgradation / environment management through incentive for ISO 9000 / ISO 14001 / HACCP certifications	• Partial reimbursement (up to 75%) of charges incurred in acquiring the certifications related to ISO 9000 / ISO 14001 / HACCP	http://dcmsme.gov.in/schemes/sciso9000.htm
	Scheme of Micro Finance programme	• Provision of meeting security deposit requirements for loans to be availed by NGOs / MFIs for on-lending to MSMEs	http://dcmsme.gov.in/schemes/microfinance.htm
	Alternative energy use scheme (formulated by Ministry of Non-Conventional Energy Sources)	• Monetary support for adoption of alternate energy forms like solar power, non-conventional sources, urban, industrial & municipal waste etc.	http://www.dcmsme.gov.in/schemes/inenviro.htm#adopt

Ministry/ Department	Entity / Scheme focused on financing support	Highlights of intervention	Web link for reference
MoCI – DIPP	Industrial Infrastructure Upgradation Scheme (IIUS)	• Financial assistance in form of one -time grant for establishment of infrastructure related to R&D, quality certification centres, common facility centres including common effluent treatment plants etc. • Restricted to 75% of project cost, subject to a ceiling of ₹ 50 Crore	http://mpcb.gov.in/images/pdf/FAP-DIPP.pdf
MoST-TIFAC	SIDBI SRIJAN (Revolving Fund for Technology Innovation)	• Support MSMEs towards development, up-scaling, demonstration and commercialization of innovative technology based projects. • Revolving fund of ₹ 30 crore • Assistance provided upto ₹ 1 crore at a softer interest rate not more than 5%	http://www.dst.gov.in/autonomous/tifac.htm

Further, it should be noted that in addition to the above interventions by MoST, MoMSME and MoCI which are specific to one of the key support areas, there are select interventions which address multiple support areas simultaneously as detailed below.

2.3.5. Interventions addressing multiple support areas

While the interventions specific to each of the four technology promotion related support areas have been detailed above, it is observed that there are select interventions which address multiple support areas simultaneously. The details for the same are presented in the table below.

Ministry/ Department	Entity / Scheme focused on cross-cutting interventions	Highlights of intervention	Web link for reference
MoST – DST	Fund for Improvement of S&T Infrastructure (FIST) in universities & other higher educational institutes	• Availability of funds for procuring basic equipments along with creation of high-tech facilities to aid R&D in universities and educational institutes aimed at S&T development	http://www.dst.gov.in/scientific-programme/ser-fist.htm
	Technology Development Board	• Assistance to industrial concerns & other agencies attempting development & commercialization of indigenous technology or adaptation of imported technology for domestic application • Financial support available in form of low-interest rates loans / equity capital support for industrial concerns and grants to R&D institutions	http://www.tdb.gov.in/

Ministry/ Department	Entity / Scheme focused on cross-cutting interventions	Highlights of intervention	Web link for reference
MoST – DST	National Science & Technology Entrepreneurship Development Board (NSTEDB) – Science & Technology Entrepreneurship Development (STED)	• Identification of S&T interventions like technology selection, modification, alteration and dissemination among entrepreneurs; upgradation of technology for modernization of respective units • Conducting skill development programmes for promoting entrepreneurship	http://www.nstedb.com/institutional/sted.htm
	National Science & technology Entrepreneurship Development Board (NSTEDB) - Innovation & Entrepreneurship Development Centre (IEDC)	• Promotion of IEDCs in educational institutes to create entrepreneurial culture which can support the development of S&T based entrepreneurs • Capacity development through entrepreneurship and skill development programmes to facilitate S&T adoption • Information dissemination through entrepreneurship awareness camps	http://www.nstedb.com/institutional/guidelines-iedc0.pdf
	Instrumentation Development Programme	• Strengthening indigenous capacity for research, design, development of instruments to keep pace with technology improvements taking place globally	http://www.dst.gov.in/scientific-programme/t-d-idp.htm
MoST – DSIR	National Research Development Corporation (NRDC)	• Development, promotion and transfer of technologies emanating from various national R&D institutions in order to translate the same into marketable product • Commercialization support including licensing, IPR related inputs etc. • Information dissemination through participation in international exhibitions, workshops, seminars to promote India as a source of technology • Financing support for setting up pilot plants for scaling up laboratory processes, pri or to commercialization in form of soft loans / equity participation • Capacity development support in form of training programmes related to technology development & transfer	http://www.nrdcindia.com/
	Technopreneur Promotion Programme (TePP)	• Support in form of i) financial assistance or ii) utilization of facilities for lab-scale demonstrations & computer simulations to convert S&T related ideas into demonstrable models • Financial & technical support in technology commercialization involving facilitating market access, adding product features, protection by patenting, aesthetic design, limited production for market seeding etc.	http://dsir.gov.in/tpdup/tepp/tepp.htm

Ministry/ Department	Entity / Scheme focused on cross-cutting interventions	Highlights of intervention	Web link for reference
MoST-DSIR	Technology Development & Utilization Programme for Women	• Technical and financial assistance to support adoption of new technologies / upgradation of existing technologies adopted by MSMEs run by women entrepreneurs • Information dissemination about potential technologies that can be adopted by women entrepreneurs by showcasing and organizing demonstration programmes • Capacity development on technology related issues	http://www.dsir.gov.in/tpdup/tdupw/tdupw.htm
	New Millennium Indian Technology Leadership Initiative (NMITLI)	• Networking of competencies of publicly funded R&D institutions, academia and industry for R&D in S&T related areas for multiple sectors • Financing support in form of grants and soft loans	http://www.csir.res.in/external/heads/collaborations/nmitli.htm
MoMSME – Office of Dev Comm (MSME)	Financial Assistance to states / state agencies for setting up mini tool rooms & training centres	• Grant in aid to state / state agency for establishment of new tool rooms (90% of cost of machinery / equipment) or upgradation of existing tool rooms (75% of cost of machinery / equipment) in order to ensure deployment of CAD / CAM techniques for advanced tool & die making • Capacity development through training on tool design & manufacturing • Assistance in product & prototype development	http://www.dcmsme.gov.in/schemes/scminitool.htm
	Micro & Small Enterprises – Cluster Development Programme (MSE – CDP) includes Integrated Infrastructure Development (IID)	• Partial financial assistance (70-90%) for establishment of common facility centres (CFCs) having modern state-of-art technology for testing, training centre, effluent treatment etc. with maximum project cost of ₹ 15 Crore • Partial financial assistance (75-90%) for conducting capacity development related initiatives for technology updation in form of training, seminars, study tours etc.	http://www.dcmsme.gov.in/MSE-CDProg.htm
	National Manufacturing Competitiveness Programme (NMCP) – Building awareness on Intellectual Property Rights (IPR)	• Enhancement of awareness among MSME about Intellectual Property Rights (IPRs) to take measure for the protecting their ideas and business strategies through seminars / workshops/ sensitization programmes etc. • Training on mechanism to be followed for securing patents • Financial support for facilitating information dissemination & training, patent registration along with establishment of IPR facilitation centre for MSMEs	http://www.dcmsme.gov.in/schemes/IPRDetail.html

Ministry/ Department	Entity / Scheme focused on cross-cutting interventions	Highlights of intervention	Web link for reference
MoMSME – Office of Dev Comm (MSME)	National Manufacturing Competitiveness Programme (NMCP) – Lean Manufacturing Competitiveness Scheme (LMCS)	• Engagement of Lean manufacturing consultants to study as-is manufacturing systems & processes and recommend interventions for implementing lean manufacturing techniques • Financial assistance in form of reimbursement up to 80% of the consultant fees for each cluster participating in the programme is provided	http://www.dcmsme.gov.in/schemes/lean-manufact.htm
	National Manufacturing Competitiveness Programme (NMCP) – Mini tool rooms & training centres in PPP mode	• Financial assistance in setting up tool room facilities through a PPP mode to ensure design & manufacture of quality tools to support the MSMEs • Serve as training centres for designing & manufacturing	http://www.dcmsme.gov.in/schemes/MTRDetail.pdf
	National Manufacturing Competitiveness Programme (NMCP) . Marketing assistance & technology upgradation	• Facilitating technology upgradation in areas related to packaging for facilitating exports • Capacity development to develop products to	http://www.dcmsme.gov.in/schemes/MarketingAss&Tech
	National Manufacturing Competitiveness Programme (NMCP) – Scheme for technology & quality upgradation support (TEQUP)	• Capacity Building of MSME Clusters for Energy Efficiency/Clean Development Interventions and other technologies mandated as per the global standards • Facilitate implementation of Energy Efficient Technologies (EET) • Establishment of Carbon Credit Aggregation Centres (CCA) for intro ducing and popularizing clean development mechanism(CDM)	http://www.dcmsme.gov.in/schemes/TEQUPDetail.htm
MoMSME	National Small Industries Corporation (NSIC) – Training cum Incubation centres under PPP mode	• Capacity development support on all aspects related to entrepreneurship, including identification of appropriate technology, project / product selection etc. • Demonstration of low cost project technologies required for setting up small units through display in working condition	http://www.nsic.co.in/Sch0709.pdf
	National Small Industries Corporation (NSIC) – Technical Service Centres	• Information dissemination on latest information related to technology upgradation & transfer • Training in hi-tech as well as conventional technology, testing, common facilities, toolkits, energy audit, environment management etc.	http://www.nsic.co.in/technology.asp

Ministry/ Department	Entity / Scheme focused on cross-cutting interventions	Highlights of intervention	Web link for reference
MoMSME	Scheme of Fund for Regeneration of Traditional Industries (SFURTI)	• Establishment of common facility centres • Capacity building activities, such as exposure visits to other clusters and institutions, need-based training, support for establishment of cluster level networks (industry associations) and other need based support	http://msme.gov.in/msme_sfurti.htm

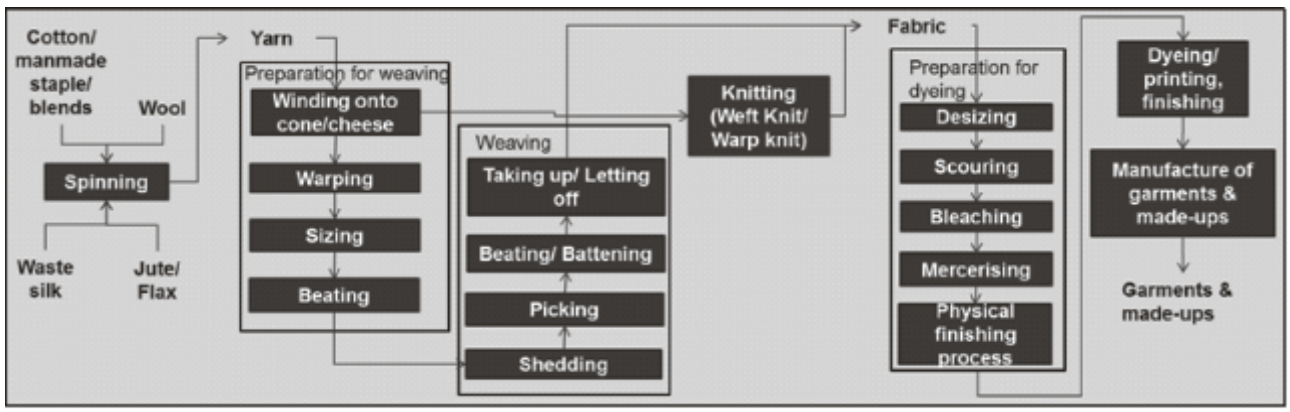
However it should be noted, that besides these programmes and initiatives detailed above, there are some programmes and initiatives which are applicable to the focal sectors selected for this study. These have been detailed in each of the sector specific chapters below, along with the role played by the respective sector-specific Government agencies.

3. Textiles

The Indian textile industry is one of the leading industrial sectors of India which accounts for 4% of GDP, about 14% of industrial production and 17% of the country's export earnings.[5] Further the industry is labour-intensive which is evident from the fact that it provides direct employment to over 35 million people and is estimated that one in every six households in the country depends upon this sector directly or indirectly for its livelihood.

On the global stage, the textile industry together is estimated to be around about $4,395 billion with the global trade in textiles valued at around $523 billion[6]. However, the Indian textile industry is valued at $55 billion[7] with exports estimated at about $22 billion[8] which translates to only 4% of the global exports in textiles. Further, it is observed that the performance of the sector is better in lower value-added part of the textile value-chain corresponding to yarns & fabrics in terms of the share of global production and exports vis-à-vis the higher value-added part of the value-chain corresponding to manufacture of readymade garments & other finished products. It has been estimated that India has a share of 12% of the global production of fabrics & yarns, which also contributes to India emerging as the largest exporter of yarn in the global markets with a share of 25% of global trade in cotton yarn.[9]

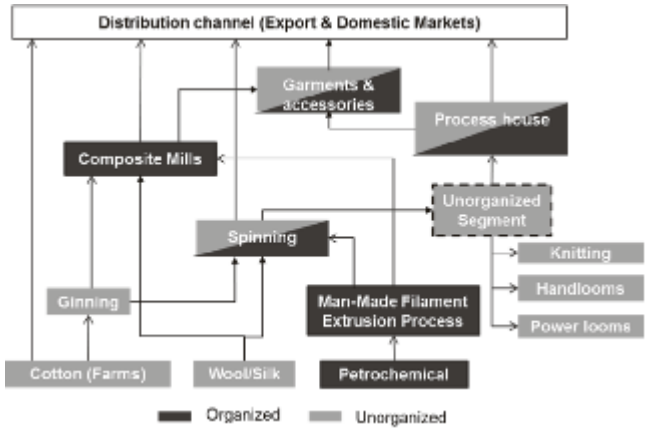
The textile industry of India can be classified according to the type of raw material being used such as cotton, wool, silk, jute and manmade staple fibres. Although the technology required in the manufacture of garments from the different raw materials vary, the basic processes for all the raw materials are spinning, weaving/ knitting, finishing, dyeing and manufacture of garments and made-ups. The high-level textile industry value chain is given in the figure below



[5] Source: Annual report of the Ministry of Textiles 2009-10
[6] Source: Annual report of TEXPROCIL 2009-10
[7] Source: Annual report of the Ministry of Textiles 2009-10
[8] Source: Annual report of TEXPROCIL 2009-10
[9] Source: Dun & Bradstreet report titled "Textile Industry Report"

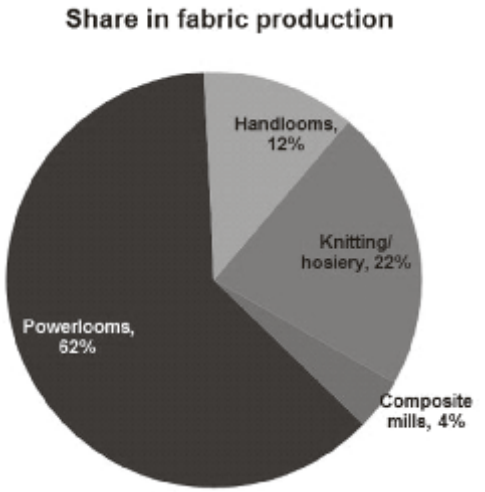
3.1. Industry Structure

A representative diagram highlighting the key stakeholders & activities associated with the textile industry is provided in the chart below which shows the presence of both organized and unorganized sector across the value chain.



- Spinning mills involved in conversion of raw materials like cotton, wool etc. into yarn. This part of the value-chain has a fair representation from both the organized sector and the small scale units, with estimates that 43% of all spinning mills belong to the small scale units.
- Yarn to Fabric conversion typically involves two key processes, viz. weaving and knitting for apparel textiles. It is estimated that weaving activities associated with handlooms & power looms accounts for 74% of the total grey / fabric production with knitting / hosiery units and composite mills (having end-to-end integrated facilities) having a share of 22% and 4% respectively. The chart below depicts the respective shares of the different types of units.

  Weaving activities involving power looms/ handloom is dominated by the unorganized sector with around 95% share. Further, it is estimated that out of the around 5.7 million looms installed in the country, power looms account for around 40% of the same with the balance being handlooms.[10] In the entire textile value-chain, it is observed that handlooms are the most labour-intensive segment with estimates that around 6.5 million people are directly or indirectly employed as weavers and allied workers resulting in handlooms being the second highest employer after agriculture.



  In the year 2000, India had about 6000[11] knitting units registered as producers or exporters with most of them being small scale enterprises accounting for 45% of India's garment exports. The key centres for knitwear in India are Ludhiana (woolen and synthetic knitwear), Delhi (synthetic knitwear), Bangalore (Cotton and synthetic knitwear), Mumbai (Cotton and synthetic knitwear) and Tirupur (cotton knitwear). Of these, Tirupur accounts for 90% of the country's knitted garment exports or about 4%[12] of India's total export trade.
- Fabric processing includes subjecting the fabric to various physical and chemical processes including dyeing, printing, finishing etc. for conversion into finished goods (garment and made-up manufacturing) and is also dominated by the small scale units.

[10] Source: Annual report of the Ministry of Textiles 2009-10
[11] Source: Dun & Bradstreet report titled "Textile Industry Report"
[12] Source: Case Study of Tirupur by UNIDO

Overall there are about 23,000 fabric finishing units with 21,000 independent units while the rest are a part of the composite mills.[13]

3.2. MSMEs in the Textiles sector

As highlighted above, the Indian textile industry is highly fragmented with MSMEs having a significant presence across select value chain activities like weaving / knitting, fabric finishing (including processing, printing/ embroidery, etc.). One of the key drivers for such decentralization may be attributed to the protectionist policies of the Government pursued from 1950s till 1970s during which several textile items were reserved for the small scale segment. Although these policies promoted extensive growth of small scale textile enterprises that were highly labour intensive, it also led to the establishment of a number of non-integrated stand-alone units which focused on only select aspects of the value chain such as knitting/ weaving, fabric finishing, etc. It also led to a number of textile units having low level of technology adoption.

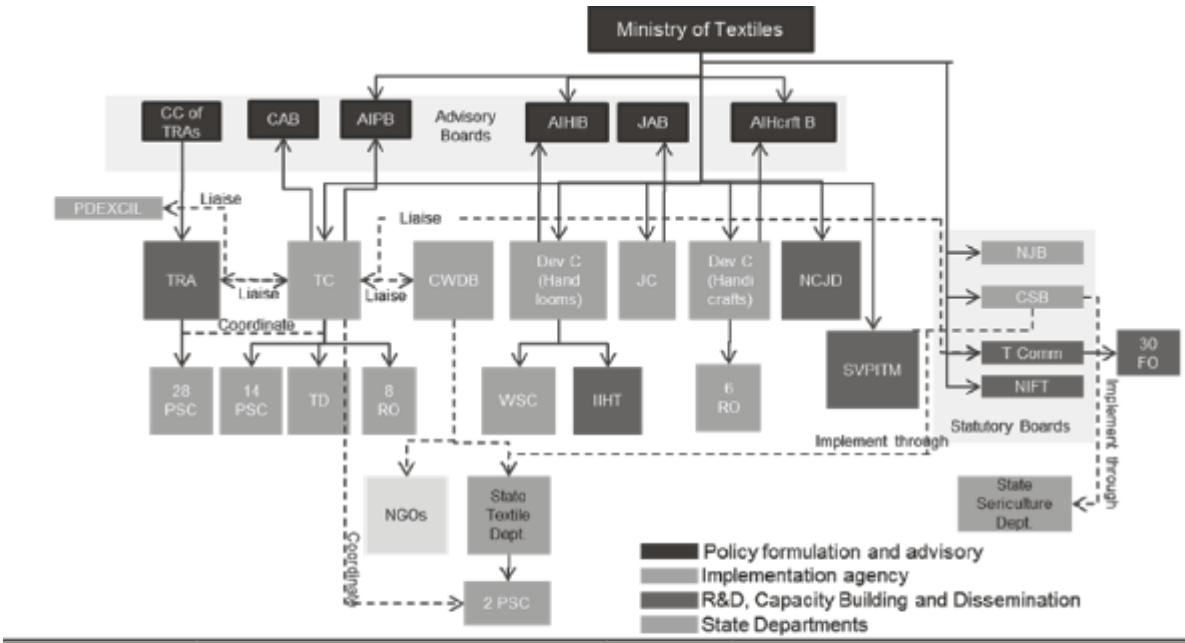
However, a policy of de-reservation was adopted from 1997 onwards resulting in removal of all textile items from the reserved list for small scale enterprises in order to facilitate greater level of competition post the Multi-Fibre Agreement (MFA) regime. With the reduction in trade barriers, increase in capital mobility and the entry of large integrated firms, the MSMEs have had to face increased level of competition from larger organized sectors. Against this backdrop, it is imperative for the MSMEs to explore avenues such as technological upgradation to remain competitive and ensure long-term sustainability.

3.3. Existing technology promotion related policy & institutional support for MSMEs

In addition to the sectoral and generic schemes & programmes being administered and implemented by the MoST and MoMSME, a number of schemes and programmes specific to the textiles industry are administered primarily by the Ministry of Textiles (MoT). MoT is responsible for policy formulation, planning, development, export promotion and regulation of the Indian textiles industry, including all natural and manmade cellulosic fibres that go into the making of textiles.

The figure below maps out the different entities under the MoT along with the role each plays vis-à-vis policy design & formulation and implementation. In line with the mandate of the current study, we have focused specifically on the agencies related to technology adoption and absorption for ensuring competitiveness of the MSMEs in this sector.

[13] Source: Indian Cotton Textile Sector Network as a part of the Sustainable Industrial Networks (SINET) initiative



C C of TRAs	Coordination Council of TRAs	NCJD	National Centre for Jute Diversification
CAB	Cotton Advisory Board	SVPITM	Sardar Vallabhbhai Patel Institute of Textile Management
AIPB	All India Powerlooms Board		
AIHIB	All India Handlooms Board	NJB	National Jute Board
AIHcrftB	All India Handicrafts Board	CSB	Central Silk Board
JAB	Jute Advisory Board	T Comm	Textiles Committee
PDEXCIL	Powerloom Development & Export Promotion Council	NIFT	National Institute of Fashion Technology
		PSC	Power loom Service Centres
TRA	Textile Research Association	TD	Technical Division
TC	Textile Commissioner	RO	Regional Offices
CWDB	Central Wool Development Board	FO	Field Offices
Dev C (Handlooms)	Development Commissioner for Handlooms	WSC	Weaver's Service Centre
JC	Jute Commissioner	IIHT	Indian Institute of Handloom Technology
Dev C (Handicrafts)	Development Commissioner for Handicrafts	C MB	Jute & Cotton Mission Board

From the chart above, it is observed that while some Government agencies are involved only with policy formulation, others are also involved with implementation of those policies through various schemes & programmes. Some of the key Government agencies associated with policy formulation role for the textile sector include the following:-

- All India Handlooms Board – associated with policy formulation for development of handloom sector
- All India Powerlooms Board - associated with policy formulation for development of powerloom sector
- All India Handicrafts Board - associated with policy formulation for development of handicraft sector
- Cotton Advisory Board - associated with policy formulation for production, consumption & marketing of cotton based textiles
- Jute Advisory Board - associated with policy formulation for production, consumption & marketing of jute based textiles

The remaining Government agencies under MoT play a specific role in the development and adoption of technology for the textile value chain through design & implementation of various schemes and programmes. The roles played by different agencies and the corresponding interventions have been categorized according to the key support areas as specified in section 2.2 and detailed below.

3.3.1. Technology Transfer & Adoption

Support for technology transfer & adoption relates to development of mechanism for technology procurement / import, indigenization, commercialization and patenting with requisite incentives for facilitating appropriate linkages with academic / research institutions and information dissemination on the same. The key initiatives undertaken to support technology transfer & adoption among the MSMEs include the following:-

Entity / Scheme focused on technology transfer and adoption	Highlights of intervention
Office of the Development Commissioner (DC) for Handlooms- Handloom Export Promotion Council	• Plays the nodal role for promoting exports of cotton handloom products through dissemination of trade information, publicity efforts and facilitating modernization of handlooms specifically for the export market
National Centre for Jute Diversification	• Provides commercialization support for development of commercial products for the jute segment of the textiles industry
National Jute Board - Jute Technology Mission	• Aims at modernization of organized jute mills including machinery development, productivity improvement & Total Quality management and acquisition of plant & machinery

3.3.2. Technology related Capacity Development

Capacity development support relates to interventions aimed at ensuring development of requisite skills and competencies among MSMEs to optimally leverage the existing technology / adoption of new technology. The key initiatives undertaken to develop capacities related to technology adoption among MSMEs include the following:-

Entity / Scheme focused on technology related capacity development	Highlights of intervention
Office of the DC for Handlooms- National Centre for Textile Design	• Evolves innovative, ethnic and contemporary designs through capacity development support and makes them available specifically for the textile sector, with specific focus on handloom sector
Central Wool Development Board- Integrated Skill Development Scheme for the Textiles and Apparel sector	• Basic & advanced training related to skill upgradation related to emerging technologies in the textile sector along with orientation towards modern technologies. Involves strengthening the capacity of MoT institutions and schemes along with skill development of the sector in partnership with the private sector
Sardar Vallabhbhai Patel Institute of Textiles Management (SVPITM)	• Imparts education and training for skill upgradation related to the textile sector
National Institute of Fashion Technology	• Facilitates training and skill upgradation in areas related to designing support and associated technology

3.3.3. R&D facilitation & infrastructure upgradation

Interventions aimed at research & development facilitation and infrastructure development in terms of establishment of laboratories along with requisite equipments & instruments, setting

up of common facility centres with requisite common infrastructure, etc. for the MSMEs include the following:-

Entity / Scheme focused on R&D facilitation & infrastructure upgradation	Highlights of intervention
Coordination Council for Textile Research Associations (TRAs)	• Plays a nodal role in ensuring that the research-related programmes & activities conducted by the TRAs are in line with the priorities of the textile industry. It also ensures that there is coordination between thevarious TRAs
Textiles Committee	• Promotes exports and R&D for the textile industry through infrastructural support such as setting up laboratories and testing of textile products
Office of the DC for Handicrafts- Research & Development Scheme	• Conducts research through studies and surveys in order to generate inputs for policy and decision making for new initiatives and to monitor the efficacy of on-going initiatives for the development of the sector, including those related to technology upgradation. It also supports the sector in standardization, protection of crafts and designs and certification

3.3.4. Financing support

Interventions related to financing support for investments in the acquisition / upgradation of technology and associated equipments and plant & machinery, working capital management for production etc. are usually bundled with other technology promotion related interventions aimed at technology transfer & commercialization, R&D facilitation and infrastructure upgradation. Select initiatives are detailed below.

Entity / Scheme focused on financing support	Highlights of intervention	Nodal agencies for implementation
Office of the DC for Handlooms- Technology Upgradation Fund Scheme (TUFS)	• Aims to address technological obsolescence by providing financial assistance for adoption of modern equipments to facilitate technological upgradation for the handloom segment	• Small Industries Development Bank of India(SIDBI) • Industrial Development Bank of India(IDBI) • Banks co-opted by SIDBI and IDBI
Office of the Jute Commissioner- Technological Upgradation Fund Scheme (TUFS)	• Aims to address technological obsolescence by providing financial assistance for adoption of modern equipments to facilitate technological upgradation for the jute industry	
Powerloom Development & Export Promotion Council- Technological Upgradation Fund Scheme (TUFS)	• Aims to address technological obsolescence by providing financial assistance for adoption of modern equipments to facilitate technological upgradation for the powerloom segment	
Office of the Textiles Commissioner- Technological Upgradation Fund Scheme (TUFS)	• Aims to address technological obsolescence by providing financial assistance for adoption of modern equipments to facilitate technological upgradation for textile sector (other than those specified above)	

Entity / Scheme focused on financing support	Highlights of intervention	Nodal agencies for implementation
Office of the Textiles Commissioner- Technology mission for Cotton (TMC), Mini Mission IV	• Financial assistance for the modernization of ginning and pressing factories	
TIFAC - SIDBI	• Revolving fund for technology innovation aims to support MSMEs towards development, up-scaling, demonstration and commercialization of innovative technology based projects	• Small Industries Development Bank of India (SIDBI)

Further, it should be noted that in addition to the above interventions which are specific to one of the key support areas, there are select interventions which address multiple support areas simultaneously as detailed below.

3.3.5. Interventions addressing multiple support areas

While the interventions specific to each of the four technology promotion related support areas have been detailed above, it is observed that there are select interventions which address multiple support areas simultaneously. The details for the same are presented in the table below.

Entity / Scheme focused on cross-cutting interventions	Highlights of intervention
Office of the DC for Handlooms- Indian Institute of Handloom Technology	• Development of short term and long term training programmes for technical personnel to be employed in the handloom sector • Undertakes experimental & research programmes to facilitate improvement in productivity in handloom sector
Office of the DC for Handlooms- Integrated Handloom Development Scheme	• Promotes and facilitates the sustainable development of handloom weavers located in and outside identified handloom clusters by the following:- - Financial assistance towards setting up common facility centres/ dyeing houses etc., acquiring designing software, setting up work sheds etc. - Providing design inputs and facilitating skill upgradation through training programmes
Office of the DC for Handlooms- Diversified Handloom Development Scheme	• Supports and strengthens the existing Weavers Service Centres (WSCs)/ Indian Institute of Handloom Technology (IIHT)/ National Centre for Textile Designing (NCTD) in order to support weavers in all aspects, including technology upgradation • Promotes R&D for the segment by supporting research studies, development of new technologies and upgradation of technology and equipment
Office of the DC for Handlooms- Weavers Service Centre	• Evolves new designs for the handloom sector and transfers R&D and technological advances in the handloom sector • Provides financial assistance to conduct training to weavers to upgrade their skills

Entity / Scheme focused on cross cutting interventions	Highlights of intervention
Office of the DC for Handicrafts- Baba Saheb Ambedkar Hastshilpa Vikas Yojana (AHVY)	• Supports the development of handicraft cluster by providing the following:- - Support for technological development by providing new tool kits - Support for organizing design and technical development workshops, training - Infrastructural support for setting up common facility centres and acquiring IT software and hardware components
Office of the DC for Handicrafts- Design & Technology Upgradation Scheme	• Supports the sector through the following initiatives: - Organizes design and technology development workshops including demonstrating new designs and technology and developing new tool kits and equipment - Organizes training on new designs, improved tools and new production technologies for trainers - Financial assistance for the development and supply of modern improved tools, equipment and process technologies
Powerloom Development & Export Promotion Council- Integrated Scheme for Powerloom Sector Development	• Aims at augmenting domestic production, marketing and exports by modernization of the powerloom sector, organizing exposure visits, buyer seller meets and development and upgradation of skills of the weavers, carrying out cluster development activities etc.
Central Silk Board- Catalytic Development Programme	• Promotes the commercialization of technologies as developed by R&D institutes related to silk cultivation, culture and development of silk products • Provides financial assistance towards the establishment of comprehensive testing facilities of seeds for diseases, seed production & common facilities such as storage and rearing houses
Central Silk Board- Cluster Development Programme	• Aims to promote and develop sericulture through transfer of technology, upgradation of infrastructure and promote good practices in sericulture to improve productivity

3.4. Findings from Cluster Visit (Tirupur)

The Tirupur Cluster in Tamil Nadu encompassing the adjoining villages of Avinashi, Nallur, Mangalam, Kangeayam, Palladam and Koduwai is the largest knitwear cluster in the country with a turnover of more than ₹ 84.5 billion of which ₹ 45 billion is contributed by the exports market. Starting with the manufacture of basic knitted garments for lower end of the domestic market, the cluster now has a diversified product range comprising T-shirts, polo shirts, sportswear, sweat shirts, ladies dresses, children garments, nightwear etc. for the domestic as well as the export markets. The cluster specializes in cotton knitwear garments and uses almost 25%[14] of the cotton yarn produced in the country.

[14] Source: http://www.apparelsindiaonline.com/news_detail.php?id=30&name=Costs%2C%20competition

The cluster has about 4,200 units involved in various operations related to knitting, dyeing, printing, and finishing of knitwear products as indicated in the table alongside. These units provide support to around 700 exporters and 1,700 domestic manufacturers of knitwear garments who out source some of the value chain activities to these units in addition to operation of their in-house facilities for orders sourced directly by them.

Type of unit	No. of units
Knitting/ Stitching	2500
Dyeing and bleaching	750
Fabric printing	350
Compacting & calendaring	200
Embroidery	150
Other ancillary	250

Source: Diagnostic Study of Tirupur Knitwear and Apparel Cluster by appointed Facilitator Agency under MSME-FDP by SIDBI

From the primary interactions with the cluster participants, we understand that the cluster is dominated by units which cater to specific activities of the value chain such as knitting, dyeing etc. with only a few units carrying out multiple value chain activities in-house. This can be attributed primarily to:

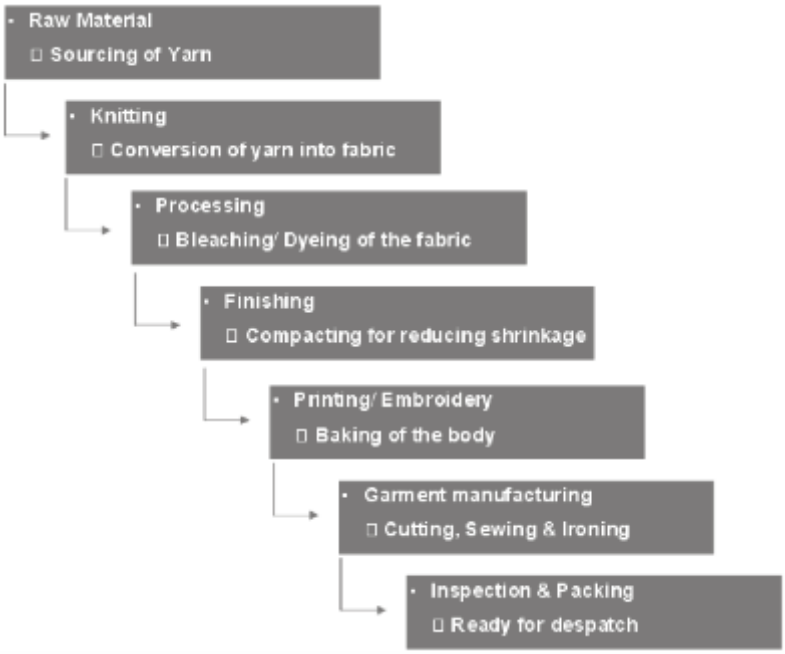
- Significant capital investment requirements for purpose for covering the entire value chain activity
- Varying levels of "economically viable" capacities of respective facilities deployed across the value chain which may result in associated production imbalances for an integrated manufacturer. Consequently, most of the units focus on one part of the value chain and optimize unutilized capacities of different facilities by accepting orders from other units on job-order basis.

The cluster is supported by the Textile Committee under the Ministry of Textiles for providing technical assistance to individual units along with monitoring and certification of the quality of textiles and garments exported from the cluster through operation of laboratories for this purpose. Further, academic/ research institutes like SVPITM and SITRA are present in close vicinity to the cluster and provide R&D support to the textile industry in addition to imparting training for development of resources for the cluster.

In terms of capacity development and training institutes, the cluster has the i) NIFT-TEA Knitwear Fashion Institute promoted by the Tirupur Exporter's Association (TEA) and supported by the National Institute of Fashion Technology (NIFT) in technical areas, ii) Premier Institute of Apparel Management (PIAM), iii) SIHMA Institute of Fashion and Apparel Training started by the South India Hosiery Manufacturer's Association, iv) Business Development Service Agency under a UNIDO project and v) Apparel Training and Design Institute started by the Apparel Export Promotion Council.

3.4.1. Value chain activities in the cluster

As highlighted above, the units in the Tirupur cluster are engaged primarily in manufacture of knitted/ hosiery garments. The high-level value chain associated with the knitted garments production is detailed in the chart below.



1. Raw Material

Depending on the type of knitted fabric to be prepared, different types of yarn including combed, semi-combed, carded, etc. are sourced either from the spinning mills directly or from the merchant suppliers. In Tirupur cluster, most of the units do not manufacture yarn in-house and depend on spinning mills for supply of the same.

2. Knitting

For the purpose of manufacturing wrinkle-resistant or stretchable fabric for garments like inner wear, T- shirts, other hosiery material, etc., the process of knitting is carried out instead of weaving. It involves conversion of the yarn into grey/ fabric typically by employing circular knitting machine. Depending on the loop length and the Grams per square meter (GSM), various grades of grey/ fabric can be manufactured.

3. Processing

Depending on the type of finished product required, the grey/ fabric is subjected to bleaching followed by dyeing by treating the fabric usually with reactive dyestuff in a dye bath. Most of the processing units in the cluster employ convention open winch technology although there has been a gradual shift towards the usage of water conserving 'soft flow' technology which has relatively less material to liquor ratio.

4. Finishing

Post processing, as part of the finishing process, the fabric undergoes the process of compacting for the purpose of reducing the cloths' shrinkage.

5. Printing/ Embroidery

Printing involves application of colour in the form of a paste or ink to the surface of the finished fabric based on approved pattern or design. It is done either manually by using

flatbed screen printing or by using automatic screen printing. Various types of print made on the fabric include water print, foil print, glitter print, high density print, foam print, puffy print etc. Further, embroidery involves making designs on the finished fabric using thread.

6. Garment manufacturing

The key activities involved in the garment manufacturing process include the following:-

- Cutting – It involves cutting the finished fabric according to the approved pattern/ design and the required sizes
- Sorting – It involves sorting and creating lots of different parts of the garment in order to allocate the parts to the different stitching stations
- Stitching - Involves sewing of different parts of the garment together to produce the finished garment. Various different types of sewing machines are used which include over lock, flat lock, single needle, plain stitch machines etc.
- Ironing – Involves removal of wrinkles in the finished garment

7. Inspection & packing

Prior to dispatch, visual and dimensional inspection is done to identify defects pertaining to stitching, sizing, coloring, etc. After inspection, the finished garments are packed in required packaging carton and stored for dispatch.

3.4.2. Existing level of technology adoption across the value chain

The units in the cluster vary widely in their technology adoption levels, with units ranging from high levels of automation to units with limited technology usage. The existing level of technology and the key observations and issues for the Tirupur units based on the mapping of the value chain activities is presented in the table below.

Value chain	Current level of Technology	Key Observations/ Technology improvement opportunity
Knitting	• Most of the units use circular knitting machines for manufacturing 'tubular' jerseys. Various types of machines currently used include single jersey, double jersey, manual/ electronic jacquard and ribbed circular knitting machines	• Most of the units use knitting machines imported from China, Taiwan and Germany. Some of the smaller / medium units also use indigenized machines. However, the indigenized machines appear to relatively dated vis-à-vis imported machines. • In terms of technology upgradation, there is a scope for employing 'open width' circular knitting machines for manufacturing knitwear which has less shrinkage and reduces slitting cost. However, this would entail significant changes in the set up & associated investments for other downstream activities

Value chain	Current level of Technology	Key Observations/ Technology improvement opportunity
Processing	• Most of the units use conventional open winch technology. However, there has been a gradual shift towards the usage of water conserving 'soft flow' technology which has relatively less material to liquor ratio	• On account of need for stringent environmental compliance in recent times, most of the units are gradually taking the initiative to invest in environmental friendly processing/ dyeing technology. Further, some of the larger units in the cluster are using efficient water conserving 'air flow' technology and continuous 'pad-batch' technology for dyeing. However, these technologies are capital intensive and may be viable only for units having higher scale of operation.
	• Colour matching is usually done manually with reliance on a master craftsman for visual matching.	• On account of manual intervention for matching colors, there are several instances of mismatch resulting in rejections of orders. However, some of the larger units have adopted advanced technology like spectrophotometer for ensuring accurate matching of the approved color with the dyed fabric color
Finishing	• Most of the units employ automated machines for compacting	
Printing/ Embroidery	• Most of the smaller units use flat-bed manual screen printing. However, the medium and large units are employing automated screen printing.	• Potential for adoption of automated screen printing even by the smaller units, subject to establishment of the same as a common facility centre in the cluster
Garment manufacturing	• Cutting - this process is carried out manually by most of the small & medium units • Stitching –Most of the units employ automated single needle, double needle stitching machines. Further, most of the medium / larger units also use flat lock machines, over lock machines, etc. for stitching hems, sleeves, bottoms, etc.	• Manual cutting is used when the lot sizes are small and for value added products and specific designs, with an estimate that around 15-20% of cloth is wasted in this method. In terms of automation, there is scope for using machine cutting which is more efficient and reduces wastage; however it requires significant investment & is suitable for units having higher scale of operation.

3.4.3. Existing level of clean / green / energy efficient technology adoption

Based on interactions with various key stakeholders including the industry players, industry associations, etc., the key issues pertaining to adoption of clean / green / energy efficient technologies is presented in the table below:--

Parameters	Current level of Technology	Key Observations / Issues
Water Consumption	• Presently most of the units have been using conventional 'open winch' and 'soft flow' dyeing technology where water consumption is relatively higher on account of higher Material to Liquor (MLR) ratio.	• Usage of conventional dyeing technology has resulted in higher water consumption along with associated depletion of groundwater. Although there are better water conserving dyeing technology available like 'air flow' & continuous 'pad-batch' process technologies, the application of the same is very limited in the cluster on account of need for higher level of investments which may be viable only for units having relatively large scale of operations.

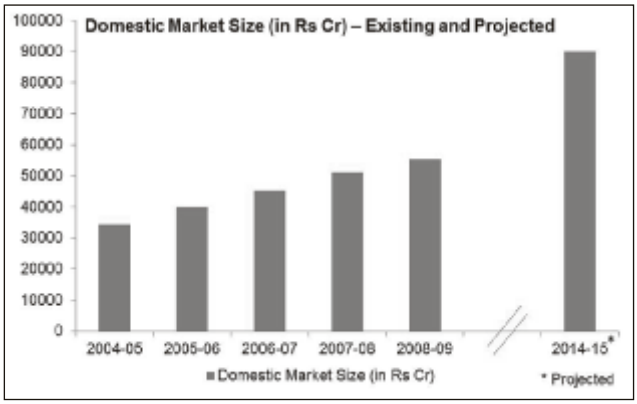
Parameters	Current level of Technology	Key Observations / Issues
Effluent treatment	• For purpose of effluent treatment, most of the large processing units have individual Effluent Treatment Plant (ETP) with Reverse Osmosis (RO) facility for water treatment and solid waste management. Further, most of the smaller / medium units are linked to Common Effluent Treatment Plant (CETP) for discharging effluent after treatment.	• On account of significant capital investment in setting up ETPs, most of the smaller and medium processing units rely on CETP for effluent treatment. However, with the inadequate functioning of the CETPs, most of the units linked to the same are facing closure since they were unable to attain zero discharge as stipulated by the State Pollution Control Board.

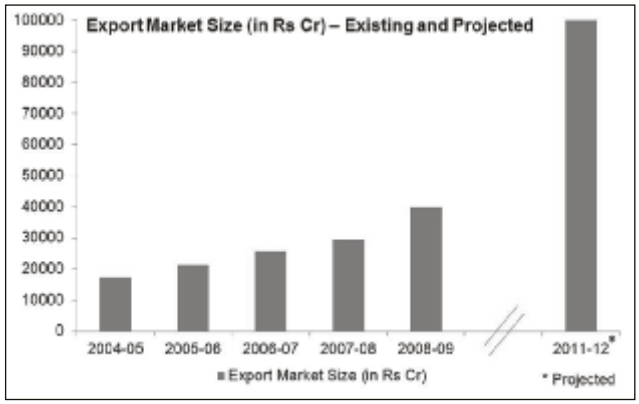
4. Drugs & Pharmaceuticals

The Indian pharmaceutical industry has been witnessing phenomenal growth in recent years, driven by rising consumption levels in the country and strong demand from export markets owing to the capability of Indian players to produce cost-effective drugs with World-class manufacturing facilities. As per the Department of Pharmaceuticals, Government of India, the Indian pharmaceutical industry with a turnover of around ₹ 1,00,611 Crore in 2009-10 (upto September, 2009) ranks 13th in the World in terms of value of production. However, it should be noted that the industry ranks 3rd globally in terms of volume of production with around 10% of the market share which can be attributed to the lower cost of drugs in India which on an average is around 5% to 50% less as compared to that in the developed countries.

Domestic market size: The Indian pharmaceuticals market generated total domestic revenues of ₹ 55,454 Crore in 2008-09, representing a CAGR of 13.65% for the period spanning 2005-2009. By 2015, industry's domestic revenues are expected to reach USD 20 billion, growing at a CAGR of around 8-10%

Export market size: The Indian pharmaceuticals market generated total export revenues of ₹ 39,821 Crore in 2008-09, representing a CAGR of 23% for the period spanning 2005-2009. By 2012, industry's export revenues are expected to reach USD 22.2 billion, growing at a CAGR of around 36%.





Source: Dept. of Pharmaceuticals, IBEF

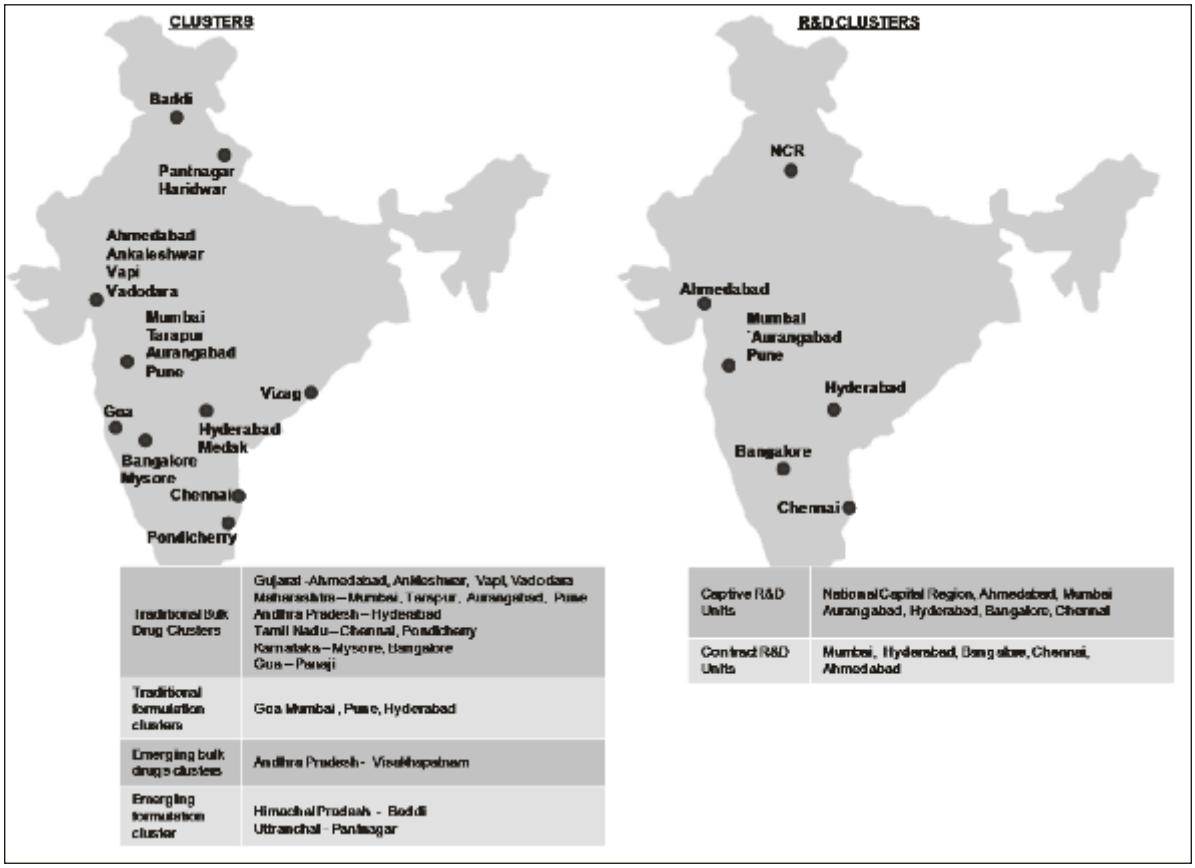
The states of Maharashtra, Gujarat, West Bengal, Andhra Pradesh and Tamil Nadu are the major pharmaceutical manufacturing clusters in the country as is evident from the chart below.

State-wise distribution of manufacturing units

State	Units – Formulation	Units – Bulk Drugs	Units – Total	% Share in # of units
Maharashtra	1,928	1,211	3,139	29.7%
Gujarat	1,129	397	1,526	14.4%
West Bengal	694	62	756	7.2%
Andhra Pradesh	528	199	727	6.9%
Tamil Nadu	472	98	570	5.4%
Others	3,423	422	3,845	36.4%
Total	8,174	2,389	10,563	100.0%
% Total	77.4%	22.6%	100.0%	

Source: Department of Pharmaceuticals

The chart below highlights the major established cluster related to production and R&D for the Drugs and Pharmaceuticals sector in India.



Source: Department of Pharmaceuticals, IBEF

4.1. Industry Structure

The Indian Drugs and Pharmaceutical Industry can be broadly divided into units engaged in either manufacturing or providing services as depicted in the chart below.

As depicted in the chart above, the key products being manufactured by the Indian drugs & pharmaceutical industry include i) Bulk Drugs or Active Pharmaceuticals Ingredients (API) and ii) Formulations. Further, it should be noted that the bulk drugs are the basic raw materials for units engaged in production of formulations.

India is globally recognized as a low cost, high quality bulk drugs and formulations manufacturer. It is estimated that domestic production has ability to cater to around 80-90% of the domestic pharmaceutical requirements in addition to addressing the export market in more than 65 countries globally. The industry produces about 60,000 formulations across 60 therapeutic categories and roughly 500 bulk drugs, which are used in the formulations.

4.1.1. Bulk Drugs / APIs

India is the third largest bulk drugs manufacturer in the World with product portfolio consisting of around 500 bulk drugs. In the year 2009-2010, the size of Indian bulk drugs market was estimated at about $11.54 billion, registering a CAGR of 18.5% during the last 5 years. Further, it is estimated that the market would grow to $16.91 billion by 2014 with a CAGR of 21%. India has about 2,400 bulk drug manufacturing units with largest share of the units present in Maharashtra and Gujarat. It is estimated that the top 10 companies contribute to 44% of the market size with the rest accounting for the balance 56%. About 35% of the bulk drugs manufactured are for domestic consumption with the balance 65% are contributed by exports to more than 50 countries. Bulk drug exports reported a CAGR of around 33% to reach a value of $ 4.8 billion in 2007-08 from $ 1.1 billion in 2002-03.

4.1.2. Formulations

The Indian formulation market is expected to reach a value of around $ 13.7 billion by 2013 driven primarily by socio-economic factors like rising income levels, increasing affordability, gradual penetration of health insurance and the rise in chronic diseases. Formulations comprise more than 75% of the total production with manufacture of nearly 60,000 formulations in 60 different therapeutic categories. The domestic formulation industry had registered a CAGR of 14% during FY 2003-08, increasing from around $3.9 billion in FY 2003 to $7.7 billion in FY 2008. In addition to meeting the domestic requirements, formulations are also exported mainly to the developing nations in CIS, South East Asia, Africa and Latin America.

As per IMS Health, patent protected drugs amounting to around $105 billion is expected to go off-patent (including 30 of the best-selling US patent-protected drugs) by 2012, thereby presenting a huge opportunity to Indian generic players who are expected to produce six of the top ten drugs that are scheduled to go off patent. Further, the key therapeutic categories driving growth in this segment include anti infectives (mainly antibiotics), cardiovascular system (mainly anti-hypertensives and cardiac therapy drugs), Central Nervous System (CNS), respiratory drugs (mainly cough & cold preparations and anti-asthmatics), and anti-inflammatory drugs.

4.1.3. Services

With a number of blockbuster drugs going off patent in the coming years and increasing R&D costs coupled with the relative lower levels of R&D productivity, major pharmaceutical companies Worldwide are finding it difficult to maintain their profitability and are increasing being forced to leverage outsourcing as a source of competitive advantage. This include outsourcing part of their research and manufacturing activities to lower cost countries, thereby saving costs and time, in the process. This has led to the evolution of Contract Research and Manufacturing Services (CRAMS) as a fast emerging business opportunity for Indian companies. CRAMS can be divided into two major business segments—Contract Manufacturing and Contract Research.

Contract manufacturing, involving production of bulk drugs & formulations, has been estimated at around $ 1 billion in 2010[15] and is included as part of manufacturing related operations in this sector. Activities in contract research predominantly consist of drug discovery, preclinical and clinical research. The Indian contract research industry has grown tremendously over the past few years with more than 70 clinical research organizations and central labs and local CROs, providing the full spectrum of services. Clinical trials, estimated to reach a market size of $ 0.6 billion in 2011, are conducted to allow safety and efficacy of data to be collected for new drugs or devices. These trials can only take place once satisfactory information has been gathered on the quality of the product and its non-clinical safety, and Health Authority/Ethics Committee approval is granted in the country where the trial is taking place.

[15] Source: http://www.apparelsindiaonline.com/news_detail.php?id=30&name=Costs%2C%20competition

4.2. MSMEs in the Drugs & Pharmaceutical sector

The Indian pharmaceutical industry is characterized by its highly fragmented nature with estimates by the Organization of Pharmaceutical Producers of India putting the number of manufacturing units at 10,000. Out of these units, it is estimated that the organized sector accounts for only 5%, with the balance being in the unorganized sector. The unorganized sector primarily comprises the small and medium enterprises, which are estimated to contribute to around 35% of the industry's turnover.

Some of the key drivers in the past for the emergence of the MSME sector as a prominent player in the Indian pharmaceutical sector can be attributed to the strong government policies like the exemption from the Drug Price Control Order (DPCO), reservation of drugs for exclusive production in small scale sector, process patent regime permitting them to develop their own process of making drug at lower cost and preference in procurement for growth in government health services. However, with the phasing out of some of these key drivers, the MSME sector has been looking at other avenues to ensure their long-term sustainability.

MSMEs in the pharmaceutical industry do not operate across the entire value chain. Traditionally they have been restricted to manufacturing of drugs by either getting outsourcing contracts from large pharmaceutical companies or by reengineering the process of patented drugs to manufacture their generic versions. However, it is observed that very limited progress has been made by the MSMEs in tapping the domestic / export markets on their own which can be attributed primarily to inability to make the requisite level of investments in research & development and technology upgradation to comply with applicable quality certification & regulatory compliance norms along with absence of market linkages. On account of the relative inability to tap the markets directly, most MSMEs suffer from low margins for their product/services with total reliance on a few established players for their markets resulting in very limited bargaining power. However, it should be noted that MSMEs are looking at increasing their presence in the more lucrative contract research and clinical research space on account of their ability to innovate in process reengineering and reduce costs.

4.3. Existing technology promotion related policy & institutional support for MSMEs

Key Ministries/ Government departments / agencies / institutions associated with providing technology promotion related policy & institutional level support to MSMEs in the drugs & pharmaceuticals sector include the following:-

- Department of Science & Technology (DST) under the administrative control of Ministry of Science & Technology (MoST)
- Department of Pharmaceuticals (DoP) under the administrative control of Ministry of Chemicals & Fertilizers (MoCF)

This section details the role played by these Government entities play along with the respective programmes which have been rolled out and the corresponding categorization of the same into the key support areas detailed earlier in Section 2.2. Further, it should be noted that this is in addition to the support available through the sector-agnostic schemes & programmes detailed earlier in Section 2.2.

4.3.1. Technology Transfer & Adoption

Support for technology transfer & adoption relates to development of mechanism for technology procurement / import, indigenization, commercialization and patenting with requisite incentives for facilitating appropriate linkages with academic / research institutions and information dissemination on the same. The key initiatives undertaken to support technology transfer & adoption among the MSMEs include the following:-

Ministry/ Department	Entity / Scheme focused on technology transfer and adoption	Highlights of intervention
MoCF - DoP	Pharma Promotion & Development Scheme (PPDS)	• Promotes the pharmaceutical industry through information dissemination using workshops / seminars etc., including that specific to technology
MoCF - DoP	IPR facilitation centre at Pharmaexcil	• Ensures dissemination of information on IPRs and related issues to the Pharmaceutical Industry in an effective manner
MoCF - DoP	Environment Cell	• Collects and compiles the data covering the latest technologies available for effluent treatment and hazard management and disseminate the information among the Pharmaceutical Industry

4.3.2. Financing support

Interventions related to financing support for investments in the acquisition / upgradation of technology and associated equipments and plant & machinery, working capital management for production etc. are usually bundled with other technology promotion related interventions aimed at technology transfer & commercialization, R&D facilitation and infrastructure upgradation. Select initiatives are detailed below.

Ministry/ Department	Entity / Scheme focused on financing support	Highlights of intervention
MoCF - DoP	Interest subsidy for Schedule M compliance in line with GMP norms	• Provides interest subsidy in respect of the loan taken by the MSMEs for implementing Schedule 'M' in line with provisions of GMP - This scheme has been aligned with existing Credit Linked Capital Subsidy Scheme of DST for micro & small scale entrepreneurs and a separate Pharmaceutical Technology Upgradation Assistance Scheme for medium scale enterprises

Further, it should be noted that in addition to the above interventions which are specific to one of the key support areas, there are select interventions which address multiple support areas simultaneously as detailed below.

4.3.3. Interventions addressing multiple support areas

While the interventions specific to each of the four technology promotion related support areas have been detailed above, it is observed that there are select interventions which address multiple support areas simultaneously. The details for the same are presented in the table below.

Ministry/ Department	Entity / Scheme focused on cross-cutting interventions	Highlights of intervention
MoST - DST	Drug Development Promotion Board (DDPB) Drugs & Pharmaceutical Research Programme (DPRP)	• Supports R&D projects in drug & pharma sector in Public Private Partnership mode involving institute – academia–industry collaboration for generating product & process patents. Involves financial assistance with reimbursement of 70% of the cost of recurring component and 100% of non-recurring equipment component for the project • Creation of state-of-the-art infrastructure in institutions and academic organizations like leading CSIR, ICMR institutes&universities for strengthening R&D in drugs & pharmaceuticals sector • Soft loan to drugs & pharmaceutical R&D projects of private sector at a simple interest of 3% p.a. with an option to return the principal & the interest during a duration of ten years after completion of the project • Support for training initiatives aimed at human resource development in Drugs & Pharmaceutical Sector
MoCF - DoP	National Institute of Pharmaceutical Educational Research (NIPER)	• Establishment of fully equipped labs with modern equipment to serve as technology development centres • Conducts continuous education programmes for academia & industry and facilitates strengthening of good institutions in various states into "Star Pharma College" for contributing to research through capacity development

4.4. Findings from Cluster Visit (Hyderabad)

Hyderabad is known as the bulk drug capital of India, accounting for around 15% of the total bulk drug production in India. The Hyderabad cluster comprises of around 390 units out of which around 68% of the firms produce bulk drugs with the rest engaged primarily in the production of formulations such as capsules, tablets, syrups, orals, ointments and injectibles. The cluster employs around 20,000 people generating a turnover of ₹ 8187 Crore per annum with a spread across 60 kms covering Hyderabad, Nalgonda, Rangareddy & Medak District.[16] The table below shows the details of SMEs with ownership, capacity, investment, employment and turnover details in Hyderabad drugs & pharmaceutical cluster.

[16] Source: http://www.hyderabadbds.com/index.php?p=cluster_overview

Snapshot of the Hyderabad Drugs and Pharmaceuticals Cluster

Type of Manufacturer	Type of Firm	No. of Firms	Ownership				Investment (₹ Cr)	Employment	Turnover (₹ Cr)
			Pvt	Pub	Part.	Prop			
Bulk Drugs	Small	86	56	-	25	5	344	3500	**1462**
	Medium	180	150	30	-	-	1620	12000	**5400**
Formulations	Small	75	40	-	45	30	187	2000	**675**
	Medium	50	246	30	10	-	275	2500	**650**
TOTAL		**391**	**246**	**30**	**80**	**35**	**2426**	**20000**	**8187**

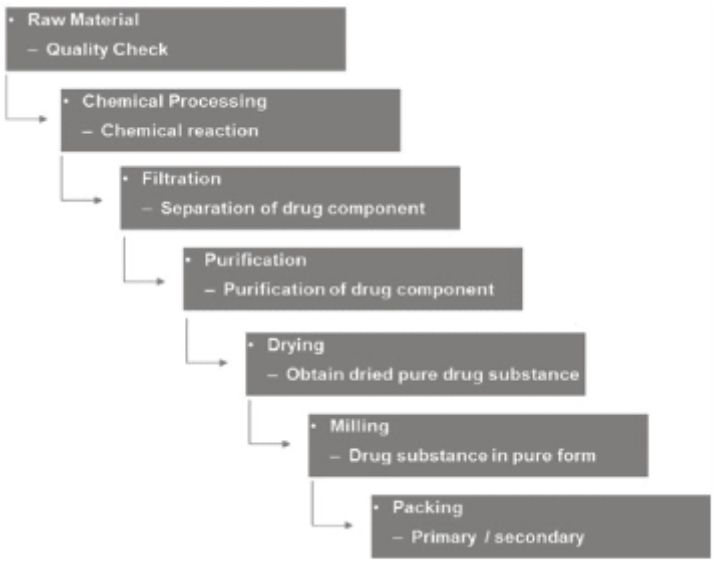
Source: http://www.hyderabadbds.com/index.php?p=cluster_overview (under MSMEFDP, implemented by SIDBI)

It has been estimated that the average investment required for setting up of a small scale enterprise in bulk drugs and formulations is around ₹ 4 Crore and ₹ 2.5 Crore respectively, while that for the medium enterprises is around ₹ 9 Crore and ₹ 5.5 Crore respectively. Most of the MSMEs in this cluster act as suppliers to bigger players like Ranbaxy, Dr. Reddy's Lab, Aurobindo Pharma, Natco, Divi's Lab, Matrix etc. on a job-work basis on account of limited market linkages and lack of investment in requisite technology & certifications to meet requisite product quality norms.

The support available to the cluster members with respect to technology upgradation in form of R&D support, capacity development, technology development & indigenization is restricted to R&D agencies like National Institute of Pharmaceutical Education & Research (NIPE) and public sector organizations like Indian Drugs & Pharmaceuticals Limited (IDPL).

4.4.1. Value chain activities in the cluster

The high-level production process associated with the bulk drug production in the Hyderabad cluster has been presented below. However, it should be noted that the "generic" production process may be customized for the specific bulk drug to be manufactured.



1. Raw Material

All the raw materials required for purposes of production of bulk drugs, including solvents, catalysts and other chemicals are generally procured from an empanelled list of vendors for the respective firm. This serves as the first stage of quality check of raw materials received, which is further tested as per applicable standards & test procedures, either in internal or external labs. Only the materials which meet the requisite norms are moved to the next stage with the return of rejected material to the respective vendor.

2. Chemical Processing

All approved raw materials are charged into a reactor for chemical processing and conversion into requisite chemical composition. Depending on the product; the duration and type of reaction is altered.

3. Filtration

Post processing, it is observed that the required drug substance is mixed with other chemicals as part of a reaction mixture. This reaction mixture is then filtered through suitable filtering equipment to separate drug substance from the liquid chemicals. This solid drug substance is taken for further processing.

4. Purification

The wet crude drug substance obtained after filtration is subjected to purification in order to obtain the pure drug substance which must meet the requisite product standards.

5. Drying

The wet pure drug substance obtained after purification is dried at requisite conditions to obtain dried pure drug substance.

6. Milling

The dried pure drug substance obtained as above is milled to obtain drug substance in the powder form.

7. Packing

Powdered pure drug substance obtained from the previous stage is packed in the primary packing material followed by a final packing in the secondary material. The primary packing material is normally poly bags and secondary packing materials normally are either fiber drums or HDPE containers. After packing in the secondary packing material, proper label is affixed with all particulars such as name of the product, batch no, expiry date, etc. During packing operation, in-process testing is undertaken for weight, presence of impurities etc.

4.4.2. Existing level of technology adoption across the value chain

The existing level of technology and the key observations and issues for the bulk-drug manufacturing units based in the Hyderabad cluster is given in the table below.

Value chain	Current level of Technology	Key Observations/ Technology improvement opportunity
Raw Material	• Reliance on internal / external labs for testing of raw materials received – may not involve use of spectrometers, high-performance liquid chromatography machines etc.	Testing labs deployed (internal / external) may not be compliant with Good Laboratory Practices (GLP) norms and do not always deploy state-of-art testing equipments like spectrometers, high-performance liquid chromatography machines etc.
Chemical Processing **Filtration** **Purification** **Drying** **Milling**	• Reliance on indigenous technology & equipments provided by local manufacturers which may not always be the 'best in class" • Primarily reliance on manual processes for material movement across the entire value chain	• Loss of by-products during chemical processing which can be a source of additional revenue through investment in technology associated with storage and requisite value-addition • Absence of focus on recovery of i) filtrate and ii) solvent during the entire production cycle resulting in significant wastages, considering the potential for deployment of technology for recovery of filtrate & solvents for re-use in the production cycle • Production facilities and processes may not be compliant with Good Manufacturing Practices (GMP) norms • Potential for deployment of Lean Manufacturing concepts to improve productivity and cost reduction, including automation of material handling facilities
Packing	• Packaging material (primary / secondary) normally supplied by buyer, thereby eliminating issues related to quality of packaging material used	Currently, packing is done manually and there exists a scope for automation of this process
Testing	• Reliance on internal / external labs for testing of final product in line with buyer specifications – may not involve use of spectrometers, high-performance liquid chromatography machines etc.	Testing labs deployed (internal / external) may not be compliant with Good Laboratory Practices (GLP) norms and do not always deploy state-of-art testing equipments like spectrometers, high-performance liquid chromatography machines etc.

4.4.3. Existing level of clean / green / energy efficient technology adoption

Based on interactions with various key stakeholders including the industry players, industry associations, etc., the key issues pertaining to adoption of clean / green / energy efficient technologies is presented in the table below:-

Parameters	Current level of Technology	Key Observations / Issues
Water management	Most of the units use ion exchange technology for production of demineralized water for use in utilities	Potential for adoption of other technologies like solar-based technology (relatively more capital intensive with lower recurring costs) for getting demineralized water which can reduce the existing level of water consumption which is significantly higher than the global benchmarks
Effluent treatment	Currently most of the units dispose the effluent generated from the process without ensuring optimum recovery of water, solvents, salts and organic elements	• There exists scope for treating the effluent through multiple effect evaporator (MEE) to recover i) organic materials which can be sold to cement industry for kiln preparation process, ii) water &solvents for re-use during the entire production process and iii) salts which can be disposed of as per applicable norms • Potential for establishment of Common Effluent Treatment Plants at a cluster level with financing support in order to facilitate adherence to applicable regulatory norms & regulations associated with effluent treatment

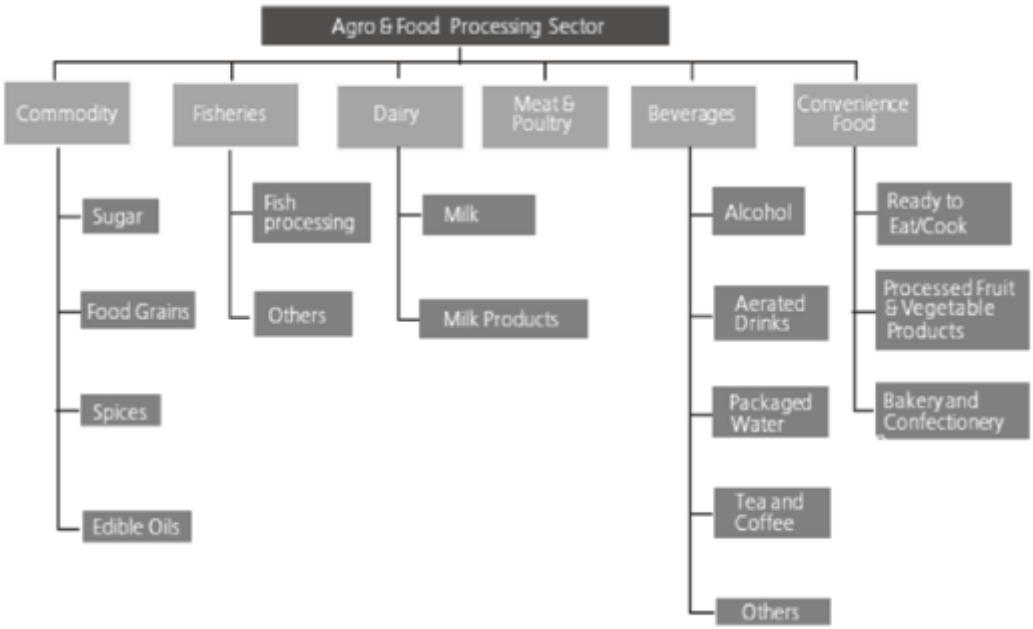
5. Food Processing - Fruits & Vegetables

With second largest arable land along with diverse agro-climatic conditions & soil, India offers signification production advantage in agriculture with the potential to cultivate a vast range of agricultural products. The strong agriculture base provides significant potential for the growth of the food processing sector which has been identified as one of the 'sunrise' sectors by the Government.

As per the Ministry of Food Processing Industry, the Food processing sector contributes significantly towards the growth of Indian economy with a share of over 14% of manufacturing GDP amounting to ₹ 2.8 lakh Crore[17]. The sector is labour intensive and employs around 13 million people directly and about 35 million people indirectly. Further, as per Rabobank estimates, the industry creates around 18 jobs directly and 64 jobs indirectly for every investment of ₹ 1 Crore.

5.1. Industry Structure

The Indian food processing industry is characterized by its highly fragmented nature with the unorganized sector accounting for 70% of the production by volume and 50% in terms of value. The unorganized sector comprises small and medium scale units along with micro/ cottage units having small capacities of up to 250 MT per annum. As per the Ministry of Food Processing Industry, the Indian food processing industry can be broadly categorized as depicted in the chart below.



[17] Ministry of Food processing Industry Annual Report FY 2010-11

As indicated in the chart above, the processed fruits & vegetables fall under the convenience food category of the food processing sector. Globally, India is the second largest producer of fruits and vegetables with a total production of 205.8 million MT (Fruits: 72.3 million MT; Vegetables: 133.5 million MT) during FY 2009-10 registering a CAGR of 6.2% during the period FY 2005-10.

While India's horticulture production base is significantly large, various issues including i) long and fragmented supply chain, with low penetration of organized retail, resulting in higher level of wastage, ii) lower productivity & poor agronomic practices leading to lack of adequate processable varieties of farm produce, iii) non-availability of adequate critical infrastructure including cold chain facilities, quality control and testing facilities, iv) lack of scale on account of seasonality of raw materials and v) socio-cultural factors including food habits like preference for fresh food etc. have adversely impacted the growth of processing industry over the years. Consequently, the processing level for fruits and vegetables is very low at around 2.2% vis-à-vis other countries like USA (65%), Philippines (78%) and China (23%). Of this, the organized sector accounts for 1.4% while the remaining 0.8% is contributed by the unorganized sector.

In terms of the installed capacity, the fruits and vegetables processing industry has witnessed an increase from 1.1 million MT in 1993 to 3.1 million MT in 2009. The major processed items in the segment include fruit pulps and juices, fruit based ready-to-serve beverages, canned fruits and vegetables, jams, squashes, pickles, chutneys/ sauce/ ketchup, ready-to-cook foods (including cooking paste, frozen foods, etc.), dehydrated vegetables, etc. In addition, there are products which have been introduced recently in this segment comprising vegetable curries in retortable pouches, canned mushroom and mushroom products, dried fruits & vegetables and fruit juice concentrates.

With the increasing urbanization/ demographic transition, rising disposable income levels, changing lifestyles and consumption pattern, the fruit & vegetable processing sector is poised for promising growth going forward. Considering this along with the potential of this sector in facilitating socio-economic development through increased employment & higher remunerative prices to the farmers, the Ministry of Food Processing Industries (MOFPI) has formulated 'Vision 2015' in pursuit of achieving envisaged targets including trebling the size of the food processing industry, raising the level of processing of perishables from 6% to 20%, increasing value addition from 20% to 35% and enhancing India's share in global processed food trade from the current levels of 1.5% to 3% by 2015.

5.2. MSMEs in the Food Processing sector

As highlighted above, the Indian fruits & vegetable processing industry is highly fragmented with MSMEs accounting for 70% of the production by volume and 50% in terms of value. Some of the key drivers leading to emergence of MSMEs as a prominent player in this sector can be attributed to i) Government's policy of reserving food processing sector for small scale units (effective till 1991), ii) low entry barriers in terms of capital investment and iii) significant variation in food habits and preferences across the country translating into a competitive

advantage for small and medium local players, who are well acquainted with local food taste & preferences and accordingly align their products to cater to the local/ regional markets.

However, post economic reforms initiated in early 1990s; the fruits & vegetable processing sector has witnessed significant investment with several large players foraying into this segment in recent years. On account of i) lower scale of operations, ii) inability to make requisite level of investments in research & development and technology upgradation to comply with applicable quality certification & regulatory compliance norms along with iii) absence of market linkages, most of the MSMEs are facing stiff competition from the relatively large players in tapping the domestic/ export markets for processed food on their own.

5.3. Existing technology promotion related policy & institutional support for MSMEs

Key Ministries/ Government departments / agencies / institutions associated with providing technology promotion related policy & institutional level support to MSMEs in the Food processing sector include the following:-

- Ministry of Food Processing Industries (MoFPI)
- Department of Agricultural Research and Education (DAR&E) under the administrative control of Ministry of Agriculture (MoA)
- Council of Scientific & Industrial Research (CSIR) under the administrative control of Department of Scientific & Industrial Research (Ministry of Science & Technology) which has established Central Food Technological Research Institute (CFTRI)

This section details the role played by these Government entities through respective programmes which have been rolled out and the corresponding categorization of the same into the key support areas detailed earlier in Section 2.2. Further, it should be noted that this is in addition to the support available through the sectoral schemes & programmes detailed earlier in Section 2.2.

5.3.1. Technology related Capacity Development

Capacity development support relates to interventions aimed at ensuring development of requisite skills and competencies among MSMEs to optimally leverage the existing technology / adoption of new technology. The key initiatives undertaken to develop capacities related to technology adoption among MSMEs include the following:-

Ministry / Department	Entity / Scheme focused on technology related capacity development	Highlights of intervention
MoFPI	Scheme of Human Resource Development	• Financial assistance through grants (up to a maximum of ₹ 75 Lakh) to four key capacity development related components viz. i) food processing training centre, ii) creation of infrastructure for running degree / diploma courses in food processing technology, iii) entrepreneurship development programme and iv) training programmes at recognized national / state level institutes
MoST – DSIR	International Food Technology Training Centre (IFTTC) – set up as a training facility under Central Food Technological Research Institute (CFTRI)	• Imparts training to professionals on food processing related technology

5.3.2. R&D facilitation & infrastructure upgradation

Interventions aimed at research & development facilitation and infrastructure development in terms of establishment of laboratories along with requisite equipments & instruments, setting up of common facility centres with requisite common infrastructure, etc. for the MSMEs include the following:-

Ministry / Department	Entity / Scheme focused on R&D facilitation & infrastructure upgradation	Highlights of intervention
MoFPI	Scheme of Research & Development	• Support to universities, IITs, central/state government institutions, public funded organizations, R&D laboratories and CSIR recognized R&D labs in the private sector in conducting research projects which could result in development of innovative products, processes, manufacturing practices etc. for the food processing industry

5.3.3. Financing support

Interventions related to financing support for investments in the acquisition / upgradation of technology and associated equipments and plant & machinery, working capital management for production etc. are usually bundled with other technology promotion related interventions aimed at technology transfer & commercialization, R&D facilitation and infrastructure upgradation. Select initiatives are detailed below.

Ministry / Department	Entity / Scheme focused on financing support	Highlights of intervention
MoFPI	Scheme for Technology Upgradation/ Establishment/ Modernization of Food Processing Industries	• Financial assistance for investment in establishment / upgradation of processing capabilities through procurement of new plant & machinery associated with food processing • Limited to 25% of cost of plant & machinery &technical civil works, subject to a maximum of ₹ 50 Lakh with increase to 33% reimbursement subject to a cap of ₹ 75 Lakh for select identified regions
MoFPI	Scheme for Cold Chain, Value Addition & Preservation Infrastructure	• Financial assistance for investment in integrated cold chain facilities from farm gate to the consumer, including pre-cooling facilities at production sites, reefer vans and mobile cooling units • Assistance limited to one-time capital grant of 50% of the project cost (75% of project cost in select identified areas) subject to a maximum of ₹ 10 Crore
MoFPI	Scheme to facilitate total quality management system through implementation of HACCP / ISO 22000, ISO 14000 / GHP / GMP Quality / Safety Management System	• Partial reimbursement (up to 50% subject to a limit of ₹ 15 lakh) of charges incurred in acquiring the certifications related to HACCP / ISO 22000, ISO 14000 / GHP / GMP Quality / Safety Management System
MoFPI	Scheme for Setting up/ Up-gradation of Quality Control/ Food Testing Laboratory	• Financial assistance in form of grants up to 100% & 25% towards cost of laboratory equipments & technical civil works respectively for labs setup by organizations under Central/ State Government; 50% & 25% for laboratory equipments & technical civil works respectively for labs set up by private sector organization

Further, it should be noted that in addition to the above interventions which are specific to one of the key support areas, there are select interventions which address multiple support areas simultaneously as detailed below.

5.3.4. Interventions addressing multiple support areas

While the interventions specific to each of the four technology promotion related support areas have been detailed above, it is observed that there are select interventions which address multiple support areas simultaneously. The details for the same are presented in the table below:--

Ministry / Department	Entity / Scheme focused on cross-cutting interventions	Highlights of intervention
MoFPI	Mega Food Parks Scheme	• Financial assistance in form of one-time capital grant of 50% of the project cost (75% of project cost in select identified areas) subject to a maximum of ₹ 50 Crore, for creation of infrastructure facilities along the value-chain, including transportation, logistics & centralized processing centres; leveraging a cluster based approach • Capacity development to ensure compliance with environmental, safety & social standards
MoFPI	National Institute of Food Technology, Entrepreneurship &Management (NIFTEM)	• Serve as knowledge repository for purposes of information dissemination on various aspects of food processing such as product information, production and processing technology, market trends, safety and quality standards etc. • Facilitating business incubation services with its state-of-art pilot plans for fruit and vegetables, dairy, meat and grain processing • Promotes cooperation & networking among existing institutions within India and as well as with international bodies for purposes of technology transfer & development • Capacity development support through courses designed to facilitate technology adoption across entire value chain (production to retail)
MoST – DSIR	Central Food Technological Research Institute (CFTRI) – a laboratory of CSIR under DSIR	• Facilitate research & development related to technology development & commercialization along with patenting support for food processing sector • Compilation of database of commercial technologies available in the area of food processing along with information dissemination on the same
MoA – DAR&E	Indian Institute of Horticulture Research (IIHR) under Indian Council of Agricultural Research (ICAR)	• Undertaking research in the horticulture sector to enhance productivity & utilization of horticulture crops along with development of commercial technology in line with industry requirements • Capacity development through training related to modern horticulture technology • Repository of scientific information related to horticulture for purposes of information dissemination on applicable technologies
MoA – DAR&E	Indian Agricultural Research Institute (IARI) under ICAR	• Facilitate development of agriculture sector through undertaking R&D for crop improvement & enhancing productivity • Conduct research, technology assessment and transfer by developing new concepts and approaches • Serve as a repository of agriculture database for purposes of information dissemination on applicable technologies

5.4. Findings from Cluster Visit (Pune)

Pune, located in the state of Maharashtra, is one of the key Fruits and Vegetable (F&V) processing clusters in Western India comprising around 550 (Micro units: 400; Small units: 120; Medium scale units: 30) processing units. The cluster employs around 13,000 people

generating a turnover of around ₹ 864 Crore per annum with a geographical spread covering Pune and other areas/ locations in proximity including Panchgani & Mahabaleshwar. In terms of product segments, the cluster produces a wide range of processed fruits & vegetable products which can be broadly categorized into the following product segments as follows:-

- Processed Fruits & Vegetables (F&V): Comprising value added products like fruit juices/ concentrates, fruit pulps, jams, sauces, purees, etc.
- Ready-To-Eat (RTE)/ Ready-To- Cook (RTC) products: Mainly includes cooked curries, frozen fruits & vegetables, frozen pulp, canned products, etc.
- Spices & Pickles: Primarily comprises raw spices, spice mixtures (powders & pastes) and pickles

The table below provides a brief profile of the SMEs highlighting investment in plant & machinery, employment created and turnover across the key product segments in the Pune Fruits & Vegetable processing cluster.

Snapshot of the Pune Fruits & Vegetable Processing Cluster

Product Segment	Investment (₹ Cr)	Employment	Turnover (₹ Cr)
Processed Fruits & Vegetables	66	2988	**198**
RTE/ RTC products	18	1560	**72**
Spices & Pickles	63	8665	**594**
TOTAL	**147**	**13213**	**864**

Source: http://www.punebds.com/thecluster.asp (under MSMEFDP, SIDBI)

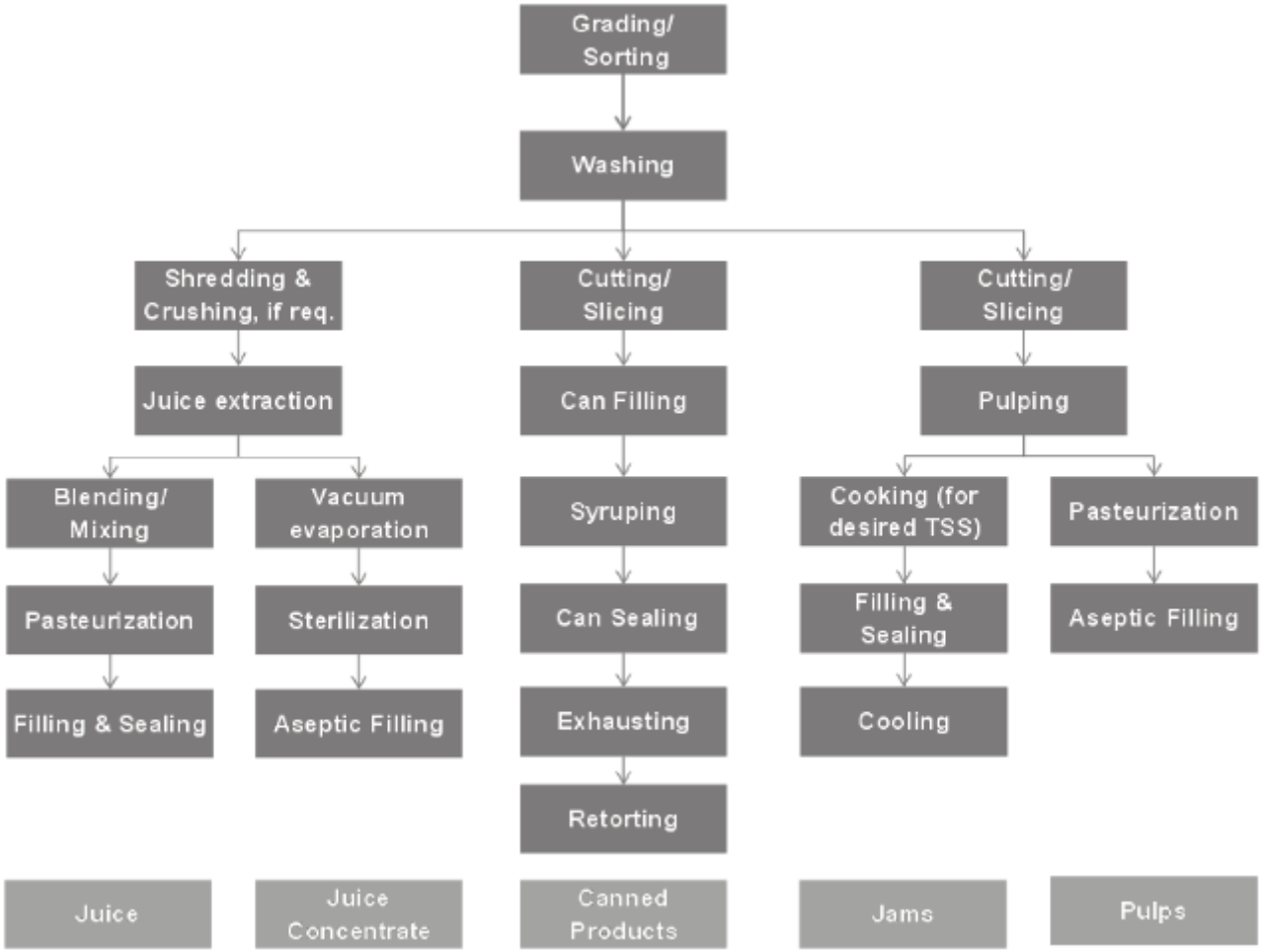
In terms of ownership of units, as per Mahratta Chamber of Commerce, Industries & Agriculture(MCCIA) study, around 64% of the units are proprietary concerns, 17% are partnership firms, 8% private limited companies & 1% being public limited companies. While the micro enterprises are almost entirely proprietary concerns, the small and medium enterprises are primarily partnership/ private limited firms. Further, most of the enterprises cater to the domestic market with only a few (around 25-30) catering to the export markets. Most of the MSMEs in this cluster operate on a job-work basis for larger players in the cluster on account of limited market linkages and lack of investment in requisite technology & quality certifications to meet requisite product norms.

In terms of academic/ research institutes, the cluster has National Agriculture and Food Analysis& Research Institute (NAFARI) having NABL accredited laboratory for chemical and microbiological analysis and is a prominent incubation centre in food sector for new product, process and service developments. In addition there are several Government institutions/ associations catering to the requirements of the cluster including MCCIA, Maharashtra State Agriculture Marketing Board (MSAMB), National Horticulture Board (NHB), etc.

5.4.1. Value chain activities in the cluster

Value added fruit & vegetable products

The high level production process associated with the value added fruit products like juice, juice concentrate, pulp, jams and canned products manufactured in the Pune cluster have been presented below.



1. Juice

For the purpose of preparing juice, the prepared fruit (after sorting/ grading, washing and peeling) is crushed using a crusher. Next, the crushed pulp is passed through the Hydraulic press where it is pressed for extraction of the juice. Post extraction, the juice passes through a filter for sieving out the unwanted fruit waste. The clear juice, thus obtained, is blended with requisite quantity of sugar syrup and is subsequently pasteurized. Finally, the juice is filled in sterilized cans/ bottles (glass or plastic), which are sealed, cooled, labeled and packaged prior to dispatch.

2. Juice Concentrate

For preparing juice concentrate, the juice extracted from the Hydraulic press is vacuum evaporated to remove the water content in order to bring it to the desired brix level. The concentrated juice is subsequently sterilized and packaged aseptically (in bulk form) in 'Bag in drums' for delivery.

3. Canned Products

For canned fruit products in syrup like canned pineapples, it is critical to select fruit of uniform size. Once the preliminary activities like sorting/ grading and washing have been performed, coring of the fruit is done for removal of core from the fruit. The cored fruit is then cut in uniform slices and is filled into the cans along with hot sugar syrup. The filled cans are sealed and subsequently exhausted (by passing it through Exhaust line), sterilized in retorts, cooled, labeled and finally packaged for delivery.

4. Pulps

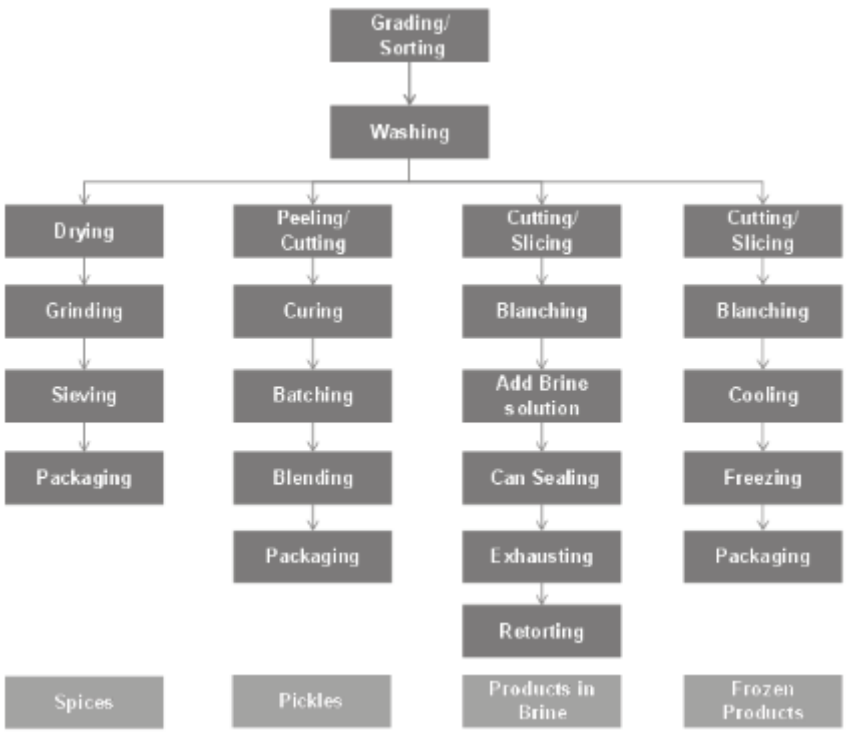
To prepare semi-processed pulp, the prepared fruit (after grading/ sorting and washing) is cut/ sliced and passed through a crusher for obtaining crushed fruit pulp. The fruit pulp is subsequently pasteurized and packaged aseptically in 'Bag in drums' using aseptic filler line and finally packaged for delivery.

5. Jam

For jam manufacturing, the fruit pulp obtained from the crusher is cooked with requisite quantities of sugar and pectin in order to ensure that the finished product has the desired Total Soluble Solids (TSS) content. Permitted colors and required amount of citric acid and flavoring is added at this stage. The product is finally packed into cans/ bottles and cooled, followed by labeling and packaging.

Spices, Pickles and other value added RTE/ RTC products

The high level production process associated with spices, pickles and other value added RTE / RTC products like products in brine solution and frozen foods manufactured in the Pune cluster have been presented below.



1. Spices

For the purpose of preparing spices, the dehydrated raw materials like chilli, coriander, turmeric, clove, ginger, cinnamon, etc. are initially prepared by cleaning/ de-stoning and are subsequently pulverized/ grinded in a grinding/ pulverizing mill and sieved through a mesh (of uniform size) for removal of waste particles including seedsand finally packed &sealed using form filling and sealing machines.

2. Pickles

For preparation of pickles, after the preliminary activities like sorting/ grading (for removal of spoilt and lower quality product), washing and drying; the fruits/ vegetables are cut/ peeled off into required sizes. The cut pieces are subsequently cured by brining (salt solution) for few hours and are dehydrated in the drier followed by blending with dry spices like red chillies, turmeric, mustard etc. The prepared pickles are then packaged in bulk form or in glass/ PET/ pouches for delivery.

3. Products in Brine Solution

To prepare products in brine, the blanched slices/ pieces of the respective product are filled in cans followed by addition of a brine solution. The filled cans are sealed and subsequently exhausted (by passing it through Exhaust line), sterilized in retorts, cooled, labeled and finally packaged for delivery.

4. Frozen Products

For preparation of frozen fruits/ vegetable products, the blanched pieces are initially cooled and then subjected to freezing either by employing 'Blast' Freezing or Individual Quick Frozen (IQF) technology followed by packing and sealing using automated form filling & sealing machines.

5.4.2. Existing level of technology adoption across the value chain

Based on the mapping of the value chain highlighted above, the existing level of technology adoption by the MSMEs in manufacturing value added fruits and vegetable products in the cluster is highlighted in the table below.

Value Chain	Current level of Technology	Key Observations/ Technology improvement opportunity
Preparatory activities like Sorting / Grading & Cleaning	• Most of the small and medium units do the preparatory/ preliminary activities manually	• There is scope for automation in select preparatory activities for enhancing productivity and addressing shortage of skilled labour. For example, in case of frozen corn items, initial activities like husking, de-kernelling and grading is done manually by most of the MSMEs on account of absence of cost-effective technology with units investing in automation primarily relying on imported machinery for the same • Absence of scale of operations required for providers of imported technology to invest in establishment of local office / affiliates for providing operation & maintenance support which impacts adoption of the same among the MSMEs

Value Chain	Current level of Technology	Key Observations/ Technology improvement opportunity
Drying of cut pieces for pickle preparation	• Most of the small units follow natural drying for drying cut pieces after curing in brine solution	• Some of the larger units have automated driers for dehydrating the cut pieces post curing
Batching - blending spices for pickle preparation	• Most of the units do batching process manually	• Some of the medium and larger units have automated facility for batching
Freezing – for frozen fruits / vegetable products	• For preparation of value added frozen fruits/ vegetable products, most of the units typically employ conventional 'Blast' freezing technology	• Some of the larger units have shifted to energy efficient 'Individual Quick Frozen' (IQF) technology for purpose of preparing frozen products. However, the cost of such technology is significantly high and may be viable only for units having higher scale of operations
Packaging	• On account of higher associated costs and inadequate scale of operations, most of the small units do packaging manually	• There is a scope for enhancing productivity and ensuring hygiene packaging through: ○ Installation of Automated packaging facility like Automated Form Filling & Sealing machines, etc. ensuring hygiene packaging through less manual intervention ○ Investment in Aseptic Packaging / Controlled Atmosphere Packaging (CAP) / Modified Area Packaging (MAP) for increasing product shelf life
Labeling / Bar coding	• Most of the small units do not have the facility for labeling and bar coding	Impacts ability to target exports or even supply to well-established domestic retail chains

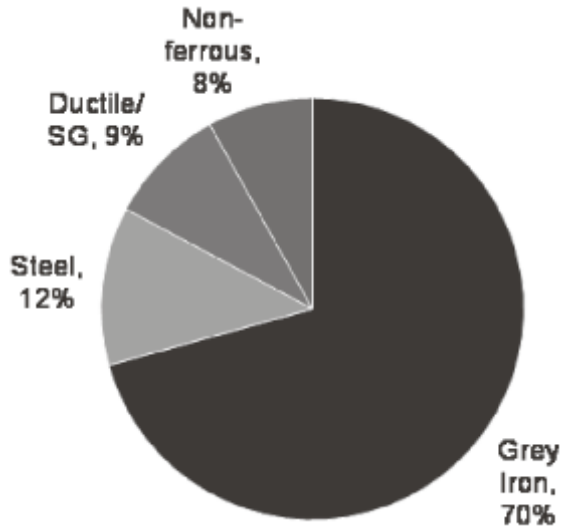
5.4.3. Existing level of clean / green / energy efficient technology adoption

Based on interactions with various key stakeholders including the industry players, industry associations, etc., the key issues pertaining to adoption of clean / green / energy efficient technologies is presented in the table below:-

Parameters	Current level of Clean & Green Technology	Key Observations / issues
Water Pollution& Effluent Treatment	Most of the enterprises do not have facilities for processing of solid waste and treatment of water for reuse in the manufacturing process	In the absence of adequate monitoring of environment compliance, most of the smaller enterprises do not have adequate facilities for effluent treatment like Effluent Treatment Plant (ETP) with Reverse Osmosis (RO) facility for water treatment/ recycling and solid waste management

6. Foundry

The Indian foundry industry ranks fourth in the World with an installed capacity of over 7.5 million MT. During FY 2009-10, the total production of castings was around 7.4 million MT, registering a CAGR of 5.3% for the FY 06-10 period. In terms of the product mix, the Indian foundry industry can be broadly categorized into i) Grey iron castings, ii) Steel castings, iii) Ductile/ SG castings and iv) Non-ferrous castings. Of these, Grey iron castings accounts for a significant share of the total castings production followed by Steel, Ductile/ SG Iron and Non-ferrous castings as highlighted in the chart alongside. The foundry industry is labour intensive and employs an estimated 0.5 million persons directly and another 1.5 million persons indirectly.



Further, in terms of market segments, Automobiles account for nearly 32.4% consumption of the total production of castings followed by other key product/ market segments viz. Sanitary (8.6%), Agriculture (8.1%), Pipes & Fittings (7.8%), Industrial Machinery (6.7%), Railways (5.2%), Pumps & Compressors (4.8%), Valves (3.2%), Diesel engines (3.2%) with the balance being accounted for by other engineering sectors. On account of significant growth envisaged in key end-use segments like automobiles and other engineering sectors coupled with the increasing shift of casting production from developed countries, the Indian foundry industry is poised for promising growth going forward.

6.1. Industry Structure

The Indian foundry industry is highly fragmented with over 5,000 foundry units located primarily in around 20 clusters, spanning across the entire geography of the country, with each cluster catering to specific product/ market segments. The predominance of MSMEs in this industry is evident from the fact that nearly 90% of foundry units fall under micro, small and medium category. These units produce a wide range of castings including automobile parts, agricultural implements, machine tools, diesel engine components, manhole covers, sewing machine bodies &stands, pump-sets, decorative gates and industrial valves. Key highlights of the major foundry clusters in the country in terms of number of units and key product/ market segments catered to are detailed in the table below.

Foundry Cluster	Location	No. of Units (Approx.)	Key Products/ Market segments catered
Rajkot	Gujarat	500	Oil engines, Automotive/ Textile machine parts, Machine tools, Pumps/ Valves
Coimbatore	Tamil Nadu	600	Pumps/ valves, Textile machine parts, Electric motor bodies
Ludhiana	Punjab	350	Sewing machine parts, Auto parts
Howrah	West Bengal	300	Manhole covers, sanitary pipes, railway sleepers inserts, electric motor bodies, valves
Kolhapur	Maharashtra	250	Automotive/ oil engines, Pumps/ valves, Sugar mill parts
Batala	Punjab	200	Agriculture implements, Machine tool parts, Railway cast steel axle boxes
Belgaum	Karnataka	100	Automobile components/ Oil engines, Pumps/ valves, Electric motor bodies

6.2. MSMEs in the Foundry sector

As highlighted above, the Indian foundry industry is highly fragmented with domination of MSMEs which account for an estimated 90% of the total foundry units. Most of the MSMEs are characterized by relatively small scale of operations with relatively low level of awareness about new and energy efficient technologies available in the market. On account of usage of energy inefficient conventional cupolas, most of the MSME units suffer from relatively lower margins vis-à-vis larger players who are increasingly shifting to energy efficient technology by employing Divided Blast Cupola (DBC) for the energy intensive melting process. However, it is observed that select medium scale units have also started adopting DBCs but their uptake of the technology has been relatively slow. Further, it has been observed that most of the MSME units are not vertically integrated with some of the activities in the value chain like Pattern making, Shot blasting, Machining, etc. being outsourced.

6.3. Existing technology promotion related policy & institutional support for MSMEs

Key Government departments / agencies / institutions associated with providing technology promotion related policy & institutional level support to MSMEs in the Foundry sector have been presented below. It should be noted that this is in addition to the support available through the sector – agnostic schemes & programmes detailed earlier in Section 2.2.

- National Institute of Foundry and Forge Technology (NIFFT): NIFFT, registered as a Society under the Societies Registration Act of 1860, was set up in 1966 in collaboration with UNDP-UNESCO with the key mandate for providing support towards technology adoption in foundry industry through interventions including i) research & development in metal casting and forging technology, ii) technology indigenization/ commercialization and iii) capacity development initiatives involving training in requisite skill sets

- The Institute of Indian Foundrymen (IIF): The Institute of Indian Foundrymen (IIF) was set up in 1950 to promote education, research, training and development to Indian foundrymen and to serve as a nodal point of reference between the customers and suppliers of the Indian foundry industry on a global scale. Consequently, it has been providing support towards technology adoption among MSMEs in the industry i) technical assistance for upgradation of technology and ii) training and capacity development initiatives

6.4. Findings from Cluster Visit (Rajkot)

Rajkot, located in the state of Gujarat, is one of the key foundry clusters in Western India comprising around 500 foundry units. The geographical spread of the cluster includes sub-clusters like Aji Vasahat, Bhaktinagar Industrial Area, Mavdi Plot, Samrat Industrial Area, Atika Industrial Area, Sapar Veraval and Metoda GIDC in Rajkot. While majority of the foundry units at Rajkot produce grey iron castings for the domestic market, a relatively small percentage (around 10%) of the foundry units also cater to the export market, primarily for electric motor body castings, etc. apart from diesel oil engines, the foundry units at Rajkot cluster caters to a number of other end-use applications / market segments, as depicted in the table alongside. Currently, most of the units (around 300-350) in the cluster operate conventional cupola furnaces while the rest operate induction furnaces. The supporting / ancillary units include those which are focused on specific activities of the value chain like pattern making, machining, fettling and typically operate on a job order basis.

End use segments	% share of the foundries
Oil Engines	42%
Automotive/ Textile	15%
Machine Tools	11%
Pumps / valves	7%
Others	25%

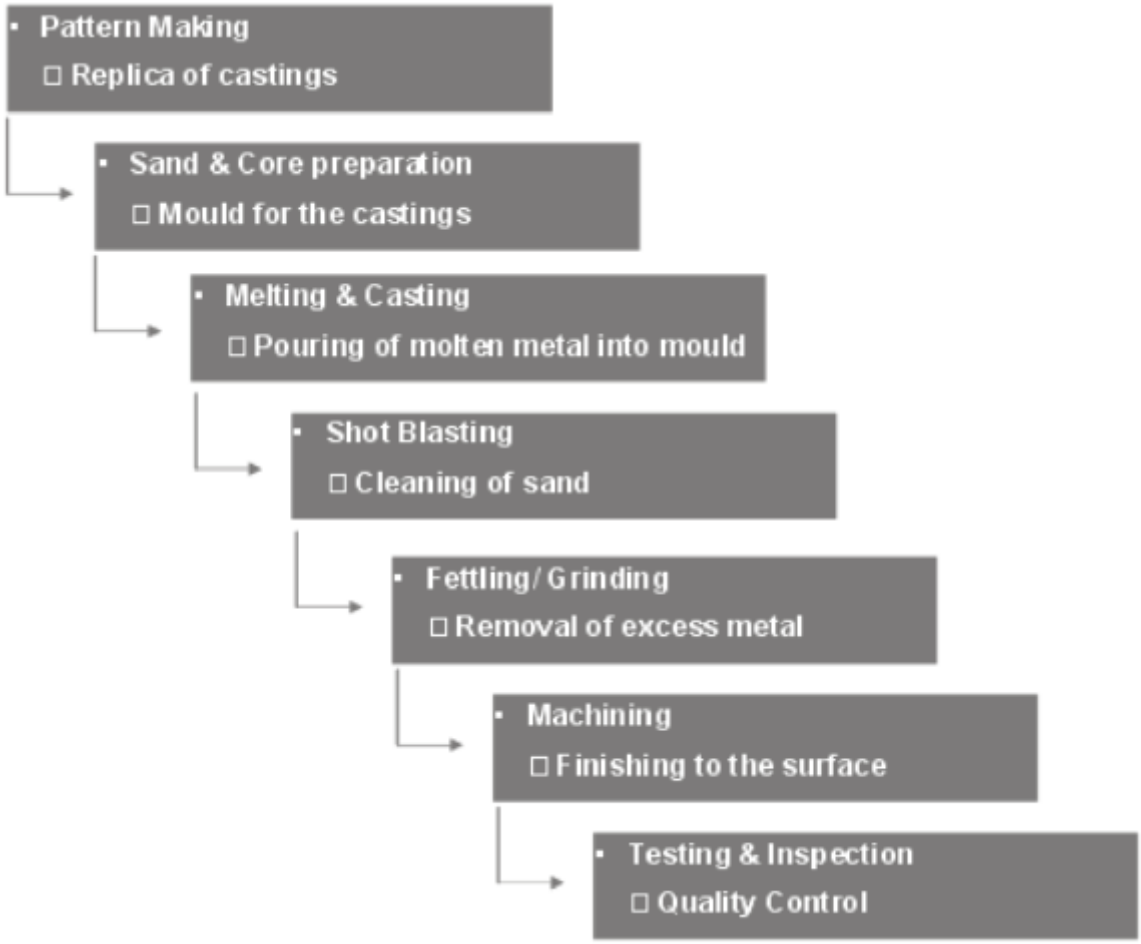
In terms of academic / capacity building institutes, the cluster has Industrial Training Institute (ITI), Indo German Tool Room (IGTR), etc. providing training in select areas like CAD/ CAM, CNC machine operation. In addition there are several Government institutions/ associations including Rajkot Engineering Association (REA), Institute of Indian Foundrymen (IIF), Machine Tools Manufacturer Association (MTMA), Rajkot Chamber of Commerce and Industry, etc. catering to the various requirement of the cluster, including those related to technology upgradation.

Given that grey iron casting is an energy intensive process; one of the key issues in the cluster relates to energy conservation. For purpose of addressing the same, an alternate energy efficient technology has been introduced in the cluster which uses Divided Blast Cupolas (DBCs) instead of conventional cupolas. As part of the cluster development services project supported by SIDBI, The Energy and Research Institute (TERI) have been providing this technology to the foundry units in the cluster by empanelling a select list of fabricators for manufacturing DBCs after providing them with requisite training and expertise. Currently, around 10-15 relatively larger foundry units have shifted to the energy efficient DBC technology.

In addition to the energy conservation, another issue which the cluster faces is the high level of air pollution on account of high content of Suspended Particulate Matter (SPM) and other harmful greenhouse gases in the flue gases produced during the melting process. In the absence of adequate monitoring of environment compliance in the cluster, the foundries have not shifted to the venturi-scrubber based pollution control technologies and have continued to use the less effective conventional dry system for reducing air pollution. Further, another issue associated with environmental compliance is the effective disposal of slag which is currently used for land filling in the adjoining areas. However, there exists scope for effective utilization of the same by supplying it to the cement manufacturers for manufacturing PSC (Portland Slag Cement).

6.4.1. Value chain activities in the cluster

The high level production process associated with the grey iron casting production in the Rajkot cluster has been presented below.



1. Pattern making

It involves preparation of replica of the castings based on the drawings given by the customers and are made typically with wood or aluminium.

2. Sand and Core preparation

Sand preparation is done based on the type of moulding required. For green sand moulding, the sand is prepared by mixing it with bentonite and coke dust while for molasses sand moulding the same is prepared by mixing sand with molasses. The core which provides the cavity to the castings is typically prepared by using resin coated sand.

3. Melting and Casting

It comprises melting of raw materials like pig iron, melting scrap, etc. in cupola furnace/ induction furnace depending on the product segment to get the required composition followed by pouring of the molten metal into the moulds through 'ladles'.

4. Shot Blasting

It involves cleaning of the sand adhering to the solid castings after removing it from the mould boxes.

5. Fettling/ Grinding

Post removal of sand adhering to the castings, the excess metal attached to it is removed through the process of fettling/ grinding.

6. Machining

After removal of excess metal from the castings, the finishing to the surface is provided though machining. Most of the units use manually operated lathe machines for this activity.

7. Testing and Inspection

Prior to dispatch of the components, visual and dimensional inspection is carried out. In select cases, as per the customer requirement, non-destructive tests like ultrasonic radiography etc. are carried out to know the internal soundness of the casting.

6.4.2. Existing level of technology adoption

Based on the mapping of the value chain highlighted above, the existing level of technology adoption by the MSMEs manufacturing grey iron castings in the cluster is highlighted in the table below.

Value Chain	Current level of Technology	Key Observations/ Technology improvement opportunity
Pattern Making	• Primarily use CAD/ CAM for designing of patterns • Employ either Computer Numerical Control (CNC) machines or Vertical Machining Centre (VMC) machines for machining patterns	This activity is typically outsourced by the foundry units to pattern makers who have the requisite competency for designing and machining patterns as this service is required only on an intermittent basis. There exists scope for organizing this activity as a common facility centre.

Value Chain	Current level of Technology	Key Observations/ Technology improvement opportunity
Sand and Core preparation	• Based on the size of castings, sand preparation includes mainly i) green sand (comprising sand, bentonite and coal dust) and ii) Molasses sand (sand mixed with molasses) • For core preparation, typically resin coated sand is used	• Improper preparation of sand results in higher rejection in castings; hence testing of the prepared sand is the key for reducing rejections. Currently, there is lack of adequate sand testing facilities in and around the cluster • Centralization of the sand preparation and testing facilities could be considered for the cluster which would result in reduction of rejections and provide economies of scale along with better control and monitoring of the process • On account of shortage of river sand, reclamation of the same is critical going forward. Currently, there is absence of a facility for reclamation of sand in most of the units on account of the process being labour intensive and requiring significant physical space
Melting & Casting	• Most of the units operate energy inefficient conventional cupola for melting purposes	• In terms of employing energy efficient technology, only a select few (around 10-15) relatively larger units use Divided Blast Cupola (DBC) technology. Some of the key benefits of this technology include: ○ Achieving charge coke percentage of 8% from 13.5% thereby reducing coke consumption by around 25-30% in DBC, resulting in cost saving of around ₹ 1000 per tonne of metal produced ○ Increase in melting efficiency and lower melting losses on account of consistent temperature achieved through controlled air flow distribution ○ Lower heat loss due to higher charge height • However, it is observed that the DBC technology has been implemented only for cupola furnaces with a diameter of 18 inches or more. However, most of smaller/ medium the units in the cluster employ 15 inches diameter furnace on account of lower scale of operations and are not aware of possibility of operating DBCs given their scale of operations – the same having been achieved for foundries in Jaipur. • Investment for setting up DBC is significantly higher vis-à-vis conventional cupola and would be viable only for units having higher scale of operations. Hence, subsidizing the costs for adopting DBC may be considered to promote higher levels of adoption

Value Chain	Current level of Technology	Key Observations/ Technology improvement opportunity
Shot blasting	• Most of the units use Automatic Shot blasting machine	This activity is typically outsourced by the smaller foundry units
Fettling/ Grinding	• Most of the units employ automated grinding machines	
Machining	• Most of the units employ lathe machines for machining	This activity is typically outsourced by the smaller foundry units. Further, there exists scope for using automated CNC machines for enhancing productivity and improving machining quality

6.4.3. Existing level of clean / green / energy efficient technology adoption

Based on interactions with various key stakeholders including the industry players, industry associations, etc., the key issues pertaining to adoption of clean / green / energy efficient technologies is presented in the table below:-

Parameters	Current level of Technology	Key Observations / Issues
Air Pollution	Most of the units use conventional dry system for removal of flue gases produced during the melting process	• In absence of adequate monitoring of environment compliance in the cluster, the foundries have not shifted to efficient pollution control technologies like venturi-scrubber and have continued to use less effective conventional dry system for reducing air pollution. • Further, based on interactions with the foundry players, we understand that this technology is capital intensive and is economically viable only for larger scale of operations. Hence, subsidizing the costs for adopting these technologies may be considered to promote higher levels of adoption
Slag disposal	Currently most of the units dispose the slag (produced as a waste during the melting process) for purpose of land filling in the adjoining areas	• There exists scope for effective utilization of slag by supplying the same to the cement manufacturers for manufacturing PSC (Portland Slag Cement) grade cement. However, on account of limited slag production by individual foundry units, this intervention may require cluster-based approach for aggregating the slag produced by the respective units

7. Ceramics

The Indian ceramic industry is ranked 8th in the World, with a production share of around 2.5% of the global output and direct & indirect employment potential of around 0.55 mn people.[20] The ceramic industry is characterized by the diversity in the types of products manufactured which include ceramic tiles, sanitary ware, crockery, refractories, etc. Further, it is observed that a significant share of the market for ceramic products is accounted by ceramic tiles and ceramic sanitaryware.

Ceramic Tiles

The Indian Ceramic tile industry ranks fifth in the World with an estimated production of around 400[21] million square meters during FY 2008-09 and accounts for over 5% share of the global production. In terms of demand, the overall market size of the ceramic tiles in India is estimated at around ₹ 7000 Crore, registering annual growth of 10-12% with the domestic players catering to 90% of the demand while the balance is being contributed by imports. The key drivers for this growth include demand emanating from Indian housing sector, retail, entertainment, IT / ITES, healthcare, hotels and resorts in the country.

Further, with an annual per capita consumption of ceramic tiles of around 0.4 sq. meters, there is significant upside in terms of increase in domestic demand in line with the levels of consumption in other growing economies like China (1.5 sq. meters), Brazil (2.3 sq. meters) and Malaysia (2.1 sq. meters). It is estimated that by 2012-13, the per capita consumption of India is expected to go up to 0.6 sq. meters on account of significant growth in consumption in key end-use segments.

On the global trade front, China has been the largest ceramic tiles exporter with exports of $ 8 billion followed by Italy, Germany and Spain while India accounted for a mere 0.9% of the global trade making it the 24th largest ceramic tile trading nation in the World.[22]

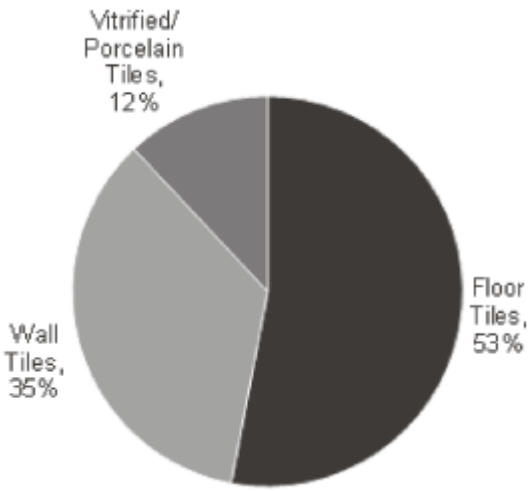
Ceramic Sanitaryware

Indian ceramic sanitaryware industry accounts for around 8% of the global sanitaryware production estimated at 187 million pieces during FY 2009-10 with the industry recording an annual growth of 10% over the last 5 years.

[20] Source: Report titled "Ceramics Industry in India: A trade perspective"
[21] Source: Report titled "Indian Tile Industry- Snapshot" by the Indian Council for Ceramic Tiles and Sanitaryware
[22] Source: Report titled "Ceramics Industry in India: A trade perspective"

7.1. Industry Structure

Indian Ceramic tile industry is largely fragmented with the organized sector accounting for 56% of the total production while the unorganized sector contributes the balance 44% share reflecting the prominence of the MSMEs in this industry. Key players in the organized sector include H&R Johnson (24%), Kajaria Ceramics (15%), Nitco Tiles (14%) and Somany Tiles (10%) with other players accounting for the remaining market share. The unorganized sector is primarily concentrated in the Western region (primarily in Morbi, Gujarat) on account of proximity to raw materials and availability of relatively cheap fuel. Further, the industry can be broadly categorized into 3 product segments viz. wall tiles, floor tiles and vitrified/ porcelain tiles with floor tiles accounting for a market share of 53% followed by wall tiles and vitrified / porcelain tiles[23] share respectively as highlighted in the chart alongside.



In line with the ceramic tile industry, the ceramic sanitaryware industry is characterized by its highly fragmented nature. It is estimated that the organized sector, comprising 6 large players, accounts for around 43% share of total production while the unorganized sector contributes to the balance production.

7.2. MSMEs in the Ceramics sector

As highlighted above, the Indian Ceramic industry is highly fragmented with MSMEs having significant presence in the ceramic tiles and ceramic sanitaryware segments, accounting for 44% and 57% share respectively. Most of the small and medium units are not vertically integrated with some of the value chain activities like preparation of body (spray dried granules) being usually outsourced by the wall and floor tile manufacturers. Further, on account of absence of adequate indigenization of technology, most of the small and medium units have to rely on second hand imported machineries adversely impacting their productivity and margins vis-à-vis large players who have access to latest technology.

7.3. Existing technology promotion related policy & institutional support for MSMEs

Key Government departments / agencies / institutions associated with providing technology promotion related policy & institutional level support to MSMEs in the Ceramics sector have been presented below. It should be noted that this is in addition to the support available through the sector – agnostic schemes & programmes detailed earlier in Section 2.2.

[23] Source: http://www.icctas.com/ceramicindustry.htm

- Central Glass & Ceramic Research Institute (CGCRI): CGCRI is a national laboratory which was set up under Council of Scientific & Industrial Research (CSIR), India in 1950 with the key mandate of providing technology support among MSMEs through interventions including R&D, technology transfer and capacity building in the ceramics industry. The key role of the institute includes i) carrying out basic & applied research in the fields of glass, ceramics, refractories, vitreous enamels, composites and allied materials in order to aid sector development and ii) providing technical advisory and infra-structural services like project engineering, testing & evaluation, training & education and dissemination of scientific information to the public domain
- Indian Council of Ceramic Tiles and Sanitaryware (ICCTAS): It is a non-profit association set up in 1990 with the objective of ensuring growth of Ceramic Tiles and Sanitaryware through activities like i) facilitating participation in Trade Exhibitions, Campaigns, Events, Seminars in India & abroad to gain exposure on latest technologies, ii)Providing trade related information on regular basis comprising articles, circulars, periodicals, statistics, etc. and iii) joint representation of issues/matters affecting the industry to Government, Local bodies & Institutions, including those related to technology
- Chemical & Allied Products Export Promotion Council (CAPEXIL): With the objective to promote export of chemicals and allied products including ceramics, Ministry of Commerce & Industry has set up Chemicals & Allied Products Export Promotion Council (CAPEXIL) which is a non-profit organization. The key role of the Council includes i) promotion of export of chemical and allied products, including ceramics, by providing export assistance and facilitating dissemination of knowledge by facilitating participation in trade delegations to different markets and providing training on international trade, ii) providing a platform for interaction between the Government and exporters on trade & policy issues, including those related to technology, and iii) disbursement of grants through various market assistance programmes

7.4. Findings from Cluster Visit (Morbi)

Based on the primary interactions with the industry associations and other key stakeholders during the field visit, we understand that the Morbi cluster, located in Gujarat, has around 400 units manufacturing various ceramic products. Key highlights of the cluster in terms of the key product segments catered and the associated number of units is presented in the table below.

Product Segment	Nos.	Key Features
Wall/ Floor tile manufacturers	~ 300	Typically the production capacity of wall/ floor tile manufacturers is in the range of 20,000 sq. ft. to around 200,000 sq. ft. per day with most of the units having production capacity of around 40,000-50,000 sq. ft. per day
Vitrified tile manufacturers	~ 40	Units having production capacity in the range of 70,000 sq. ft. to around 1,50,000 sq. ft. per day
Sanitaryware manufacturers	~ 50-60	Typically the production capacity of such units is in the range of 600 – 2000 pieces per day

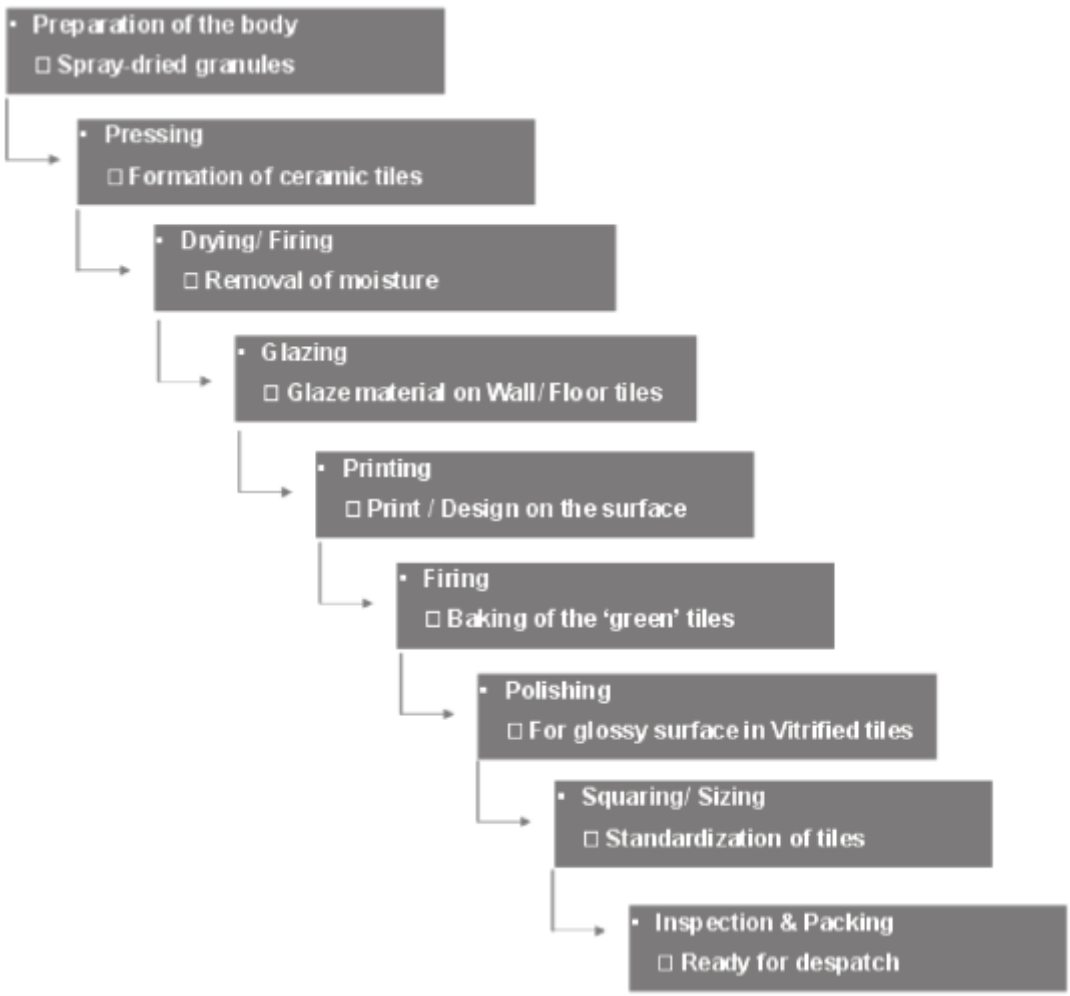
Further, there are around 30 manufacturing units dedicated for preparation of body (spray dried granules) typically outsourced by the smaller units manufacturing wall /floor tiles. Most of the units have their own brands and primarily have a presence in tier II cities and sell through the dealers appointed by them in respective cities. Also, there are few units (around 10-12) which do job work for the large tile manufacturers like HR Johnson, Kajaria, Bell Ceramics, etc.

In terms of support towards technology related requirements, the cluster primarily relies on CGCRI located at Ahmedabad. Further, there are select associations like Morbi – Dhuva Glaze Tile Manufacturer Association, Sanitaryware Manufacturer Association, etc. catering to the needs of MSMEs in the cluster.

7.4.1. Value chain activities in the cluster

Ceramic Tiles (Wall/ Floor/ Vitrified)

The high level production process associated with the Ceramic Tiles (Wall/ Floor/ Vitrified) production in the Morbi cluster has been presented below:--



1. Preparation of the body

This involves i) preparation of homogenous slip/ slurry through wet grinding in ball mills along with the grinding media which is then transferred to ii) storage tanks which are agitated continuously with blungers to avoid setting of slip followed by iii) feeding of slip/ slurry into the spray dryer wherein the slurry is atomized against hot air for conversion into spray - dried granules and subsequently stored in the silos before the process of pressing.

2. Pressing

It involves pressing/ shaping of the spray-dried granules through automatic hydraulic presses to facilitate formation of ceramic tiles as per the cavity of the die.

3. Drying

In case of floor & vitrified tiles, the tiles formed through hydraulic pressing are passed through the horizontal dryer for removal of moisture.

4. Firing

In case of wall tiles, the tiles formed post hydraulic pressing pass through the first firing (also called bisque firing) in the roller kiln where the tile is fired at a temperature of around 1100 - 1150^{o}C.

5. Glazing

It involves coating of the glaze material on the fired wall/ floor tiles through primarily bell flow method and comprises laying of 3 layers viz. i) engobe, ii) opaque and iii) transparent. The glaze is typically prepared through grinding of materials such as fritz, feldspar, quartz, china clay, etc. in the ball mills.

6. Printing

Post application of the glaze (in case of wall and floor tiles) or drying (in case of vitrified tiles), the color/ design is applied on the surface by employing automatic screen printing/ roto printing/ digital printing for purpose of printing the tiles.

7. Firing

For the wall tiles, the manufacturing requires second firing (also called gloss firing) through the rotary kiln. This stage of firing is also required in case of Floor and Vitrified tiles for purposes of baking. Typically the cycle time for this process is around 60-70 minutes.

8. Polishing

In case of vitrified tiles, instead of providing a glaze material on the body, the baked tiles are polished in order to provide glossy feature to the surface. This is done using abrasive materials and involves 3 stages viz. i) Rough, ii) Medium and iii) Final polishing.

9. Squaring/ Sizing

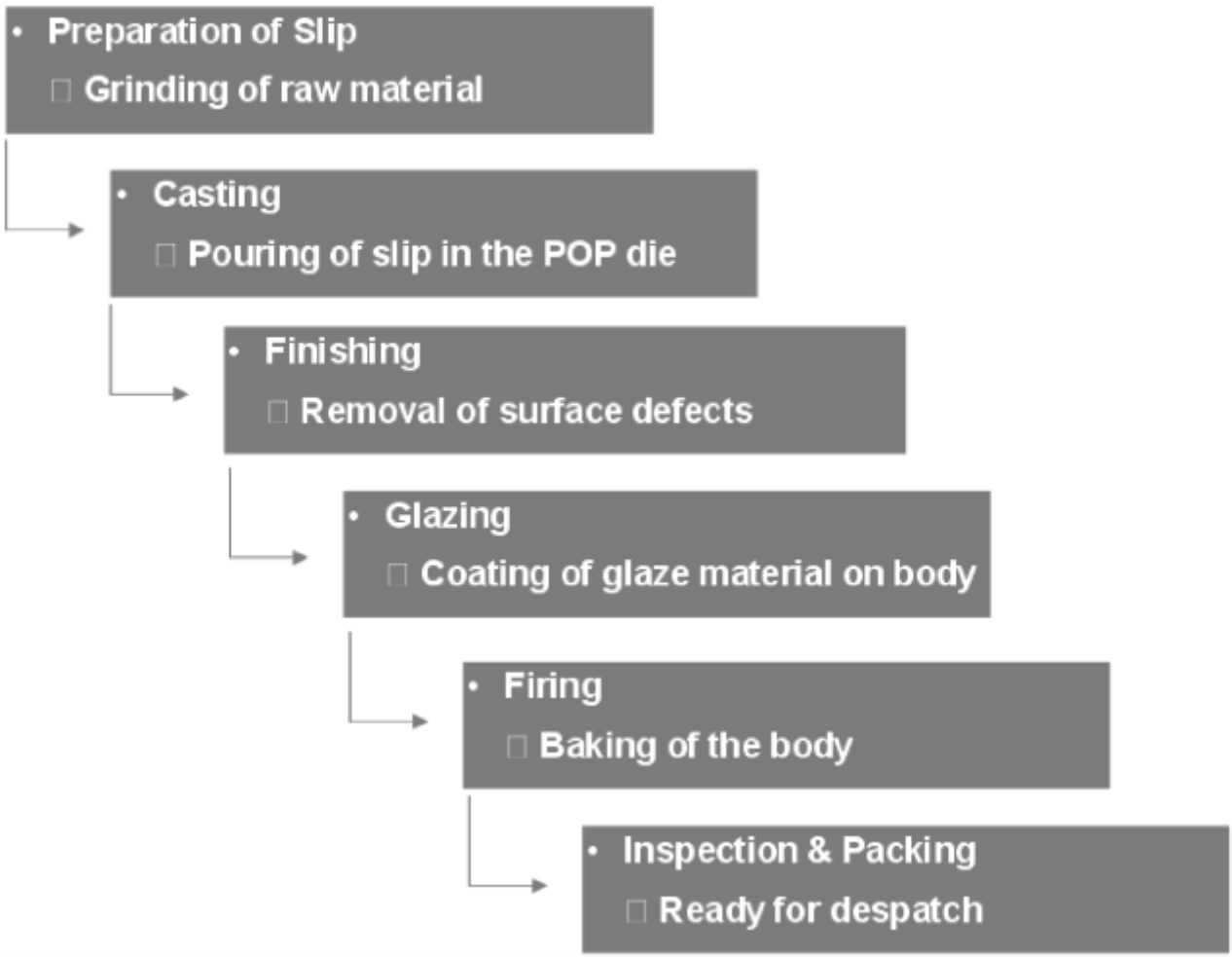
It typically involves side-chamfering and ensures standardization of the tile sizes.

10. Sorting and Packing

It involves quality checking and segregation of tiles into different categories such as first, second or third grade quality based on defects identified. Different grades of the finished tiles are then packed into different types of packing boxes, which are marked accordingly. The packed finished goods are thereafter sent for dispatch.

Ceramic Sanitaryware

The high level production process associated with the Ceramic Sanitaryware production in the Morbi cluster has been presented below.



Key highlights of the value chain activities for manufacturing ceramic sanitaryware in the Morbi cluster are detailed below.

1. Preparation of Slip

This comprises grinding of the raw materials in the ball mills (having grinding media) along with water for preparation of slurry. After blunging and attaining required parameters like thixotropy, viscosity, etc., the slip is stored in storage tanks with continuous agitating system for proper ageing. After around 72 hours of ageing, the slip is supplied to casting process through slip supply distribution system using Willet pumps.

2. Casting

It involves pouring of the slip/ slurry into the Plaster of Paris (POP) dies which absorbs moisture from the slurry thereby giving it the shape of the die. After this, the cast (green piece) is released from the mould and is left for overnight drying at 40-45^{o}C and 65%-75% humidity by using hot air generators and humidity controllers. Some of the units have explored the possibility of deploying automatic pressure casting which significantly i) enhances productivity and ii) eliminates manual intervention and space required for casting.

3. Finishing

Post drying, the green piece is visually checked and thorough finishing is done manually using sand paper to remove surface defects and cracks. In case of automated pressure casting, the quality of the green piece is better thereby requiring less manual effort for finishing the same.

4. Glazing

Glazing is a process of applying coating on finished ware to i) make the body impervious and more durable and ii) to increase aesthetic appeal. It involves sponging the green piece with water for removal of fine dust adhering to the ware surface in order to make the ware suitable for glazing process. The sponged wares are placed on specially designed booths having rotating tables and the wares are glazed using spray gun & diaphragm pump. This operation is done by skilled operators as well as mechanized robots (in case of large units).

5. Firing

Post glazing, the product undergoes firing through tunnel kiln. In this process, the products are placed on the trolley which passes through the tunnel kiln having several zones. Typically the firing takes place at 1200^{o}C with average cycle time ranging from 26-28 hours.

6. Sorting and Packing

It involves quality checking and segregation of sanitary ware pieces into different categories based on defects identified. Different grades of the products are then packed into different types of packing boxes, which are marked accordingly. The packed finished goods are thereafter sent for dispatch.

7.4.2. Existing level of technology adoption across the value chain

Based on the mapping of the value chain highlighted above, the existing level of technology adoption by the MSMEs manufacturing various product segments viz. wall, floor and vitrified tiles is highlighted in the table below:-

Value Chain	Current level of Technology	Key Observations/Technology improvement opportunity
Preparation of the body	• For grinding & preparation of slip/ slurry, ball mills are used along with the grinding media • Spray dryer is used for conversion of slip/ slurry into granules/ ceramic powder	• On account of significant investment in Spray dryer along with low scale of operations resulting in sub-optimal capacity utilization, this activity is primarily outsourced by smaller/ medium units engaged in manufacture of wall & floor tiles • However, this activity is conducted in-house by vitrified tile manufacturers for ensuring control on quality & strength of the body material, critical for manufacturing vitrified tiles
Pressing	• Most of the units use automatic hydraulic press for dust pressing	• On account of absence of any local equipment fabricators, most of the units have to rely on imported machinery primarily from Italy & China
Glazing	• Most of the units employ Bell Flow method for applying glaze material on the tiles	
Printing	• Most of the units use Automatic Screen printing	• For purpose of increasing the color options and for improving printing quality, some of the larger units have upgraded to digital printing. However, the cost of such machine is significantly high and may be viable only for units having higher scale of operations
Firing	• Most of the units have shifted from conventional tunnel kiln technology to energy efficient roller kiln technology	• Given that ceramic tile manufacturing is an energy intensive process, reduction in energy consumption is the key to ensure cost competitiveness. Roller kiln technology facilitates energy conservation on account of usage of recycled hot air. Further, these roller kilns are primarily sourced locally from the fabricators by most of the units
Squaring/ Sizing	• Most of the units have automated squaring/ sizing line	• On account of absence of any local fabricators, most of the units have to rely on imported machinery primarily from Italy & China
Sorting & Packing	• Currently, this activity is done manually by most of the units	• On account of labour shortage, there exists a scope for introducing automation/ semi-automation for sorting and packing of the tiles to reduce manual intervention

Based on the mapping of the value chain highlighted above, the existing level of technology adoption by the MSMEs manufacturing sanitaryware is highlighted in the table below.

Value Chain	Current level of Technology	Key Observations/ Technology improvement opportunity
Preparation of the slip/ slurry	• For grinding & preparation of slip/ slurry, ball mills are used along with the grinding media	• Done in-house by most of the units
Casting	• For preparation of green pieces, slip is poured into the Plaster of Paris (POP) moulds for getting the desired shape	• There exists a scope for deploying automated pressure casting which significantly i) enhances productivity and ii) eliminates manual intervention and physical space required for casting. • Further, pressure casting enhances the finishing of the green piece thereby requiring less manual effort for finishing the same. However, in this case, the raw materials required for preparation of the slip may have to be imported to facilitate the process
Glazing	• Most of the small & medium units perform this activity manually by using hand spray gun & diaphragm pump	• For purpose of enhancing productivity, som e of the larger units have introduced mechanized robots for spraying, which may not be viable for units with limited scale of operations
Firing	• Most of the units employ conventional tunnel kiln technology having higher cycle time of around 26-28 hours	• Given the energy intensive process, there exists a scope for shifting to the energy efficient roller kiln technology which uses recycled hot air and has significantly shorter cycle time for firing. However, this will be viable only for units having higher scale of operations
Sorting & Packing	• Currently, this activity is done manually by most of the units	• On account of labour shortage, there exists a scope for introducing automation/ semi-automation for sorting and packing of the tiles to reduce manual intervention

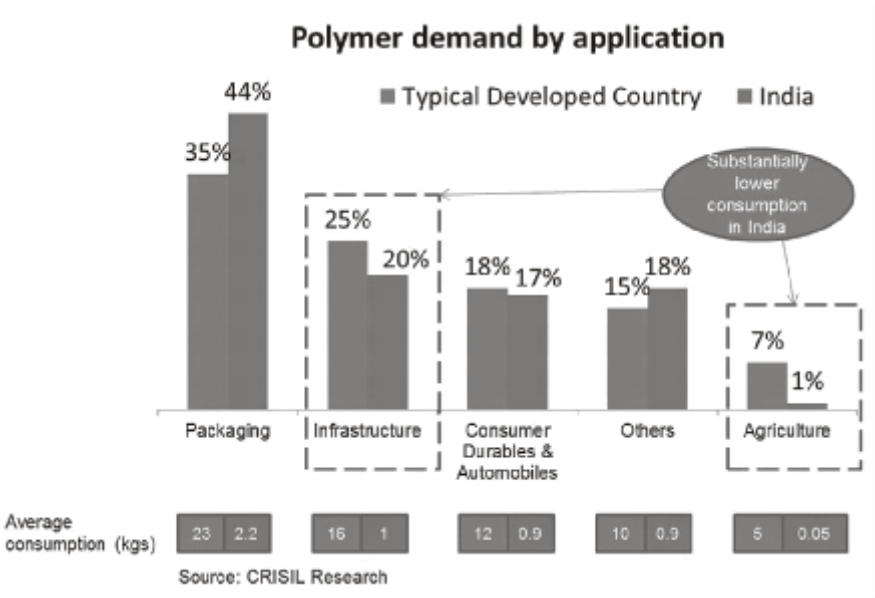
7.4.3. Existing level of clean / green / energy efficient technology adoption

Based on interactions with various key stakeholders including the industry players, industry associations, etc., the key issues pertaining to adoption of clean / green / energy efficient technologies is presented in the table below:-

Parameters	Current level of Technology	Key Observations / Issues
Water Pollution	Most of the units do not have facilities for processing of solid waste and treatment of water for reuse in the manufacturing process	• In the absence of adequate environment compliance in the cluster, most of the small and medium ceramic units do not have effluent treatment plant for processing of solid waste and treatment of water
Energy Efficiency	Currently most of the units use energy inefficient conventional tunnel kiln technology for purpose of baking of 'green' Sanitaryware pieces	• There exists scope for energy conservation through shift to energy efficient roller kiln technology which uses recycled hot air and has significantly shorter cycle time for firing. However, the cost of such technology is significantly high and may be viable only units having higher scale of operations.

8. Plastics

Plastics is one of the fastest growing sectors in India with an estimated 25,000 units employing around 3.3 million people and having a turnover of around ₹ 85,000 Crore. With export earnings of around $ 1.9 billion, India has a relatively low share in the World trade for plastics which is expected to reach 140 MMT by 2012.[24] The per capita consumption of plastic in India is as low as 5 kg vis-à-vis around 109 kg in US, 32 kg in Brazil and 29 kg in China. However, the growth recorded by this industry in the last few decades has been in the range of 12-14% which is expected to further increase with projected doubling of per capita consumption of plastic by 2012. It is estimated that polymer demand would reach 12.5 MMT, driven primarily by derived demand from packaging, infrastructure in form of roads, railways, power, ports & airport and agriculture applications like water irrigation, etc. The adjoining chart highlights the relatively lower levels of current consumption of plastic in India, especially in areas of infrastructure and agriculture, translating into higher potential for demand emanating from these sectors in line with the global trends.



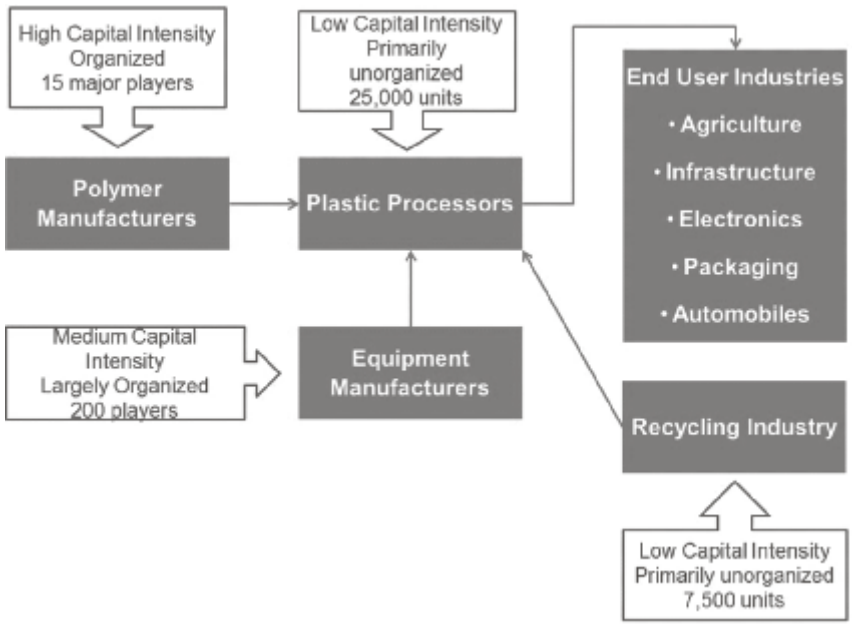
It is expected that around $ 80 billion of new investment will take place in the Indian plastic industry in the next 2-3 years.[25] This growth is expected to be supported with supply of key raw material in the form of polymeric materials with proposed capacity expansion programmes of existing petrochemical complexes and setting up of new cracker units.

The Vision 2015 for the Plastics Sector as laid down by the Government of India envisages achievement of a turnover of around ₹ 1,33,245 Crore with consumption of 18.9 MMT of polymers and additional employment for around 7 million people.[26]

[24] Source: www.chemicals.gov.in/pp-scheme131010.pdf
[25] Source: Sector report titled "Indian Plastic Industry" dated September 9, 2010 and published by Firstcall Research
[26] Source: http://cipet.gov.in/plastics_statics.html

8.1. Industry Structure

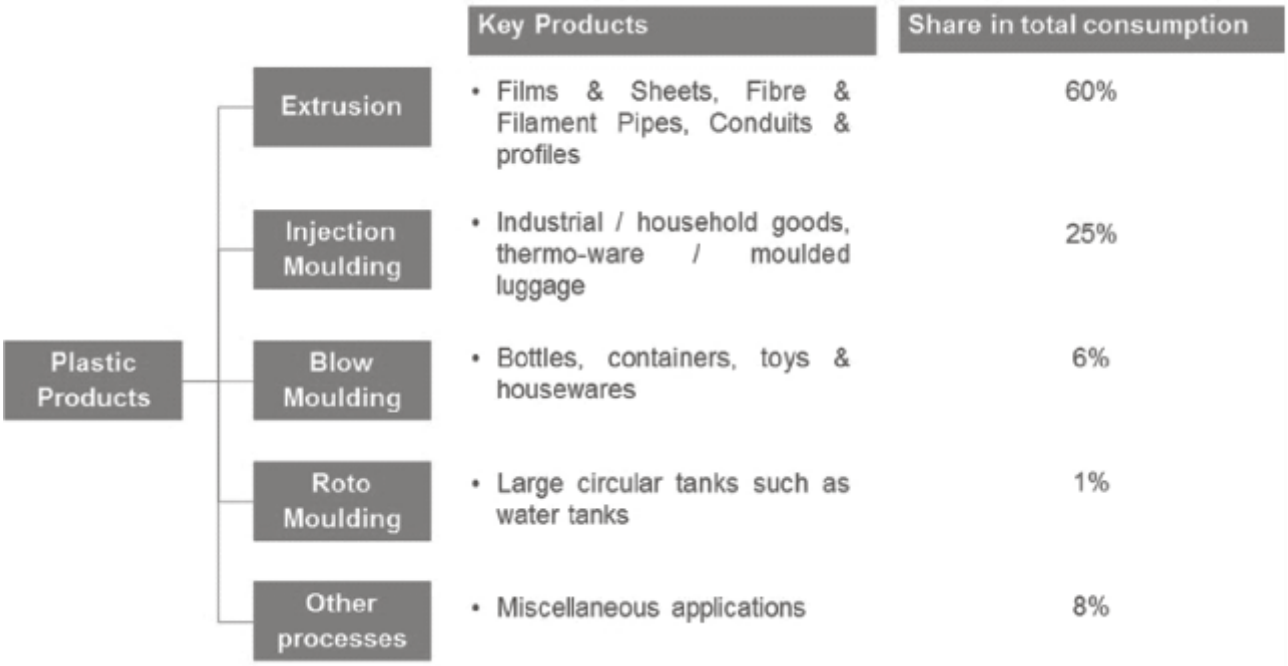
The key stakeholders associated with the plastic industry in India have been depicted in the chart below.



As depicted in the chart alongside, the raw material suppliers in form of polymer manufacturers are relatively large players from the organized sector, including Reliance, GAIL, HPL etc. and enjoy significant bargaining power.

Equipment manufacturers are also primarily from the organized sector and include the mould manufacturers, suppliers of extruders & moulding machines, printing & packaging line suppliers etc.

Plastic processing sector is dominated by the unorganized sector which primarily deploys the following manufacturing processes for conversion of polymers to plastic products, as depicted in the chart below.



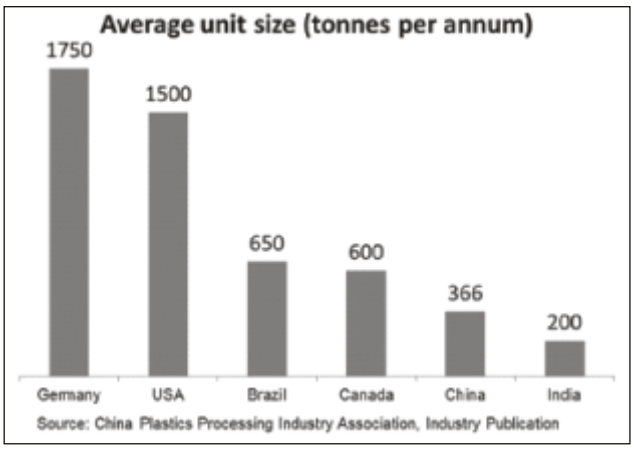
Source: http://cipet.gov.in/plastics_statics.html

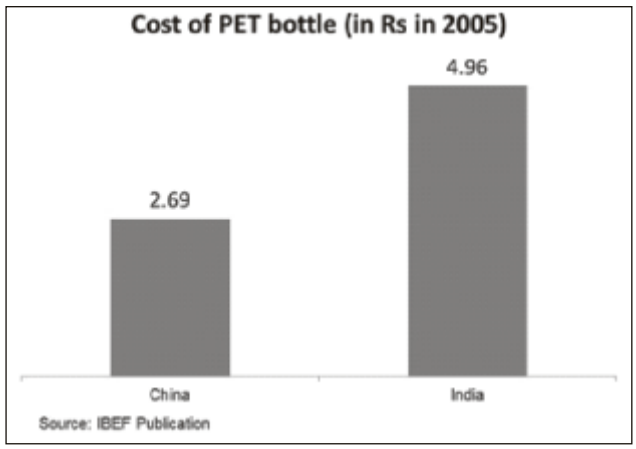
Further, a key stakeholder in the plastic sector is the recycling industry which is involved in recycling of around 60% of the total plastic in circulation for application into i) non-critical items of daily use, ii) as a source of fuel generation or iii) infrastructure projects.

8.2. MSMEs in the Plastics sector

The Indian Plastics industry is highly fragmented with the top 100 players accounting for only 20% of the industry turnover and the share of the unorganized sector estimated at around 70% of the industry turnover.[27] As depicted in the high-level industry structure, the presence of the MSMEs in the plastic sector is primarily restricted to plastic processing and recycling units with limited presence in equipment /mould manufacturing.

One of the key drivers in the past for the emergence of the MSME sector as a prominent player in the plastic sector can be attributed to the policy of reservation of certain products for exclusive manufacture by the MSMEs. On account of reservation of key household products, pipes, packaging materials etc. for exclusive manufacture by MSMEs, it has been observed that the economies of scale and cost structures of the Indian plastic processing industry have been impacted. This has resulted in inability to compete with global players in the export market as depicted in the chart below.





On account of the above-mentioned issues, it is observed that the Indian plastic processors have been restricted to production of low value added products related to domestic application like kitchenware, tableware, soap cases, buckets, water jugs, plastic cane, rain coats, polyester sheets, office/ school supplies made of plastic, etc. It is estimated that around 97% of all exports of processed plastic products from India relate to these low-value products[28] which can be attributed to the relative low levels of investment in technology in line with past trends wherein MSMEs have made limited investments in technology upgradation to continue availing the reservation benefits. As a result, the Indian manufacturers have not been able to establish their presence in relatively higher- value added products/ applications like in agriculture, infrastructure and packaging for processed food. Another key issue relates to non-availability of high-grade raw material in form of polymers to the MSMEs engaged in plastic processing on account of significantly higher level of exports of the same and the resultant reliance on recycled plastic granules.

[27] Source: http://cipet.gov.in/plastics_statics.html
[28] Source: Publication titled "Indian Plastics Industry – Vision 2012" by CRISIL

8.3. Existing technology promotion related policy & institutional support for MSMEs

Key Government departments / agencies / institutions associated with providing technology promotion related policy & institutional level support to MSMEs in the plastics sector have been presented below. It should be noted that this is in addition to the support available through the sectoral schemes & programmes detailed earlier in Section 2.2.

- Department of Chemicals & Petrochemicals (DoCP): DoCP promotes the plastic sector through establishment of plastic parks & requisite ecosystem with requisite state-of-art infrastructure & common facilities to assist the sector move up the value chain. It also supports the value addition to the plastic processing industry through adaptation of R&D measures, achievement of environmentally sustainable growth through innovative methods for waste management, recycling, etc.
- Central Institute of Plastics Engineering & Technology (CIPET): CIPET is engaged in providing technology support with linkage to research & development along with capacity development for the MSMEs in the plastic sector. Currently, CIPET has 15 centres spread across the nation at key plastic clusters with the following support offered to the MSMEs:
    - Assistance in upgrading technology and manufacturing processes in order to successfully face increasing global competition
    - Enhancement of capacity utilization of testing, processing/job working, tool room and CAD/CAM facilities through efficient costing & pricing modes
    - Recycling of plastics and application development of value added recyclates as well as waste management.
    - Design and development of modular prosthetic appliances at commercially competitive costs
    - Mould making with modern CNC machines contributing to import substitutions and saving of foreign exchange

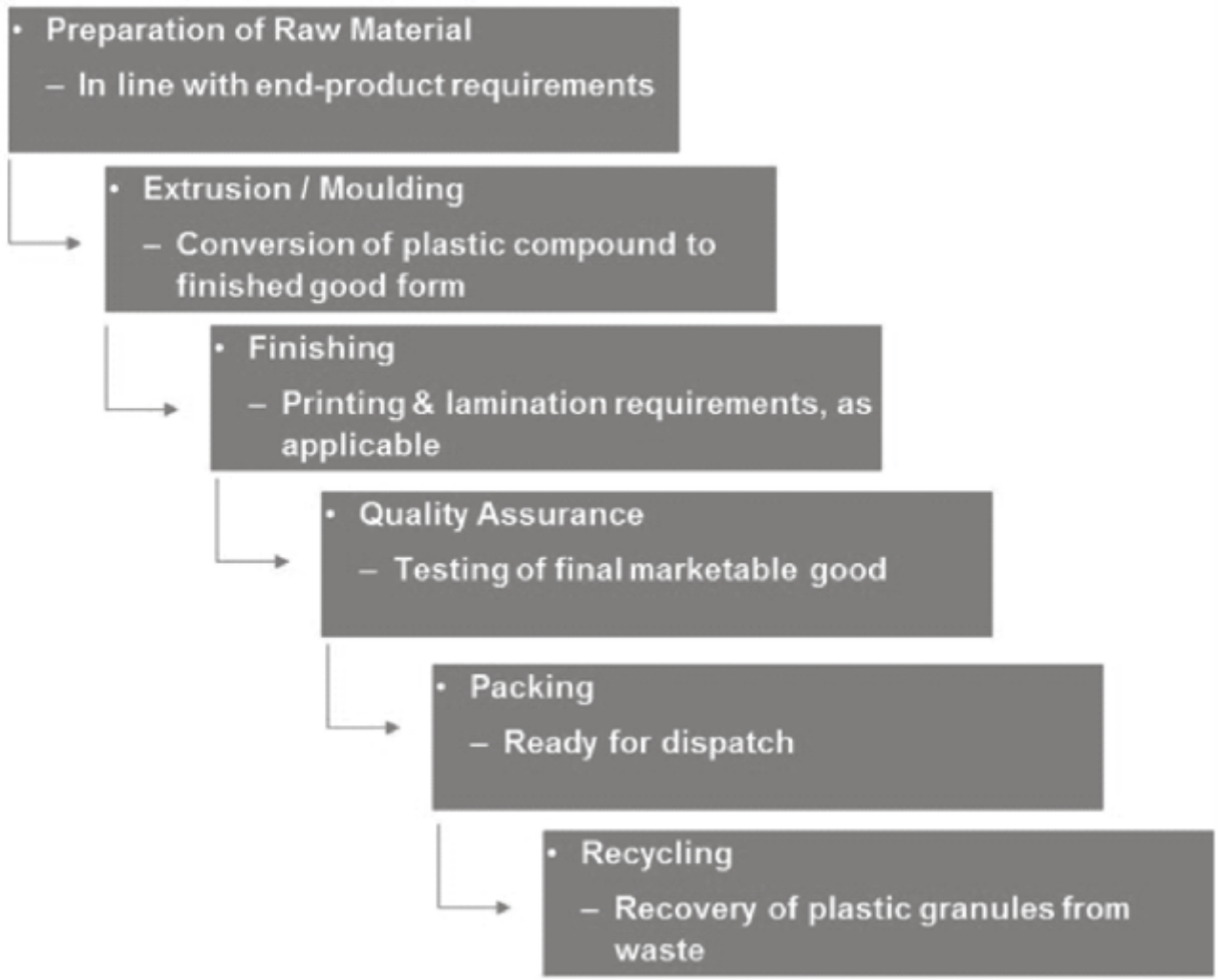
8.4. Findings from Cluster Visit (Ahmedabad)

Gujarat contributes to around 14% of the total plastic production in the country, with around one-fifth of all the production units in the country located in the state.[29] Based on discussions with the local industry association, we understand that the Ahmedabad cluster has around 3000 plastic manufacturing units employing either extrusion / moulding (injection / blow / roto) processes. Further, the cluster in Ahmedabad is well-served with a network of equipment & machinery suppliers and mould & dye manufacturers along with support from institutions like Indo-German Tool Room and CIPET for purposes of facilitating technology dissemination and associated capacity development support.

[29] Source: Publication by iNDTEXTb on Gujarat

8.4.1. Value chain activities in the cluster

The high-level production process associated with the plastic processing units in the Ahmedabad cluster has been presented below. However, it should be noted that depending on specific end-product requirements, the "generic" production chain depicted below may need to be customized.



1. Raw Material Preparation

Different grades of polymers like HDPE, LDPE, LLDPE etc. based on the underlying end-product requirement are melted, pre-mixed with various chemicals & additives to produce the requisite plastic compound which would be moulded / extruded. Testing of the raw materials and additives are conducted on a sample basis to ensure quality control and potential losses at a later stage.

2. Extrusion / Moulding

Depending on the end-product required, the plastic compound is either blown into a bubble to produce the mono / multi-layer film through the extrusion process or molten in specific moulds using injection / roto / blow moulding to get requisite shapes.

3. Finishing

Wherever applicable, the plastic component / product either extruded or moulded could need additional finishing in terms of machining or printing &lamination prior to dispatch to end-customer. While machining is primarily done in-house, select printing & packaging requirements could be out-sourced to smaller players dedicated to the same or retained in-house depending on the quality required.

4. Quality Assurance

Testing of the finished goods is usually limited to post-production testing through in-house testing labs.

5. Packing

Packing for plastic products is dependent on the end-product manufactured, e.g. conversion to rolls / drums in case of packaging materials, packing into woven sacks for domestic household goods like buckets, tubs, bottle caps etc., fiber drums or HDPE containers for sophisticated products like irrigation components, automobile components etc.

6. Recycling

Plastic waste generated during the plastic manufacturing process is either routed to in-house granulators for recovery of plastic granules which can be used for low-end plastic applications or is sold as scrap to dealers who then recover the granules and sell the same to processors engaged in production of low-end plastic products.

8.4.2. Existing level of technology adoption across the value chain

The units in the cluster vary widely in their technology adoption levels, with units ranging from high levels of automation to units with limited technology usage. The existing level of technology and the key observations and issues for the plastic processing units based in the Ahmedabad cluster is given in the table below.

Value chain	Current level of Technology	Key Observations/ Technology improvement opportunity
Mould & die preparation	• Deployment of manually operated lathes & machining centres for production of moulds & dies	• Availability of moulds & dies from local sources of requisite quality and in-time is an area of concern, resulting in dependence on import of the same (primarily from China). • Lack of deployment of automated CNC / VMC machines for production of moulds & dies, which may impact quality

Value chain	Current level of Technology	Key Observations/ Technology improvement opportunity
Raw Material Preparation **Extrusion / Moulding**	• Material handling is done primarily manually • Extrusion: Primarily focused on production of mono layer films with single screw extruder, deployment of automatic sensor & cutter as per user specifications • Injection Moulding: Single screw based moulding machines, adoption of "cold runner" resulting in wastage of plastic during processing, manual process of picking up finished good after moulding	• Lack of automation in raw material handling and movement systems impacts productivity • Extrusion: Demand from the packaging-related user industry for multi-layer films for flexible packaging which requires multiple extruders; adoption of "twin screw" technology provides better precision & strength vis-à-vis single-screw • Injection Moulding: Adoption of "twin screw" technology provides better precision & strength vis-à-vis single-screw; potential for introduction of "hot runner" to reduce plastic wastage during processing; potential for deployment of automated material handling system for picking up finished goods after optimum cooling and use of vacuum based system which prevents wear & tear of tool moulds
Finishing	• Printing & Lamination: Primarily restricted to ability to use 4 colour ink; lamination primarily restricted to ability to use mono layer lamination • Machining: Reliance on manual processes	• Printing: Deployment of 8 colour ink by relatively larger units for printing which can reduce ink consumption, increase output & improve quality • Lamination: Deployment of multi-layer lamination in line with evolving requirements of packaging industry, especially those in flexible packaging for food processing sector • Adoption of second hand imported machinery impacts precision and output, resulting in requirement of non-value added machining
Quality Assurance	• Reliance o n in-house testing facilities	In-house testing facilities, wherever available, may not be of requisite standards as required by the end - customer – could result in higher level of rejections
Packing	• Primary reliance on manual process, with automation for packing limited to extrusion based products for packaging industry	Potential for introduction of automation in the process for counting, sorting and packing finished goods, especially for moulded products
Recycling	• Installation of granulators for recovery of plastic granules which can be re-used, depending on scale of operations of the respective units	Smaller units typically tend to dispose the plastic waste as scrap with the relatively bigger ones deploying granulators

8.4.3. Existing level of clean / green / energy efficient technology adoption

Based on interactions with various key stakeholders including the industry players, industry associations, etc., the key issues pertaining to adoption of clean / green / energy efficient technologies is presented in the table below:-

Parameters	Current level of Technology	Key Observations / Issues
Energy Efficiency	• Deployment of single-screw based technology for ensuring optimum melting of polymers • Adoption of conventional hydraulic injection moulding machines • Deployment of cooling towers to dissipate process heat during injection moulding • Adoption of solvent-based lamination for packaging films	• Potential for adoption of twin screw based technology which ensures much better melt quality leading to higher precision & strength, while reducing the energy consumption levels • Lack of adoption of servo motor in injection moulding process to reduce energy consumption levels • Limited adoption of chillers for heat dissipation during injection moulding which improves quality of finish while reducing energy consumption levels • Potential for adoption of solvent-less lamination technology which saves the extra energy required to dry the solvents used in the alternative solvent-based lamination. Further, adoption of this technology al so reduces the wastage of solvents in the drying process associated with adoption of solvent-based lamination
Plastic waste &recycling	• Deployment of "cold runner" moulds which are relatively less expensive. Leads to wastage in form of production of a runner with the product in each cycle	• Lack of adoption of relatively-expensive "hot runner" moulds which can significantly reduce the production of plastic waste vis-à-vis "cold runner" moulds. • Production of runner in each cycle using "cold runner" results in waste which would need to be fed into granulators for recovery of plastic granules for re-use. However, the quality of such granules decreases with each level of recycling and may be deemed fit only for low-value added applications
Clean / green technology	• Deployment of conventional nitriding process for surface treatment	• Lack of adoption of "eco-friendly" plasma nitriding process for surface treatment which uses non-toxic & precisely controlled gas mixtures vis-à-vis environmentally harmful chemicals like cyanides, ammonia etc. • Lack of awareness about the mechanism for availing carbon credits on deployment of "environment friendly" technologies

9. Paper

The Indian paper industry, accounting for around 2.6% of the global production, has been estimated to have recorded a turnover of ₹ 25,000 Crore while providing direct and indirect employment to around 1.3million and 0.34 million people respectively. This clearly highlights the key role played by the paper industry in the overall industrial growth of the country and its evolution since the commissioning of the first mill at Sreerampur, West Bengal in 1832. With an operating capacity of around 9.32 million tonnes/ annum of paper and paper board and 0.79 million tonnes/ annum of newsprint against an installed capacity of 11.5 million tonnes/ annum which includes 1.39 million tonnes/ annum which lies idle due to closure of 106 units, the Indian paper industry ranks 15th in the list of the top paper producing nations globally.

Though India's per capita paper consumption at around 9.3 kg in 2009-10 is significantly lower than that recorded by China (44 kg), USA (312 kg), Germany (235 kg), UK (215 kg), Japan (249 kg), Sweden (272 kg) and the global average of 50 kg per annum, it is observed that the estimated growth rate for paper consumption at around 9% will outweigh the likely growth in production estimated at around 8.4%. This is likely to result in increased reliance on import of paper products as well as raw materials required to produce paper to meet the growing gap between demand and supply.

9.1. Industry Structure

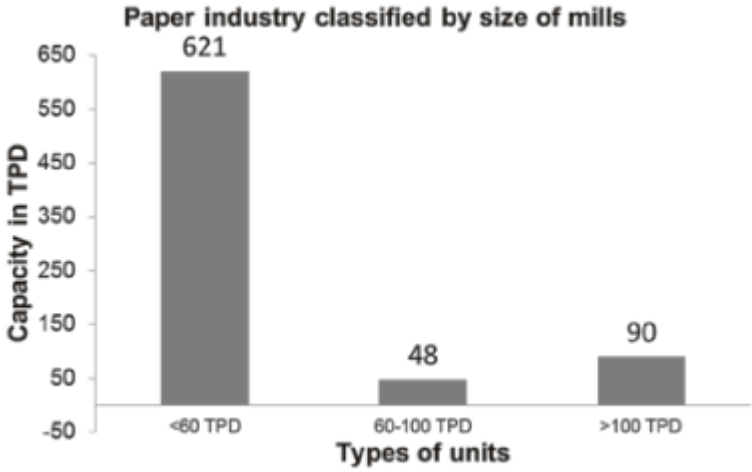
The Indian paper industry comprising around 759 units use a variety of raw materials for production of paper and paper-based products which include wood, bamboo, recycled fibre, bagasse, wheat straw, rice husk etc. The table below details the number of mills, scale of operation and percentage share of mills based on different type of raw materials.

Particulars	Scale of operation (in TPD)	No. of mills	Production share (in %)
Large integrated wood based	250-800 (avg. 350)	19	31
Medium agro based	30-350 (avg.60)	165	22
Small waste paper based	10-500 (avg.30)	575	47
Total		759	100

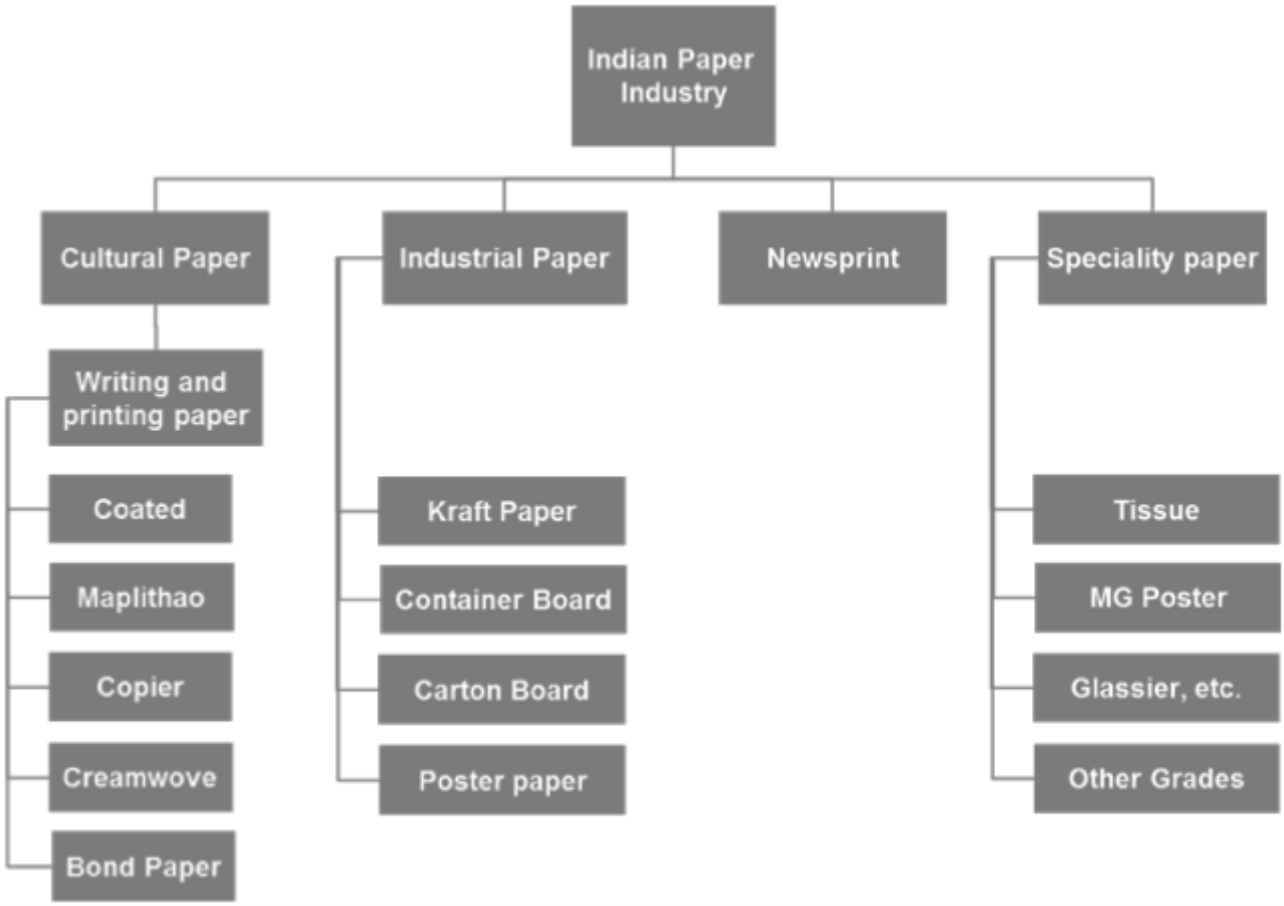
The chart alongside highlights the fact that most of the units in the domestic paper industry are relatively small in size, with around 80% of the units being less than 60 tpd capacity.

It is estimated that around 47% of the capacity is based on recycled fibre, 31% on chemical pulp and balance 22% on agro-residues. These raw materials are first processed into pulp which is

later converted to paper & paper products. Different categories of manufacturers exist in this industry depending on whether they produce i) only paper out of purchased pulp / recycled waste paper (paper mills) or ii) integrated pulp & paper mills which combine the two processes and is the most common in the industry.



Using the above sources of raw material, the Indian paper mills are primarily engaged in the production of the following varieties of paper products, as depicted in the chart below.



The domestic demand of different varieties of paper is 3.8, 4 and 1.8 million tonnes respectively for Writing and Printing Pulp, Packaging Pulp and Newsprint.[33]

[33] Source: IPMA

9.2. MSMEs in the Paper sector

The Indian paper industry is highly fragmented with estimates of around 90% of all paper mills in the country belonging to the SME sector. The relative size of the units can be gauged from the fact that the number of mills of capacity 50,000 tonnes per annum or more is less than 25, which clearly highlights the relatively smaller size of the units vis-à-vis the global standards. There are only 19 wood based mills all of which are large integrated mills. The agro based mills have also enhanced their capacities since it is not economical for these mills to install the chemical recovery system below 80-100 tpd capacity. It is quite important to note that most often mills using agro residues have presently either installed chemical recovery or shifted over to waste paper processing primarily because of the release of spent pulping liquors without any treatment into river/ land by the small and agro based mills earlier resulting in extensive pollution problems.

The SMEs are represented by mostly waste paper based mills. Some of the key issues affecting the SMEs in the paper sector include the lack of sustained supply of raw materials in form of waste paper, higher cost of raw material and energy costs on account of withdrawal of "core sector" status, adoption of obsolete technology impacting product quality etc. The lack of access to raw materials could be attributed to the lack of well-defined system for collection, sorting, grading & utilizing waste paper in India resulting in recovery rate of around 20% vis-à-vis global norms of around 65%. The higher cost of raw materials on account of scarcity of the same in the domestic markets, low technology levels and higher energy costs are impacting the profitability of the SMEs in the paper industry which in turn is impacting their ability to invest in requisite level of technology upgradation to improve productivity and reduce costs associated with production.

Further, the paper industry has signed the Government of India's charter on Corporate Responsibility for Environmental Protection (CREP) to ensure adoption and compliance with stringent environmental & pollution control norms for industrial sectors. Further, pulp & paper industry has been identified as one of the 15 large energy-intensive sectors by National Action Plan on Climate Change and designated consumers (DCs) identified will be required to conform to energy consumption norms specified by the Government. The mills identified as DCs are usually large mills consuming more than 30,000 metric tonne oil equivalent per annum and therefore a large number of the small and medium paper mills are not covered under the EC Act 2001. Hence, through the SMEs in the paper sector do not have target for reduction on energy consumption, they are finding it difficult to make the requisite investments in technology upgradation to ensure saving in energy costs and adherence with environmental-related compliances given the relatively lower scale of operation of these units.

9.3. Existing technology promotion related policy & institutional support for MSMEs

It is observed that other than the sectoral technology promotion related policy & institutional support available to MSMEs detailed in Section 2.2, the specific initiatives aimed at facilitating technology adoption & absorption among the MSME units in pulp and paper sector is primarily

limited to schemes initiated by the Department of Industrial Policy & Promotion, Ministry of Commerce Industry, Government of India.

The initiatives aimed at facilitating technology development and adoption for the SMEs in this sector is mostly addressed by Central Pulp & Paper Research Institute (CPPRI), an autonomous body under the administrative control of DIPP, Ministry of Commerce &Industry. The institute was established in 1980 and is funded through Grants in Aid to carry out the focused R&D support to the paper industry. The objective of the Institute is to promote Global Competitiveness of the Indian Paper Industry & focus its research & scientific work in areas of Quality improvement, Cost competitiveness, Resource conservation and Cleaner Production. It has been supporting research & development with specific focus on i) conservation & upgradation of raw materials, ii) upgradation of quality of paper from locally available fibres, iii) energy management, iv) environment protection, v) human resource development. It also supports the development of the pulp & paper industry through the following interventions:

- Assisting Bureau of Energy Efficiency (BEE) in implementation of the EC Act 2001 and setting targets of energy consumption for the Indian pulp and paper sector
- Supporting the Central Pollution Control Board (CPCB) and various State Pollution Control Board to address the environmental issues faced by the industry
- Development of technologies for the small and medium segment of the industry and facilitating technology transfer through establishment of demo sites highlighting technologies developed
- Development of training curriculum and facilitating capacity development

9.4. Findings from Cluster Visit (Vapi)

Based on the primary interactions with the industry association and other key stakeholders during the field visit, we understand that the Vapi cluster has around 32 paper mills engaged in the production of kraft paper, duplex and newsprint. Further, it is estimated that the total production in the cluster was around 90,000 tonnes per month, with primary contribution from kraft paper being 60,000 tonnes, duplex being 17,000 tonnes and newsprint being around 6,000 tonnes.

Most of the units in this cluster depend on waste paper as the primary raw material, which is either imported or sourced domestically. Though the cluster is well-served by local manufacturers of plant & machinery required for the paper sector, it was observed that select units have made investments in importing state-of-art technology from China and other European countries which is not available with the local technology providers.

One of the key issues impacting the SMEs in this cluster is related to disposal of plastic waste separated from the waste paper, with estimates of daily plastic waste being around 70 tonnes. Further, need for compliance with environment and energy efficiency norms is proving to be a key issue impacting the sustainability of SMEs in Vapi in this sector.

Limited support is available to the SMEs in this cluster for purposes of facilitating technology

upgradation along with associated capacity development support through interactions with institutes like Central Pulp & Paper Research Institute.

9.4.1. Value chain activities in the cluster

As detailed above, most of the units in this cluster are engaged in conversion of waste paper into finished product in form of kraft paper, duplex and newsprint. The high-level value chain for conversion of waste paper to paper products has been detailed in the chart below.

1. Raw Material preparation

As detailed above, the raw material for most of the SMEs in the Vapi cluster is waste paper. This is either imported or sourced from local waste paper merchants who collect the waste paper and then sort into different grades which are suitable for recycling. The waste paper suitable for recycling is then converted into bales which are supplied to the paper mill.

2. Re-pulping

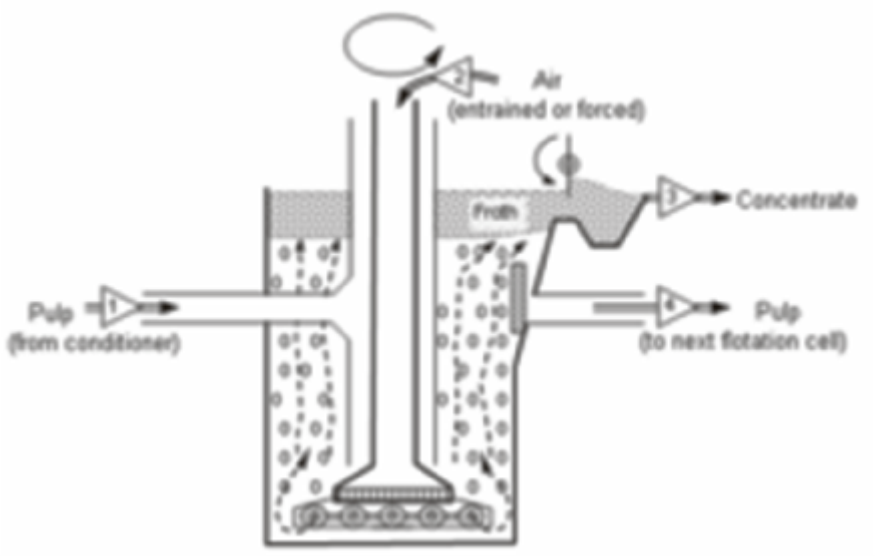
The bales of wood pulp or waste paper are loaded onto a conveyor and fed into a hydra pulper. The hydra pulper has an agitator to disintegrate the waste paper into pulp slurry. The hydra pulpers used are of different types and they are selected based on the consistency of pulp slurry which it will be required to handle. At this stage, due to the action of the hydra pulper the slurry is referred to as the "stock" which will be used for further processing of the fibres. With the completion of the disintegrating process of the waste-paper, the hydra pulper discharges the stock into large storage tanks.

3. Cleaning of stock using turbo-separators, Centricleaners and Screens

Impurities such as wire, plastic, paper clips, staples are removed using turbo-separators while adhesive particles known as "stickies" are removed by screening.

4. Deinking

Deinking is the process associated with removal of printing ink from paper fibers of recycled paper to make deinked pulp. In the deinking stage, the goal is to release and remove the hydrophobic contaminants from the recycled paper which are mostly printing ink and stickies. Of the different processes used for deinking, the most common processes include flotation deinking and washing deinking as detailed below along with others like combined washing and flotation, Dissolved Air Flotation (DAF), etc.



Flotation deinking: In this process, deinking chemicals are added to the pulp and air is blown into the pulp suspension. The chemicals have affinity both to the ink particles and air bubbles, causing them to attach. The air bubbles lift the ink to the surface and form a thick froth that can be removed. Normally the setup is a two stage system with 3/ 4/ 5 flotation cells in series. Flotation deinking is very effective in removing ink particles larger than about 10 μm. The figure alongside shows a deinking cell.

Wash deinking: Wash deinking consists of a washing stage where dispersants are added to wash out the printing inks. When the pulp slurry is dewatered/ thickened, the medium to fine particles are washed out. This process is effective for removing particles smaller than about 30 μm, like water-based inks, fillers, coating particles, fines and micro stickies and is extensively used when making deinked pulp for tissue. The processing equipment are belt filters, pressure belt filters, disk filters and static filters. This stage is much more efficient than normal washing / dewatering stages.

5. Refining

Pulp is refined before making a sheet in order to open-up the fibre bundles and fibrillate them in such a way so that they entangle with one another to form a uniform web. Refining is a mechanical action which by opening up the surface of the fibre, increases the water retention capabilities of pulp, known as freeness of pulp and based on the quality of the product desired, the pulp is refined to the desired freeness level.

6. Fine screen

The pulp after mixing and blending with chemicals and dyes is further cleaned at a very low consistency level (below 1.0%) to remove small particles of dirt using fine screens and centrifugal cleaners. The finally cleaned pulp is then fed to the head box of the paper machine.

7. Mixing

The fibres so recovered in the refining process are transferred to a mixing and blending tank where chemicals and dyes (starch, alum etc.) are added to obtain the required characteristics of the finished paper. Pulp consistency at this stage is reduced below 10% before passing it through another screening process before being fed to the paper making machine.

8. Paper Making

The paper machine which is mainly used by the paper mills of Vapi are either the Machine Glazed (MG) or the Fourdriener Machines (MF). The paper machine typically consists of two parts: i) wet end wherein the fibres are laid down on a wire section or a former for gradual removal of water and ii) dry end wherein mechanical presses and heat from a battery of steam heated drying cylinders, are utilized to get the finished paper. In a MG Machine, a single large diameter steam heated dryer is used to dry the paper web after the presses so that one side of the paper is glazed. In a MF machine, a large number of steam heated cylindrical dryers are used to dry the paper web after it leaves the press section.

Wire Section: The wire section of the paper machine consists of plastic woven mesh on which dilute suspension of fibers called stock lands from the head box. The wire section consists of different draining elements which drain water from the web as it proceeds towards the end of the wire. The stock from the head box drains due to gravity and the action of the table rolls/ foils up to a consistency level of 7-8%. This is followed by a process of draining by the help of vacuum applied through suction boxes. The web finally reaches the end of wire called the couch roll where it is about 20-25% dry.

Press Section: From the wire section the web is transferred to the press section where water is removed by the mechanical action by applying pressure between two rotating heavy rubber covered metallic rolls running with synthetic felts. The press roll may be plain or may have vacuum suction. During pressing, the web consolidates and moisture from paper web enters the felt from where it is taken out though suction.

Dryer Section: This section consists of a number of steam heated hollow cylindrical rolls on which paper is dried by the action of the steam. The paper is conveyed through dryers by the synthetic screen running around the dryers. The number of dryers depends on the production capacity of the paper machine. The paper is dried to about 90-95% by the end of the dryer section.

Size Press: It is situated between the group of pre and post dryers. It consists of two rolls rotating in contact with each other in opposite directions. The solution of starch and other additives

forms a pond between two rolls of the size press through which the paper is passed and a uniform layer of starch is applied over the paper surface. This helps in improving the smoothness and other properties of the paper surface.

Calendar: After passing through the drying section, the paper is passed through the calendar which consists of a stack of polished iron rollers mounted one above the other. The function of the calendar is to consolidate and polish or glaze the surface of the paper, giving the same effect as ironing.

Rewinding: After calendaring, the paper now comes off the machine ready for reeling up into large reels which are either cut into sheets or slit into smaller reels according to the customer requirements. The finished reels or sheets are then packed for dispatch

9.4.2. Existing level of technology adoption across the value chain

The units in the cluster vary widely in their technology adoption levels, with units ranging from high levels of automation to units with limited technology usage. The existing level of technology and the key observations and issues for the paper units based in the Vapi cluster is given in the table below.

Value chain	Current level of Technology	Key Observations/ Technology improvement opportunity
Re-pulping	• Use of low consistency hydra pulpers, mostly from domestic suppliers, resulting in low cleaning efficiency & high water and energy consumption by the equipment	• Potential for deployment of medium & high consistency hydra pulper to reduce water consumption, damage of fibres and energy consumption.
Cleaning of stock using turbo-separators, Centri-cleaners and Screens	• Domestic equipment with low cleaning efficiency and high water & energy consumption.	• Higher removal of contaminants, impurities, etc. with less water and energy consumption by using state of art modern turbo separators
Refining	• Use of disc refining operating at low consistency (2-3%) resulting in high energy consumption and poor fiber quality development due to high fibre cutting	• Potential for deployment of conflow type refiners resulting in less energy consumption and better fiber quality development
Fine screen	• Use of indigenous single stage hole type basket in screening system resulting in poor cleaning efficiency and high water consumption	• Adoption of slotted type screening system in cascade arrangement for better screening efficiency
Mixing	• Manually operated valves in blending and mixing resulting in disproportional mixing giving variation in quality of product	• Automatic blending & mixing arrangements resulting in uniform quality.

Value chain	Current level of Technology	Key Observations/ Technology improvement opportunity
Paper Making **Wire section** **Press section** **Dryer section** **Size Press** **Calendar** **Rewinding**	• Open Head box resulting in grammage and caliper variation. Limits machine speed • Straight, open plain press with speed and moisture limitations resulting in low production rate, and higher energy consumption in dryer section • Live steam heated dryers with poor steam condensate removal system	• Closed pressurized head-box for better regulation of and high speed of machine • Double felted, blind drilled / vacuum suction process with high speed, high dryers capability resulting in high productivity and less energy consumption • Use of flash steam in dryers by cascade heating arrangement resulting in steam economy and use of better condensate removal system. Deployment of shoe-press machines by large organized players to squeeze out water from wet fibre, which in turn will reduce the consumption of steam in drying the paper in the drying section. Positive impact on environment with reduced consumption of fuel in boiler to produce steam
	• Open or semi open type hood without pocket ventilation system and heat recovery system • Use of multi-nip calendars resulting in reduced paper bulk and machine speed limitations • Use of line shaft drive with gear box resulting in high power consumption and low machine speed • Use of manually operated rewinders & cutters resulting in poor reel/ sheet quality and higher level of rejections	• Closed hood with pocket ventilation and heat recovery system resulting in productivity enhancement and steam saving • Adoption of single nip calendar with required properties at high machine speed • Adoption of A/c sectional drive for enhanced speed & low power consumption • Adoption of automated rewinders and cutters producing quality reels & sheet with less rejection
Testing	• Primarily restricted to post-production testing with limited in process testing	• Potential for deployment of online process quality monitoring technology to track level of moisture, thickness, GSM etc. and preventing rejections at end of production process

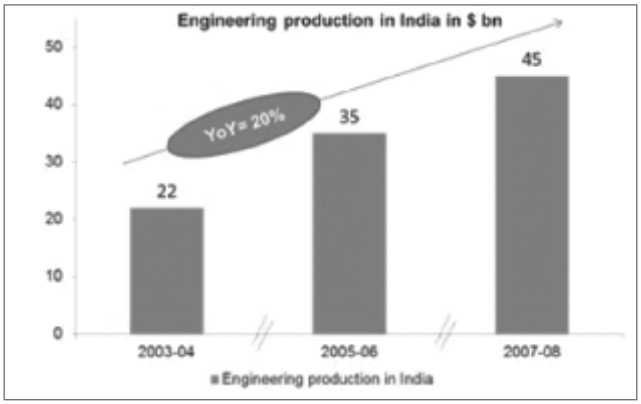
9.4.3. Existing level of clean / green / energy efficient technology adoption

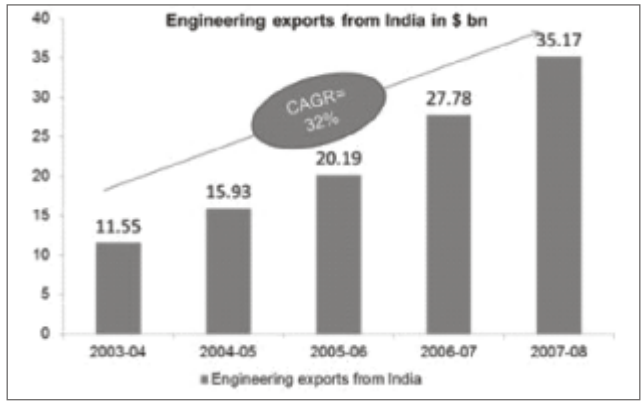
Based on interactions with various key stakeholders including the industry players, industry associations, etc., the key issues pertaining to adoption of clean / green / energy efficient technologies is presented in the table below:-

Parameters	Current level of Technology	Key Observations / Issues
Energy Efficiency	• Adoption of conventional drives in paper processing • Use of coal as the primary fuel for boiler operations • Adoption of conventional steam-heated drying cylinders for drying • Low efficiency boilers producing low pressure steam and high emissions.	• Potential for energy consumption reduction through deployment of a/c variable drives • Potential for using gas based boilers, subject to detailed cost-benefit analysis and successful pilot demonstration of savings • Potential for adoption of shoe-press machines to squeeze out water from wet fibre, which in turn will reduce the consumption of steam in drying the paper in the drying section. Positive impact on environment with reduced consumption of fuel in boiler to produce steam • Use of high pressure boilers leading to co-generation of power.
Solid waste disposal	• Most of the units do not have facilities for processing of solid waste resulting in sale as scrap to downstream processors	• Around 55% of all dry waste is plastic which can be used in the following manner: i) burnt in incinerators to generate steam for use in boilers / power generation for sale to grid, ii) recovery of plastic granules through grinding of plastic waste in granulators which can be mixed with virgin polymer for low-value added plastic applications, iii) palletization of plastic waste in form of bullets for supply to cement industry for burning as fuel in kilns
Air pollution	• Primary dependence on Back Filters which require significantly high level of maintenance	• Adoption of electrostatic precipitator system (ECPS), which is currently only mandatory for all boilers with a capacity greater than 10 tonnes
Water Treatment & Recycling	• Most of the units do not have facilities for treatment of water for reuse in the manufacturing process	• Select units have managed to achieve very high levels of water recycling for use in manufacturing process through effluent treatment systems. Further, potential exists for use of anaerobic water treatment process to convert solid waste to gas which can be used as an input to the boiler • Potential for establishment of Common Effluent Treatment Plants at a cluster level with financing support in order to facilitate adherence to applicable regulatory norms & regulations

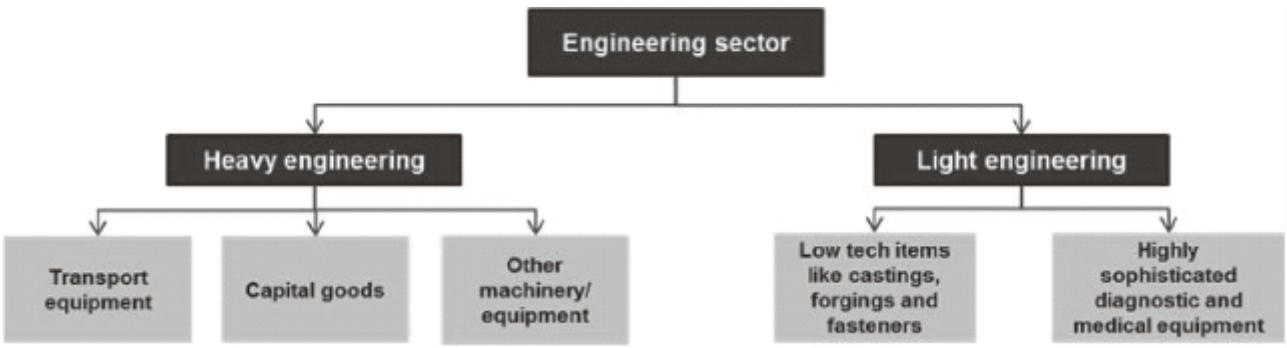
10. Engineering

With a size of around $ 45 billion[34] in FY08, the engineering sector is one of the largest segments of Indian industry which includes products like machinery & instruments, castings, forgings, fasteners, automotive components etc. The sector employs over 4 million skilled and semi-skilled workers directly or indirectly.





In recent years, India is being preferred by global manufacturing companies as an outsourcing destination due to its lower labour costs, good designing capabilities and engineering talent. This has contributed to a growing acceptance of Indian engineering goods in overseas markets with the result that exports have been growing at a CAGR of 32%[35] from FY03 to FY08 as depicted in the chart above. The growing demand for exports coupled with a growth in the domestic markets is driving high capacity utilization across the sector. This has also resulted in capacity additions across the sector worth around $ 35 bn as of January 2007. The sector can be categorized into heavy engineering and light engineering industry as given in the chart below.



[34] Source: Report by Italian Trade Commission titled "Engineering Sector- India"
[35] Source: IBEF report titled "Engineering sector in India"

The heavy engineering constitutes over 80%[36] of the total industry and comprises large units which produce high-value products using high end technology. The high capital investment required poses a major entry barrier and thus is dominated by bigger players such as Bharat Earth Movers Limited (BEML), Siemens, Cummins India, ABB, L&T, Bharat Heavy Electricals Ltd. (BHEL).

Industry segment	No. of units
Heavy Engineering	
Heavy electrical	144
Heavy engineering and machine tools	443
Automotive	617
Light Engineering	
Low technology products	826
High technology products	673

Source: IBEF report titled "Engineering" April 2010

The light engineering industry on the other hand contributes to the remaining 20% of the total industry with an estimated size of $ 7 bn[37] in 2002-03. Further, it is estimated that exports from light engineering units account for 40% of the total engineering exports. The light engineering industry is a key industry associated with facilitating industrial growth in the country on account of it serving as an intermediate industry which feeds a variety of end-user industries such as power, mining, oil and gas, consumer goods, automotive and the heavy engineering sector.

10.1. Industry Structure

The light engineering segment mostly manufactures low-value products using medium to low-end technology. Due to the lower requirement of capital and technology, the segment is dominated by MSMEs and the unorganized sector with limited presence of large organized players.

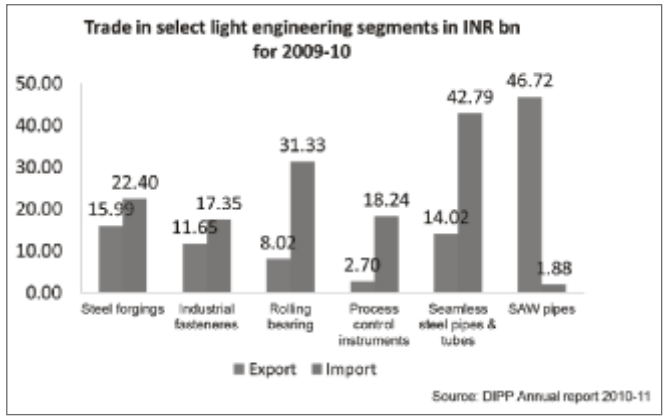
The sector can be classified according to the different types of products along with their application, which are manufactured by a combination of the key processes like forging, casting, sheet metal, fabrication, machining etc.

- Steel Forgings- Involves converting a plastic state of metal to a desired shape by application of pressure. The key driver of the forging industry is the automobile industry which accounts for 65% of the total demand. In addition to demand from the automobile sector, forging related demand is derived from railways, defense, cement, steel and other engineering industries.
- Industrial fasteners- The fasteners industry which include nuts, bolts, studs, rivets and screws can be classified as either high tensile or mild steel fasteners. Fasteners are used in almost all engineering and chemical industries with the automobile industry accounting for a majority of the demand.
- Rolling bearing - Essential components in the rotating parts of virtually all machines such as automobiles, electric motors, diesel engines, industrial machinery, etc. with the automobile industry accounting for around 35% of the total demand. Indian

[36] Source: IBEF report titled "Engineering- Market & Opportunities"
[37] Source: Report by UNIDO on "Indian manufacturing industry: technology status & prospects"

manufacturers meet 70% of the domestic demand for general purpose bearings. Special purpose bearings are mostly imported because the volume required is low and it requires higher capital investments.

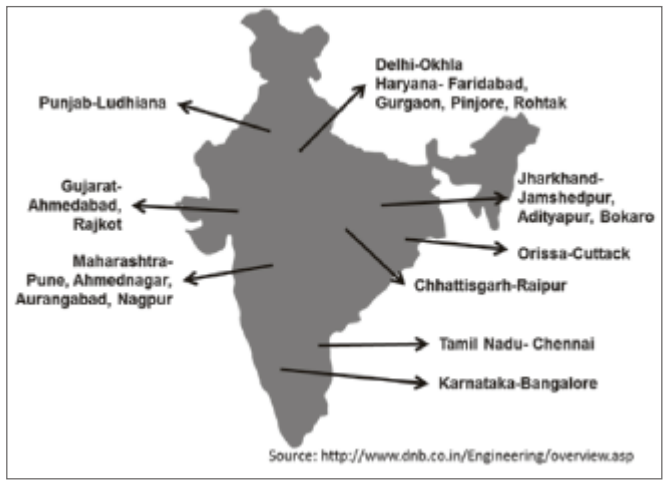
- Process control instruments- Includes a wide range of products for monitoring and measuring of physical, chemical and biological properties such as pressure, humidity, level, flow, temperature, etc.
- Seamless steel pipes and tubes- Application in various industries such as aircrafts, oil and gas, steam boilers, chemical, etc.
- Submerged arc welded (SAW) steel pipes & tubes- Estimated presence of 123 units engaged in the manufacture of welded steel pipes and tubes in the organized sector. Total installed capacity in the country in 2006-07 was around 0.65 mn tonnes. The demand for this product is driven primarily by the transportation of oil, gas and water.



The export and import figures for these major segments of light engineering are provided in the adjoining chart.

Further, there are specialized products manufactured using a combination of the above-mentioned light engineering related manufacturing processes, which are as detailed below.

- Electrical resistance welded (ERW) steel pipes and tubes which are used in fencing, lining pipes, scaffolding, water and gas conveyance, structural and engineering purposes on account of high corrosion resistance, deformability strength & toughness.
- Bicycle components
- Medical and surgical instruments which includes a wide range of equipment and apparatus such as dental equipment, electro-medical apparatus, orthopedic appliances, x-ray machines, etc. which find application in diagnosis, therapy, patient monitoring related areas of healthcare system. In recent years, there has been a growing demand for such equipment and apparatus driven by growing health awareness, growing medical tourism and rising income levels. Majority of the demand is met by imports with only about 40% of the demand being met by domestic manufacturers.



The light engineering industry is well distributed across the country. A key feature of the industry is that since it produces intermediate products for capital goods industry and OEMs, clusters usually develop around large units with the MSMEs therein

serving as ancillary suppliers. The key light engineering clusters in the country which have evolved over a period of time are highlighted in the adjoining chart.

10.2. MSMEs in the Engineering sector

The light engineering sector is dominated by MSMEs with the primary reason for the same being the reservation policy adopted by the Government for the small scale units wherein select products were reserved for exclusive production by the small scale sector only. While this policy supported the development of the MSME sector but incentives among MSMEs to invest in technology upgradation for moving to higher-value added products could have enhanced the impact. As a result, most of the MSMEs in this sector are associated with production of low-value added products using medium to low-end technology as detailed below.

- Steel forging industry- MSMEs dominate this industry segment with presence of around 14,000 units, of which only 198 units were registered.[38]
- Industrial Fasteners- Presence of MSMEs is restricted to the manufacture of mild steel fasteners as the same is reserved for exclusive production by them. It should be noted that the manufacture of high tensile fasteners requires superior technology and is primarily restricted to larger organized sector players with the requisite financial ability to make investments in high-end technology.
- Rolling bearing industry- This segment is dominated by the MSMEs with the medium sized enterprises engaged in manufacture of ball & roller bearings catering primarily to the requirement of Original Equipment Manufacturers (OEMs) and the micro & smaller units engaged in production of low quality small bearings catering to the replacement markets
- Process control instruments- Significant presence of the units from the MSME sector in addition to presence of larger organized sector players who have adopted state-of-art technology vis-à-vis relatively outdated technology adopted by the MSME units
- Steel pipes & tubes- Significant number of steel pipes & tubes production units are in MSME sector.
- Bicycle components- Majority of bicycle parts are manufactured by MSMEs since most of the components other than free wheels and single piece hubs are reserved for the micro and small sector
- Medical and surgical instruments- Estimated presence of around 1900 MSME units in the country engaged in manufacture of medical, surgical and orthopedic appliances.

With the policy shift in terms of delicensing the respective industries to remove / reduce the level of reservations, key products in the engineering sector like process control instruments, seamless, ERW and SAW steel pipes and tubes, steel forgings and bicycles have been delicensed. This is increasingly resulting in entry of larger organized players with state-of-art technology on account of which MSMEs are being increasingly forced to invest in technology upgradation in order to maintain their competitiveness.

[38] Source: Quick results: 4th All India MSME census

10.3. Existing technology promotion related policy & institutional support for MSMEs

Key Government departments / agencies / institutions associated with providing technology promotion related policy & institutional level support to MSMEs in the engineering sector have been presented below. It should be noted that this is in addition to the support available through the sectoral schemes & programmes detailed earlier in Section 2.2.

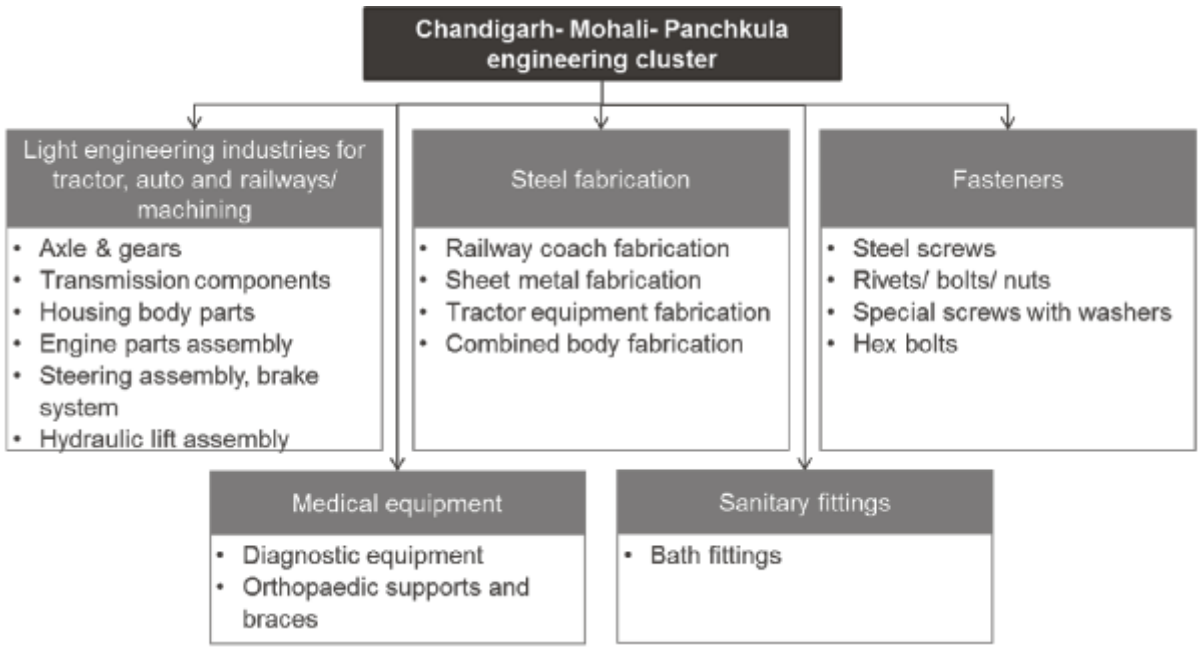
- Department of Industrial Policy & Promotion (DIPP) under the administrative control of Ministry of Commerce & Industry is associated with formulation and implementation of promotional and developmental measures for growth of all industrial sectors including the light engineering industry. Further, DIPP is involved in framing and administering overall industrial policy, policy incentives, FDI policy and promoting FDI inflow into the respective industrial sectors, including light engineering
- Central Manufacturing Technology Institute (CMTI): The CMTI was set up by the Government of India in collaboration with Institute for Machine Tools and Production Engineering (VUOSO) of erstwhile Czechoslovakia in 1962 as a R&D organization for machine tools and production engineering. Besides conducting R&D in manufacturing technology, CMTI presently supports various industries in the adoption and absorption of technology through technical assistance, assistance in designing, prototyping, testing and other related services
- Central Scientific Instruments Organization (CISO), a CSIR laboratory under the administrative control of DSIR, is responsible for the development of scientific instrumentation in the country through requisite R&D support. Besides conducting R&D on instrumentation, it also provides services related to designing of scientific and industrial instruments, components and instrument systems. Further, it also provides technical assistance to industries by fabricating, testing, calibrating, analyzing and performing evaluation of instruments used by the industry

10.4. Findings from Cluster Visit (Chandigarh – Panchkula - Mohali)

The tricity engineering cluster of Chandigarh- Mohali- Panchkula cluster is one of the leading light engineering clusters in the country with a turnover of ₹ 10.28 billion and providing employment to more than 21,000 skilled and semi-skilled workers directly.

The units in this engineering cluster primarily manufacture steel forgings, industrial fasteners along with production of intermediate components for the railways and automotive & tractor industry in the vicinity such as the tractor units of Mahindra & Mahindra, Sonalika, Eicher and HMT. Other than these key products, select units in this cluster are also engaged in the production of medical & diagnostic equipments and sanitary fittings. Based on the range of products manufactured, the key segments served by cluster units have been detailed as below.

Limited support is available to the SMEs in this cluster for purposes of facilitating technology upgradation along with associated capacity development support through institutes Central Scientific Instruments Organization (CISO) and it is in the geographic vicinity.



10.4.1. Value chain activities in the cluster

This section details the different value chain activities for the respective category of units based in this engineering cluster.

Light engineering for tractor/ auto/ railway components

This cluster segment is dominated by the micro and small units accounting for 95% of the units as can be noted from the table alongside.

Most of the units in the cluster source either forged metal, castings or sheet metal from units located in geographic proximity and carry out either fabrication or further machining as per specific product requirements. The primary machining processes carried out include turning, milling and drilling.

- Turning operations: Rotation of the work piece against the cutting tool.
- Milling operations: Rotation of the cutting tool to bring cutting edges to bear against the work piece.
- Drilling operations: Production / refining of holes by bringing a rotating cutter into contact with the work piece.
- Miscellaneous operations including shaping, planning, sawing, etc. which are carried out on machine tools

Type of units	No. of units
	Light engineering for Tractor/ auto/ Railway components
Micro units	893
Small units	805
Medium units	89
Total	1787

Source: http://chandigarhbds.com/a/cluster/vital-statistics

Steel fabrication

This cluster segment is dominated by the micro and small units with only 5% of the units being medium units. The units in this cluster segment supply sheet metal products such as railway coach water tanks, passenger coach

partitions and dividers, etc. primarily to the coach and wagon factory of the Indian railways at Kapurthala. These structures are produced through key processes including cutting, bending and assembling structural steel or sheet metal.

- Cutting may involve any of the activities of sawing, shearing, chiseling and torching.
- Bending is carried out by hammering and pressing
- Assembling is carried out by using welding, riveting, adhesives or fasteners.
- Coating is carried out to reduce the effect of corrosion and ensure longevity of the product

Type of units	No. of units
	Steel fabrication
Micro units	148
Small units	108
Medium units	13
Total	269

Source: http://chandigarhbds.com/a/cluster/vital-statistics

Fasteners

Around 60% of all units producing fasteners in this cluster are micro units as is evident from the adjoining chart. The units in this cluster manufacture screws, rivets, nuts, bolts, special screws and hex bolts.

Screws and bolts are made from wire or round bar stock which are used for larger screw. The wire or rod is cut to the required length for the type of screw made which is called a blank. This stage is followed by the following key operations related to the manufacture of screws and bolts:

- Heading: The operation in which the head of the screw is produced in requisite shape
- Thread rolling: The threads are either rolled or cut on the body
- Coating is carried out to reduce the effect of corrosion and ensure longevity of the product

Type of units	No. of units
	Fasteners
Micro units	213
Small units	124
Medium units	17
Total	354

Source: http://chandigarhbds.com/a/cluster/vital-statistics

Sanitary fittings

There are about 250 units in the cluster which manufacture sanitary fittings such as single lever faucets, quarter turn bath fittings, flushing systems, bath accessories, showers, etc. The key processes involved in the manufacture of these fittings include casting, machining, grinding, polishing, electroplating and assembling.

- Casting: The casting of the required piece is prepared by pouring liquid material into a mould which has a hollow cavity of the desired shape and then allowed to solidify
- Machining: Various turning, milling and drilling operations are carried out on the castings produced
- Grinding: Work piece is moved in a plane while a grinding wheel contacts the surface to remove minute materials creating a flat surface
- Polishing & electroplating: The parts which would come in contact with water need to be treated to make them resistant to corrosion. Usually chrome is used to achieve this and is electroplated by first applying a layer of nickel followed by a thin layer of chrome. For brass plating, a clear polymer coating is applied. For white and other colour finishes, a polymer added with the desired colour is sprayed onto the faucet in an electrically charged environment.

- Assembling: The different parts and components are assembled and packed for delivery

A number of these activities are outsourced to units which specialize in the individual activities.

Medical equipment

There are a number of medical, surgical and orthopedic equipment manufacturing units in this cluster. These could include i) orthopedic equipments which are a mix of production of medical textiles, fabrication and assembling or ii) medical devices like X-ray machines which involve fabrication of the outer frame and the assembling of the X-ray unit along with the electronic control panel unit. Thus the value chain of the medical equipment involves a number of engineering processes primarily related to fabrication and assembling. Select areas of production related to production of electronic circuit boards & associated components are primarily outsourced.

10.4.2. Existing level of technology adoption across the value chain

For the cluster segment related to light engineering tractor/ auto/ railways components, the current level of technology and key observations and issues related to the same are given in the table below.

Value chain	Current level of Technology	Key Observations/ Technology improvement opportunity
Turning	• Primarily deployment of lathe machines, with select units upgrading to Computer Numerical Control (CNC) machines/ Vertical Machining Centre (VMC)	• CNCs/ VMCs provide the following benefits over the conventional technologies of lathes, mills and drill presses: o High part accuracy and consistency o Fast & consistent through -put of finished goods o Lower cost per unit product, subject to requisite scale of operations Although the units are aware of the benefits of upgrading to CNCs or VMCs, the initial installation of these machines requires substantial investment. Presently, a number of units do not have the order sizes to justify the initial investment and upgradation to CNCs/VMCs
Milling	• Primarily dependence on horizontal / vertical milling machines, with select units upgrading to CNCs/ VMCs	
Drilling	• Primarily reliance on drill presses with use-based deployment of lathes or milling machines. Shift observed towards deployment of CNCs/ VMCs	
Miscellaneous operations	• Different machine tools are used and even lathes and mills can be used. However, a lot of units are upgrading to CNCs/ VMCs	

For the cluster segment related to steel fabrication, the current level of technology and the key observations and issues related to the same are given in the table below.

Value chain	Current level of Technology	Key Observations/ Technology improvement opportunity
Cutting	• Mainly reliant on manual cutting operations like sawing, chiseling, shearing • Material handling done primarily manually	• Potential for deployment of CNC laser/ plasma/ flame cutting, water-jet cutting machine which provides greater cut quality & accuracy. However, the high upfront capital investment makes the adoption of the same difficult for units not having the requisite order book position to justify the investment • Loading sheets onto the cutting bed can be done through automated vacuum loading systems
Bending	• Primarily use of rolling machines	• Potential for adoption of CNC machine bending which provides a high dimensional accuracy & design flexibility. However, the high upfront capital investment makes the adoption of the same difficult for units not having the requisite order book position to justify the investment
Assembling	• Different types of welding is used such as arc welding, CO_2 welding, metal inert gas (MIG) welding, tungsten inert gas (TIG) welding	
Coating	• Zinc coating and power coating is used	

For the cluster segment related to fasteners, the current level of technology and the key observations and issues related to the same are given in the table below.

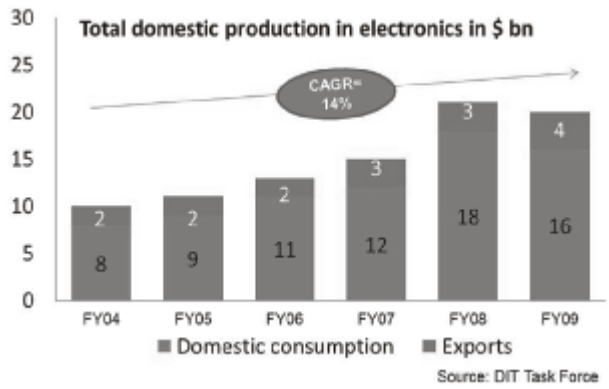
Value chain	Current level of Technology	Key Observations/ Technology improvement opportunity
Heading	• Use of hot forging only for higher diameter of bolts with lower diameter bolts requiring cold forging process	• Most of the units in the cluster have imported refurbished machinery or indigenously developed machinery which is cost-effective but usually outdated and not the best-in-class. Potential for adoption of modern multi-station bolt maker & nut former machine which is not readily available in the country • Potential for deployment of automatic assemblers of nut and bolts to reduce level of manual intervention
Thread rolling	• Deployment of roll threading and cutting machines	
Nut preparation	• Deployment of lathes, milling and drilling machines	
Coating	• Hot-dip galvanizing or blackening is applied to prevent corrosion	
Assembly	• Primarily done manually with select units installing automatic machines for assembling nuts and bolts	

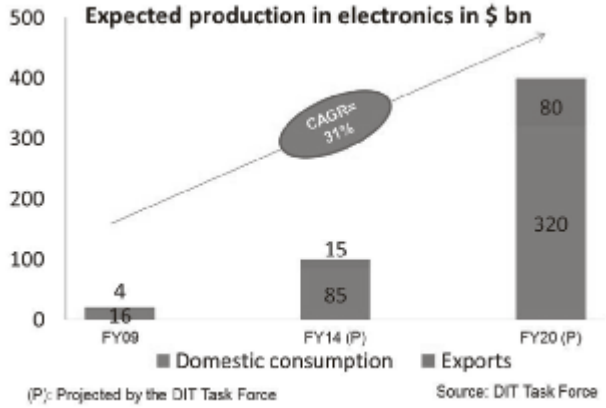
For the cluster segment related to sanitary fittings, the current level of technology and the key observations and issues related to the same are given in the table below.

Value chain	Current level of Technology	Key Observations/ Technology improvement opportunity
Casting	• The cluster units source the castings from other vendors	There is a need for low pressure die casting (LPDC) products which would provide the units with a better range of shapes of components along with better quality finish
Machining	• Different machine tools are used including lathes, mills, etc.	Potential for adoption of CNCs/ VMCs which provides a high dimensional accuracy & design flexibility. However , the high upfront capital investment makes the adoption of the same difficult for units not having the requisite order book position to justify the investment
Grinding	• Conventional grinding machines are used	
Polishing & coating	• Electroplating with diff erent types of finishes such as gold and chrome plating, satin finishes etc.	
Assembling	• Mostly done manually	Scope for automating the process of assembly of components

11. Electronics

The Indian electronics industry is one of the leading industrial sectors of the country. Driven by a steadily growing economy, government's focus and spending on e-governance, increasing buying power of the people and changing lifestyles, the consumption of electronic gadgets and devices has been growing at a CAGR of 14% for the period FY04 to FY09 as depicted in the chart below. However on the global stage, India accounted for a miniscule 1.2% of the $ 1.75 trillion global electronics industry in 2009 with a ranking of 29th in the World in terms of production.[39] In comparison, China with a share of 14.6% of the global electronics industry ranked 1st in the World in terms of production. Further, it is observed that China's electronics industry contributed to 12.7% of the GDP with the Indian electronics industry contributing to only 1.7% of the GDP, thereby highlighting the growth potential for this industry in India.





The scope for further growth of the electronics industry is also established by the fact that in 2009, India's demand for electronic goods was $ 45 billion whereas the supply from domestic sources for local consumption was valued at $ 16 billion. This resulted in almost 65% of the demand being fulfilled by imports primarily from China. The huge gap in the demand and supply for electronic products provides a significant opportunity for India to become an electronics hardware manufacturing hub to meet its domestic and global requirements.

In order to address this opportunity, the Department of Information Technology (DIT) constituted a Task Force to study the electronics industry and develop a roadmap for its growth and development. The Task Force in its report has set a growth target of 31% CAGR for the electronics industry for the period 2009-2020 as depicted in the chart above. According to estimates, this would effectively result in a production of around $ 400 bn by 2020 with exports of $ 80 bn of electronic goods. Projections suggest that this would translate to the industry

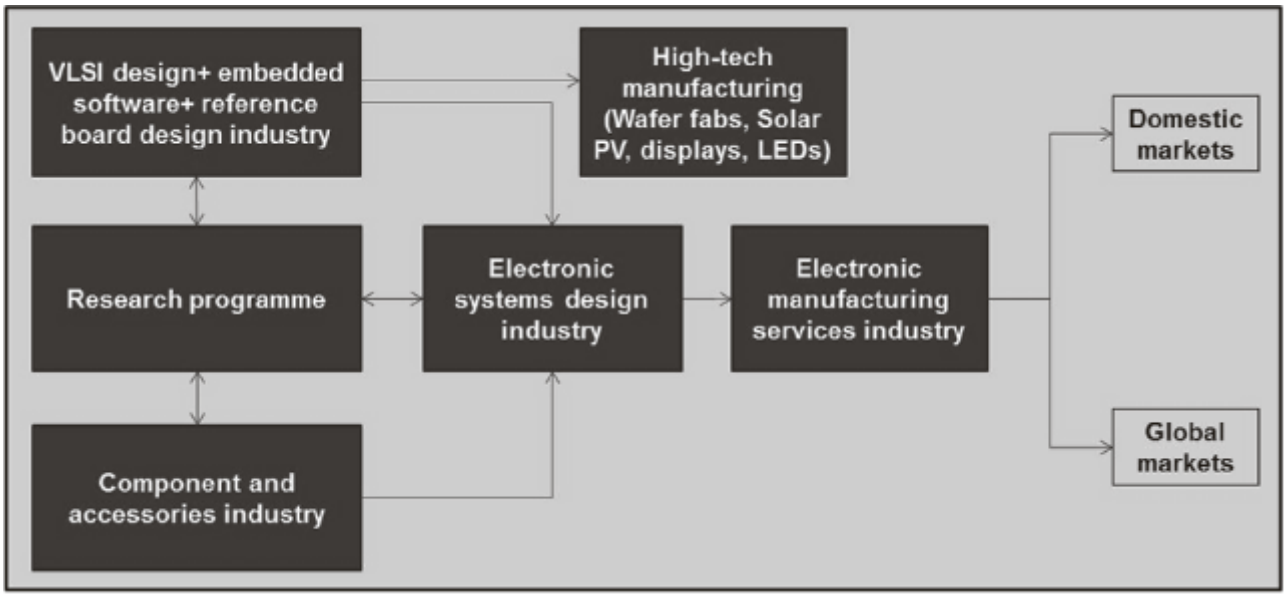
[39] Source: http://www.indianmirror.com/indian-industries/electronics.html

contributing around 20% to the GDP. It would also provide a scope for increase in employment to 27.8 million in 2020 from the present level of 4.4 million.[40]

One of the key recommendations of the Task Force report was on increasing the value addition by the Indian electronic units in order to distinguish themselves from countries like China and Taiwan which have already progressed and established themselves in the high-volume products. In order to achieve the target of domestic production of $ 400 bn by 2020, the Task Force has set a target value addition of 30-40% which would primarily be driven through technology upgradation, innovative product design and investment in R&D.

11.1. Industry Structure

The key stakeholders associated with the electronics industry have been depicted in the chart below:--



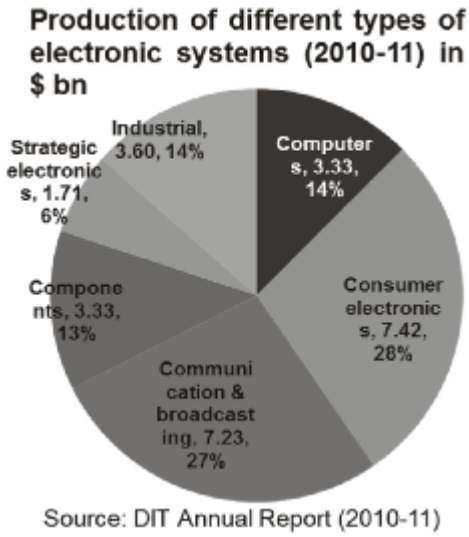
As detailed in the chart above, the stakeholders involved along with their respective role has been detailed below:-

- Semiconductor design which includes VLSI design, embedded software, reference board design industry etc.
- High-tech manufacturing which includes wafer fabs for semiconductors, solar photovoltaic, displays, LEDs, etc.
- Electronic manufacturing services (EMS) which includes the activities of designing, testing, manufacturing, distribution and servicing of electronic components and assemblies for original equipment manufacturers. It is also referred to as Electronic Contract manufacturing
- Electronic systems which cover a wide array of products from gadgets sold directly to consumers to devices which are critical to systems used in communication, defense,

[40] Source: DIT Task Force report titled " Electronic systems, design and manufacturing ecosystem"

telecom, process control and automation. Depending on the area of application and the user, the electronics systems can be broadly categorized into the following:-

- Consumer electronics- It is the largest segment in electronics and has been growing steadily fuelled by a trend of convergence of information, communication and entertainment, changing lifestyles, higher disposable incomes and greater affordability. This segment includes colour television (LCD TVs, CRT TVs), DVD players, home theatre systems, microwave ovens, etc.



Source: DIT Annual Report (2010-11)

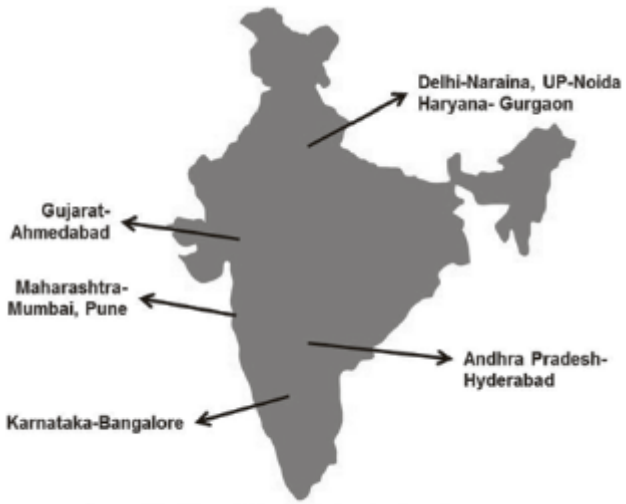
- Communication & broadcasting equipment- Includes communication technology (wireless and wire-line) and broadcasting channels and systems of radio and TV
- Computers & peripherals- Includes Personal Computers (PCs), digital notebooks, desktop computers, servers. India is one of the fastest growing markets for computer hardware driven by a growing demand from the banking, financial services, insurance, telecom, manufacturing industries and e-governance
- Components- Includes semiconductor, capacitors, resistors, picture tubes, x-ray tubes, etc. and caters to the needs of the consumer electronics, telecom, communication and IT segments.
- Strategic electronics- Includes satellite based communication, navigation and surveillance systems, radars, navigational aids, sonar, underwater electronic systems, disaster management systems, etc. This segment mainly caters to the requirements of India's defense and paramilitary forces.
- Industrial electronics- Includes hardware technologies and systems with built-in software for application in various industries. Although the country has a strong base of conceptualizing and commissioning such systems, the sector is largely dependent on imports of critical hardware and associated software

According to the report of the Task Force, the potential of each segment in terms of value addition it requires, its contribution to the economy and future growth potential has been depicted in the table below.

Industry segment	Size of industry in $ bn	Value addition required	Employability potential	Contribution to GDP	Growth potential	Target for 2020 in $ bn
Semiconductor design	9.0	High	Low	Medium to High (Long term)	Very high	58.2
High-tech manufacturing	0.6	Medium	Medium	Medium to High (Long term)	Long term impact	22.6
Electronic components	2.1	Low	Medium	Low	Very high	3.4
EMS/ Assembly	1.0	Low	High	Low	Medium	2.3
Electronic systems design	27.9	High	Medium	High	Very high	233.5

India's electronics industry is concentrated in 3 main regions- the Northern region around Delhi, the western region around Mumbai and Pune and the Southern region encompassing Hyderabad, Chennai and Bangalore. The share of the production for these regions along with key electronics clusters in the country is given in the adjoining charts.

Region	Share in production
Northern region around Delhi	37%
Western region around Mumbai & Pune	25%
Southern region around Hyderabad, Chennai and Bangalore	32%



Source: http://www.dnb.co.in/Engineering/overview.asp

11.2. MSMEs in the Electronics sector

In India, there are more than 35,000 MSME units are engaged in the electronics industry with an output of $ 1.9 billion. Among these, the breakup of the units according to the type of products manufactured and the corresponding gross output is given in the table alongside.

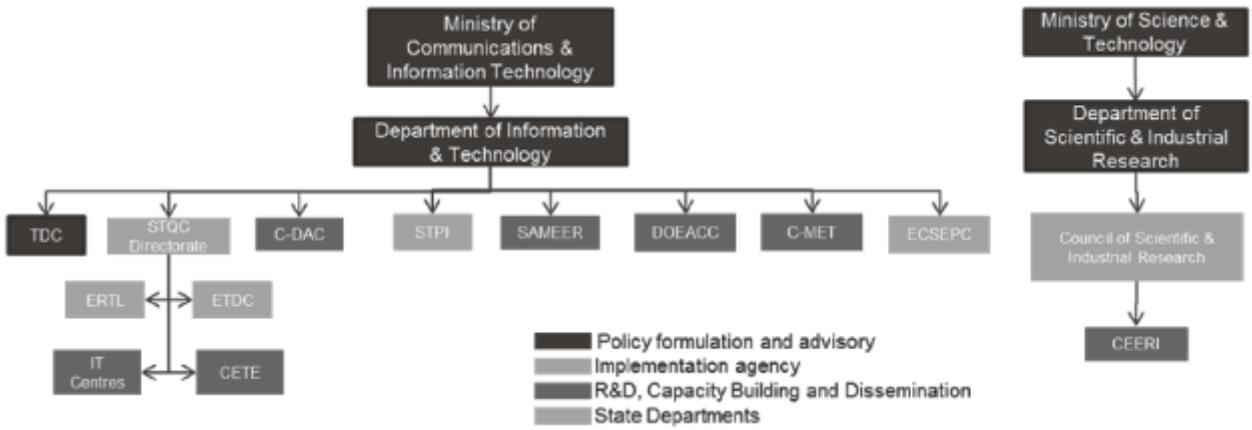
Type of units	No. of units	Gross output in INR billion
Electronic valves, tubes and other electronic components	9,514	54.48
TV, radio transmitters and apparatus for line telephony and telegraphy	12,468	11.83
TV, radio receivers, sound or video recording or reproducing apparatus and goods	12,799	19.63
Total	**34,781**	**85.95**

Source: Quick results: 4th All India MSME census

11.3. Existing technology promotion related policy & institutional support for MSMEs

It addition to the sectoral and generic schemes and programmes being administered and implemented by the MoST and MoMSME, a number of schemes and programmes specific to the electronics industry are implemented by the Ministry of Communication & Information Technology (MoC&IT) and CSIR under the administrative control of DSIR.

The chart below maps out the different entities belonging to the Department of Information Technology (DIT) under the MoC&IT and the CSIR along with the role each plays vis-à-vis policy design & formulation and implementation related to technology promotion for the MSMEs in the electronics industry.



TDC	Technology Development Council	C-MET	Centre for Materials for Electronics technology
STQC Directorate	Standardization, Testing and Quality Certification Directorate	ECSEPC	Electronics and Computer Software Export Promotion Council
C-DAC	Centre for Development of Advanced Computing	CEERI	Central Electronics Engineering Research institute
STPI	Software Technology Parks of India	ERTL	Electronic Regional Test Laboratory
SAMEER	Society for Applied Microwave Electronics Engineering and DOEACC Society	ETDC	Electronics Test and Development Centre
DOEACC		CETE	Centre for Electronics Test Engineering

Each of the Government agencies specified above under the MoC&IT and MoST has different roles to play in the development and adoption of technology for the electronics sector and they fulfill their roles through various schemes and programmes. The roles played by different agencies and the corresponding interventions have been categorized according to the key support areas as specified in section 2.2 and detailed below.

11.3.1. Technology Transfer & Adoption

Support for technology transfer & adoption relates to development of mechanism for technology procurement / import, indigenization, commercialization and patenting with requisite incentives for facilitating appropriate linkages with academic / research institutions and information dissemination on the same. The key initiatives undertaken to support technology transfer & adoption among the MSMEs include the following:-

Ministry/ Department	Entity / Scheme focused on technology transfer and adoption	Highlights of intervention
MoC&IT- DIT	Multiplier Grants Scheme	• Promotes the development of products and its commercialization by facilitating collaboration between industry and R&D institutions.
	Centre for Materials for Electronics Technology (C - MET)	• Promotes the commercialization and technology transfer of new technologies in the area of electronic materials, components and devices through R&D activities • Also provides technical services for product development, trouble-shooting, testing especially ROHS related testing and certification.
MoST- CSIR	Central Electronics Engineering Research Institute (CEERI)	• Provides support to the electronic industry in technology adoption, absorption and upgradation by conducting R&D activities related to electronic devices & systems. Also provides technical services to support the industry in product development, quality design, testing and fabrication

11.3.2. Technology related Capacity Development

Capacity development support relates to interventions aimed at ensuring development of requisite skills and competencies among MSMEs to optimally leverage the existing technology / adoption of new technology. The key initiatives undertaken to develop capacities related to technology adoption among MSMEs include the following:-

Ministry/ Department	Entity / Scheme focused on technology related capacity development	Highlights of intervention
MoC&IT- DIT	DOEACC Society	• Imparts training for the formal and informal sectors in the areas of information, electronics, communication technology • Development of training content and also accredits institutes/ organizations for conducting courses related to capacity development for this sector

11.3.3. R&D facilitation & infrastructure upgradation

Interventions aimed at research & development facilitation and infrastructure development in terms of establishment of laboratories along with requisite equipment& instruments, setting up of common facility centres with requisite common infrastructure, etc. for the MSMEs include the following:-

Ministry/ Department	Entity / Scheme focused on R&D facilitation & infrastructure upgradation	Highlights of intervention
MoC&IT- DIT	Convergence Communications & Broadband Technologies	• Supports research, development and study and the development of R&D capability in convergence communications, broadband technologies and other strategic areas
	National Mission on Power Electronics Technology (NaMPET)	• Provides support for setting up infrastructure for carrying out research in power electronics at leading academic institutes including IITs/ IISC and C-DAC
	Software Technology Parks of India (STPI)	• Implements various schemes for setting up and managing infrastructural facilities and providing related support. It also provides incubation support to MSME entrepreneurs in the field
MoST- CSIR	New Millennium Indian Technology Leadership Initiative (NMITLI)	• Supports R&D in identified areas for development based on a public-private-partnership mechanism in order to support the growth of the Indian electronics industry

11.3.4. Financing support

Interventions related to financing support for investments in the acquisition / upgradation of technology and associated equipment and plant & machinery, working capital management for production etc. are usually bundled with other technology promotion related interventions aimed at technology transfer & commercialization, R&D facilitation and infrastructure upgradation. Select initiatives are detailed below.

Ministry/ Department	Entity / Scheme focused on financing support	Highlights of intervention
MoC&IT - DIT	R&D funding scheme	• Provides financial assistance in the form of grant-in-aid for R&D in different fields related to electronics
	Scheme to Support International Patent Protection in Electronics & IT (SIP-EIT)	• Supports and promotes filing of international patents by MSMEs and technology start-up companies by reimbursing part of the cost of filing international patent applications in electronics and ICT sectors
	STPI- Electronic and Hardware Technology Parks Scheme	• Provides financial assistance to units set up in the demarcated area through income tax exemptions, customs duty exemptions, reimbursements, etc.
	Export Promotion Capital Goods (EPCG) Scheme	• Provides import of capital goods, including equipments, for pre-production, production and post-production at concessional customs duty, subject to export obligations

Further, it should be noted that in addition to the above interventions which are specific to one of the key support areas, there are select interventions which address multiple support areas simultaneously as detailed below.

11.3.5. Interventions addressing multiple support areas

While the interventions specific to each of the four technology promotion related support areas have been detailed above, it is observed that there are select interventions which address multiple support areas simultaneously. The details for the same are presented in the table below.

Ministry/ Department	Entity / Scheme focused on cross-cutting interventions	Highlights of intervention
MoC&IT- DIT	Technology Incubation and Development of Entrepreneurs (TIDE)	• The scheme includes the following activities: - Provides support in setting up and strengthening Technology Incubation Centres in institutions of higher learning - Provides support in the commercialization of technologies developed by technology entrepreneurs - Promotes product oriented research and development
	Centre for Development of Advanced Computing (C-DAC)	• Conducts R&D in the field of information, communication technologies & electronics • Designs, develops and deploys manufacturing technology for the adoption and absorption of technology by the industry • Provides training and capacity building in IT, Enterprise system management, geomatics, VLSI design, etc. through various courses.
	Society for Applied Microwave Electronics (SAMEER)	• Conducts R&D in the areas of radio frequency/ microwave electronics, electromagnetic, etc. for developing new technologies and subsequent commercialization of the same • Provides testing and measurement related facilities
MoC&IT- DIT	Special Manpower Development in VLSI Design and Related Software	• Supports the establishment of VLSI Design laboratory • Supports the development of manpower for VLSI design which includes enhancing capabilities of faculties
	Standardization, Testing and Quality Certification (STQC) Directorate	• Provides testing & calibration facilities and certification services. It overseas the functioning of a number of laboratories across the country including the Electronic regional Testing Laboratories (ERTL), Electronic Test & Development Centres (ETDC), IT Centres & Centre for Electronics Test Engineering (CETE) • Provides training in various areas such as laboratory management, quality engineering and quality management, reliability engineering testing, skill development and test engineering, etc.

11.4. Findings from Cluster Visit (Chandigarh – Panchkula - Mohali)

The tri-city cluster of Chandigarh- Panchkula- Mohali is one of the leading electronics clusters in the country. It includes units which are engaged in manufacture of switches, electronics components and a wide range of electronic devices.

11.4.1. Value chain activities in the cluster

The cluster is primarily involved in the manufacturing of i) electronic systems such as IT hardware, assemblies, devices and ii) electronic components for automotive industry, industrial electronics, medical electronics, etc. The key activities undertaken for both these key product segments have been detailed below.

Electronic devices

- Assembling- Most of the units in the cluster produce Printed Circuit Assemblies (PCAs) for which the Printed Circuit Boards (PCBs) and the various electronic components such as switches, transistors, capacitors, resistors, etc. are sourced primarily from units in Noida. Only a few units in the cluster manufacture PCBs. Depending on the design for the electronic circuit, the components are mounted and fixed electrically and mechanically onto the PCB with molten metal solder. There are primarily 2 ways of mounting the components:
  - o Through-hole construction- components leads are inserted into holes on the PCB
  - o Surface-mount construction- components are placed on pads or lands on the outer surface of the PCB

- Testing- The PCA is tested on various parameters and for different states (on and off states)
- The outer casing is fabricated and prepared. This maybe outsourced or manufactured in-house
- The PCA is mounted and fixed onto the casing for the final assembly

Electronic components

We have considered the manufacturing process of an electronic switch as an illustrative example of an electronic component manufactured in this cluster. The various stages in its manufacture are as follows:

- The raw material includes metallic (copper, brass, silver, gold) and non-metallic (plastics for insulators) components
- The raw material in the form of rods or wire are converted into the required shape and size by various mechanical processes such as stamping, pressing, etc.
- The plastic casing to house the metallic components is manufactured by either injection moulding or compression molding
- Potting- Process of sealing or embedding electronic components and assemblies in a liquid resin in a plastic shell. This is done to reduce the corrosion of metals, shortages, and damage caused by vibration and mechanical stress. At times instead of potting, encapsulation can also be used in which case a reusable mould is used instead of an injection moulded plastic shell
- Final assembly in which all the different sub-components are fixed together in line with product requirements

11.4.2. Existing level of technology adoption across the value chain

The units in the cluster vary widely in their technology adoption levels, with units ranging from high levels of automation to units with limited technology usage. The existing level of technology and the key observations and issues for the electronic units is given in the table below.

Value chain	Current level of Technology	Key Observations/ Technology improvement opportunity
Machining of metallic components	• Deployment of lathes, presses, drilling machines etc. with adoption of CNCs / VMCs by relatively larger units	• Processing of metallic components which form a part of the electronic circuit in switches can be done using CNCs / VMCs subject to having requisite scale of operations to ensure viability of making these investments • Scope for automation for the material handling processes which are completely manual, subject to units having the requisite order books to justify the investments
Manufacture of plastic components	• Deployment of injection moulding machines	• Relates primarily to casings for metallic components, which is also outsourced
Potting	• Reliance primarily on manual processes • Pouring of liquid resin in the plastic casing followed by the introduction of metallic components forming part of the electronic circuit in order to reduce the corrosion of metals, shortages, and damage caused by vibration and mechanical stress	• Manual pouring and mixing can lead to sub-optimal results in terms of uniformity of spread of resin. Further, some of the compounds used may be hazardous • Scope exists for automating the potting process which has been deployed by select units through development of the special purpose machines indigenously in collaboration with domestic equipment manufacturer
Assembly of electronic components	• Manual printed circuit assembly, based on electronic components received from vendors	Automated systems of assembly are available which may be viable only for units having requisite level of scale of operations
Testing	• Visual testing and some measurement tests are conducted	A number of sub-components are sourced from outside vendors for which testing is done a sample basis. However, there are issues observed in terms of ensuring compliance with requisite quality norms in select cases
Final assembly of finished product	• Entirely manual process	Scope exists for automation of the assembly line with viability of investments in the same dependent on the scale of operations

11.4.3. Existing level of clean / green / energy efficient technology adoption

Based on interactions with various key stakeholders including the industry players, industry associations, etc., the key issues pertaining to adoption of clean / green / energy efficient technologies is presented in the table below:-

Parameters	Current level of Technology	Key Observations / Issues
E-waste management	• E-waste management involves primarily 3 stages: Sorting, recycling and disposal o Sorting is done by hand and hand tools such as screw drivers and hammers. o Recycling is carried out mostly by using acids to remove heavy metals and by smelting to retrieve precious metals such as copper o Disposal is carried out by burning or disposing of the parts and materials in open dumps which emanates various pollutants and are hazardous to the environment	• The e-waste management presently is carried out informally. o For sorting, no personal protective equipment is used for extraction of different materials o In the recycling stage, injuries and cuts may occur in breaking operations while respiratory problems can occur while to shredding, burning, etc. o In the disposal stage, burning in incinerators can result in contamination of the environment while dumping the materials as landfill can release toxic lead into ground water. With growing awareness, there is pressure due to International Environmental Regulations and buyers to ensure proper e-waste management. The onus of ensuring and complying with regulations are being put on the manufacturer which may impact the cost of the products

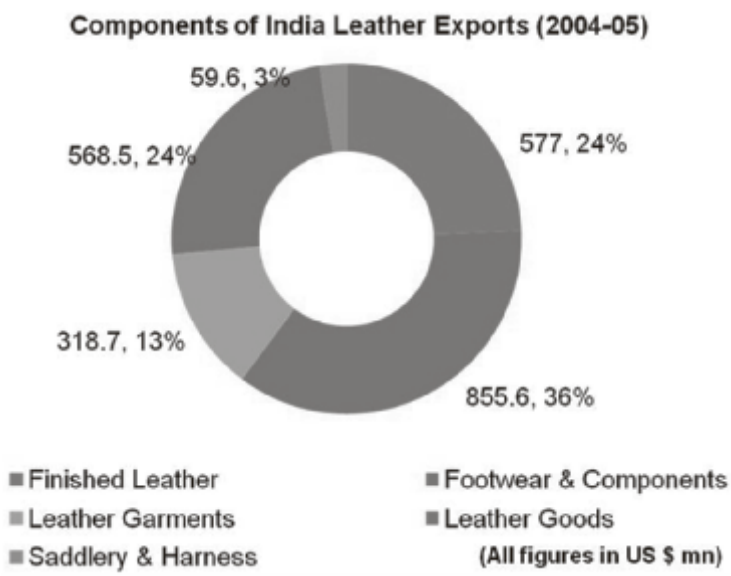
12. Leather

With an estimated output valued at $ 5 billion, Indian leather industry is the third largest leather producer in the World while contributing to around 10% of all global leather requirements. However, India's share in the global $ 116 billion leather market is just about $ 3.5 billion which is merely 3-4% of the global leather market[41]. The Government of India in its Foreign Trade Policy for 2004-2009 had identified the leather industry as a focus sector in view of its immense potential for export growth and employment generation prospects, with the current levels of employment in this industry estimated at around 2.5 million.

12.1. Industry Structure

India has a significant strength in the availability of the raw material since India is the leading livestock holding country in the World accounting for 14.2% of the global livestock population. With 19.5% of the global bovine (cattle and buffalo) population, it has the highest number of cattle and buffaloes; with 21.4% of the global goat population, the second highest number of goats; and with 4.7% of the global sheep population, the fourth highest number of sheep.[42] This was one of the key reasons for India focusing on mere exports of raw materials in forms of hides & skins till the sixties.

However, the Indian leather industry has evolved since then to emerge from being a mere exporter of raw materials in form of hides & skins in the sixties to a leading producer of value-added finished products in the nineties in order to tap the significant potential in the downstream leather products globally. This has been facilitated with active support from Government in terms of requisite policy and regulatory support to support this industry which is one of the top ten foreign exchange earners for the country. The leather sector can be broadly categorized into the following:-



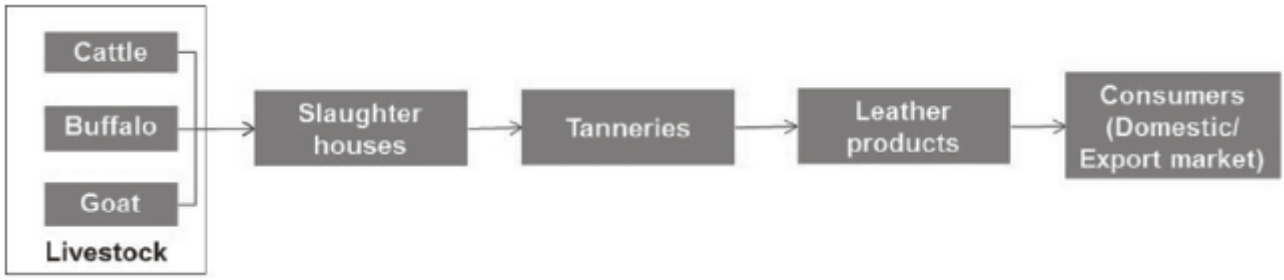
- Conversion of raw hides and skins into finished leather at tanneries
- Value adding units for conversion of leather into finished goods, which are broadly

[41] Source: Report titled "Leather & Leather Products: New Avenues of Growth" by the CII
[42] Source: Indian Leather Industry: Growth, productivity and Export performance by Subhas C.Kumar

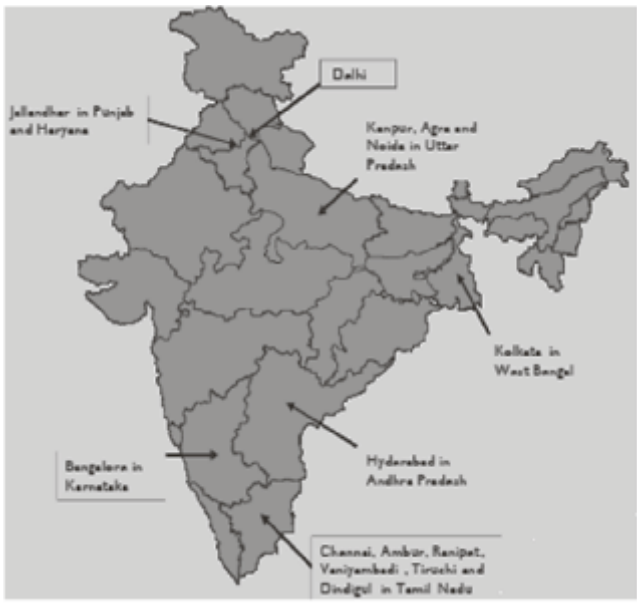
classified into the following:-

- Leather footwear and footwear components
- Leather goods like bags, handbags, gloves, wallets, brief cases, belts, sports goods, etc.
- Leather garments comprising of jackets, coats, etc.
- Leather saddlery and harness goods

The contribution of these respective products to the overall exports from this sector have been presented in the chart above, highlighting the fact that finished leather and footwear are the top two contributors to the exports with an estimated share of around 60%.[43] A representative diagram of the value-chain of the Indian leather industry, highlighting the various stakeholders involved in conversion of hides & skins to finished leather and leather products along with their interdependencies, has been presented in the chart below.



The chart alongside highlights the fact that leather producing regions in the country are concentrated in a few clusters, with presence of both tanneries and value-adding units in form of finished goods producing factories.



These key leather clusters include Chennai, Ambur, Ranipet, Vaniyambadi, Trichi and Dindigul in Tamil Nadu, Kolkata in West Bengal, Agra and Kanpur in Uttar Pradesh, Jalandhar in Punjab, Hyderabad in Andhra Pradesh, Bangalore in Karnataka and Delhi.

Among these key leather clusters, West Bengal has 23% of the total tanneries and produces a wide range of finished products including finished leather, leather goods like bags, wallets, footwear (closed and open) and industrial gloves. On account of the same, the Kolkata cluster has been considered for purposes of detailed analysis as part of this study.

[43] Source: Report titled "Leather" published by IBEF

12.2. MSMEs in the Leather sector

The leather sector is characterized by the presence of a large number of MSMEs across the entire value-chain with estimates putting 60-70% of all production & processing facility being under the control of MSMEs.

In the year 2006-07, it was estimated that there were around 2091 tanneries of which 1831 were operational.[44] Of these, about 95% of the units were in the MSME sector and were involved in conversion of the relatively low quality hides and skin into high quality leather.[45] Further, it has been estimated that India has around 8,000 leather products manufacturing units[46] which produce a wide range of leather products such as footwear, leather garments, leather goods such as handbags, belts, wallets, gloves, harness & saddlery of which footwear alone accounts for 60% of the leather produced. It is estimated that around 4,000 units are engaged in manufacture of footwear with around 55% of them being in the small sector. This industry is a mix of traditional hand-based manufacturing units catering primarily to the domestic market along with the modern technology-based highly-automated assembly lines focused exclusively on the export markets. The leather garments industry is also dominated by the small scale sector with the large units accounting for less than 3% of the leather garments produced.

The need for environmental compliance in terms of effluent treatment, water recycling, & solid disposal along with need to improve productivity & quality through higher level of automation and reduce costs through achievement of higher energy efficiency levels in order to stay competitive is proving to a key challenge to the sustainability of the MSMEs operating in this sector, particularly the micro and the smaller units.

12.3. Existing technology promotion related policy & institutional support for MSMEs

Considering the significant impact of the leather industry to exports, employment generation and growth, it is observed that there are a number of Government departments / ministries / agencies associated with formulation and implementation of policies & programme aimed at growth and development of this sector. For the purposes of this study, we have focused specifically on the technology adoption and absorption related interventions for ensuring competitiveness of the MSMEs in this sector. Based on secondary research, we observe that the key departments/ ministries as depicted in the chart below along with their affiliated agencies & institutions are associated with technology promotion related initiatives for MSMEs in the leather sector in their respective roles associated with policy design, formulation and implementation.

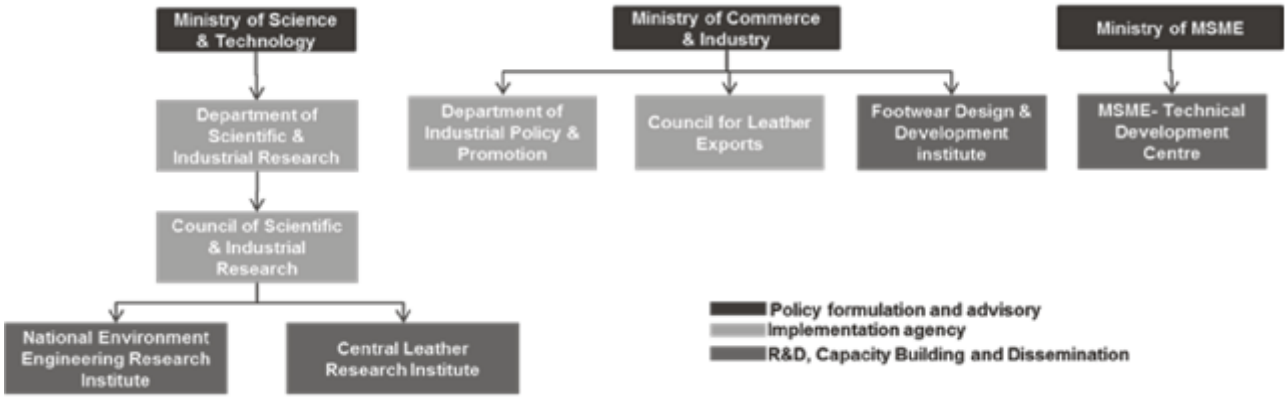
Each of the Government agencies specified above under the Ministry of Science & Technology (MoST), Ministry of Commerce & Industry (MoCI) and Ministry of MSME (MoMSME) has different roles to play in the development and adoption of technology for the leather and leather

[44] Source: Report on Technology Upgradation for Enterprises in the Unorganized sector by NCEUS

[45] Source: Indian Leather Sector Network Report for the initiative of SINET by the Asia Pro Eco Programme

[46] Source: Indian Leather Sector Network Report for the initiative of SINET by the Asia Pro Eco Programme

products sector and they fulfill their roles through various schemes and programmes. The roles played by different agencies and the corresponding interventions have been categorized according to the key support areas as specified in section 2.2 and detailed below.



12.3.1. Technology Transfer & Adoption

Support for technology transfer & adoption relates to development of mechanism for technology procurement / import, indigenization, commercialization and patenting with requisite incentives for facilitating appropriate linkages with academic / research institutions and information dissemination on the same. The key initiatives undertaken to support technology transfer & adoption among the MSMEs include the following:-

Ministry/ Department	Entity / Scheme focused on technology transfer and adoption	Highlights of intervention
MoCI	Council for Leather Exports	• Promotes joint ventures, technical collaborations and strategic alliances • Disseminates technology related information • Provides technical and design assistance to Indian exporters
MoCI	Support for Rural artisans under ILDP	• Provides support to artisans based in a cluster on design and development of products
MoST - DSIR	Central Leather Research Institute (CLRI)	• Provides support to the leather and allied sectors in terms of development of technology & its commercialization to improve productivity / cost reduction etc.
	National Environmental Engineering Research Institute (NEERI) under CLRI	• Development of technology solutions to various sectors (including leather), industries and governments regarding threats to the environment posed by the respective sectors through R&D in environmental science and engineering

12.3.2. Technology related Capacity Development

Capacity development support relates to interventions aimed at ensuring development of requisite skills and competencies among MSMEs to optimally leverage the existing technology / adoption of new technology. The key initiatives undertaken to develop capacities related to technology adoption among MSMEs include the following:-

Ministry/ Department	Entity / Scheme focused on technology related capacity development	Highlights of intervention
MoCI	Footwear Design and Development Institute (FDDI)	• Provides training specific to the footwear sector regarding footwear design, retail management and merchandising, footwear technology etc.
MoCI- Department of Industrial Policy & Promotion (DIPP)	Saddlery Development under Integrated Leather Development Programme (ILDP)	• Provides support to the International Institute of Saddlery Technology and Export management at Kanpur for scaling up skill upgradation programmes and other long term and short term programmes focused on the saddlery segment
	Development of Human Resource under ILDP	• Provides support for skill development of work force in rural areas associated with leather sector

12.3.3. R&D facilitation & infrastructure upgradation

Interventions aimed at research & development facilitation and infrastructure development in terms of establishment of laboratories along with requisite equipments & instruments, setting up of common facility centres with requisite common infrastructure, etc. for the MSMEs include the following:-

Ministry/ Department	Entity / Scheme focused on R&D facilitation & infrastructure upgradation	Highlights of intervention
MoCI- DIPP	Establishment of new FDDI & other centres along with upgradation of existing facilities under the ILDP	• Provides support for setting up new centres at Tamil Nadu, West Bengal and Haryana along with upgradation of facilities at FDDI Noida which facilitates R&D related to footwear designing
	Upgradation/ installation of infrastructure for environmental protection under ILDP	• Provides support for adhering to applicable environmental norms and regulations through requisite R&D support

12.3.4. Financing support

Interventions related to financing support for investments in the acquisition / upgradation of technology and associated equipments and plant & machinery, working capital management for production etc. are usually bundled with other technology promotion related interventions aimed at technology transfer & commercialization, R&D facilitation and infrastructure upgradation. Select initiatives are detailed below.

Ministry/ Department	Entity / Scheme focused on financing support	Highlights of intervention
MoCI- DIPP	Integrated Development of Leather Sector (IDLS) under ILDP	• Provides financial assistance in the form of a grant up to an extent of 30% of cost of plant & machinery for the Micro & Small units subject to investment ceiling of ₹ 2 Crore for technology upgradation /modernization and/or expansion and setting up a new unit • Nodal agency for the same is Small Industries Development Bank of India(SIDBI)
MoFPI	Scheme of Modernization of Abattoirs	• Financial assistance in the form of a grant of 50% towards the cost of plant & machinery, technical civil work and other related infrastructure for the modernization of existing abattoirs & establishing new ones, subject to a maximum of ₹ 15 Crore • Facilitates i) scientific and hygienic slaughter of animals, ii) application of modern technology in the slaughter waste management and pollution control iii) providing better preservation of product through cold chains

Further, it should be noted that in addition to the above interventions which are specific to one of the key support areas, there are select interventions which address multiple support areas simultaneously as detailed below.

12.3.5. Interventions addressing multiple support areas

While the interventions specific to each of the four technology promotion related support areas have been detailed above, it is observed that there are select interventions which address multiple support areas simultaneously. The details for the same are presented in the table below.

Ministry/ Department	Entity / Scheme focused on cross-cutting interventions	Highlights of intervention
MoMSME	MoMSME- Technical Development Centres (formerly the Central Footwear Training Institute)	• Provides training and R&D services in footwear technology, machinery and design. • Development of designs and testing of new products, facilitating technological upgradation and establishing linkages between academic and R&D institutes in India and abroad.

12.4. Findings from Cluster Visit (Kolkata)

West Bengal has been associated with the leather industry since the pre-independence era with evolution of Kolkata into a significant hub for the leather industry with an aggregate turnover of ₹ 45 billion. The cluster is known for its cow and buffalo hides and specializes in Drum dried mill leather (DDM), Natural dried mill leather (NDM), Nappa leather and Vegetable tanned leather while also producing other types of leather such as Suede, Nu'bulk, Antique and Patent leather. The cluster includes specialized units covering the whole value chain with the different types of units along with their turnovers detailed in the table below.

Category of unit	Type of units	No. of units	Total no. of units	Turnover in ₹ million
Tanneries	Tanneries	224	224	12500
Goods manufacturing	Manufacturer cum exporter	236	1532	18000
	Merchant exporter	96		
	Fabricator cum manufacturer for local market	1200		
Footwear	Large scale manufacturing unit (Bata)	1	2026	15000
	Small and medium manufacturer	19		
	Manufacturer & exporter	6		
	Fabricator and household unit	2000		
Industrial gloves	Manufacturer cum exporter	31	242	3800
	Merchant exporter	11		
	Fabricator	200		

Source: Report titled "Diagnostic Study Report on Implementing BDS in the Kolkata Leather Cluster" by EDI

The cluster also contributes significantly to the exports with estimates that the units based in this cluster contribute to around 60% of the export of leather goods and 90% of export of leather gloves from India.

The cluster includes the geographical boundaries of Kolkata as well as the Calcutta Leather Complex situated in Bantala. Majority of the tanneries are located at the newly developed Calcutta Leather Complex. Kasba, Topsia and Tangra are the focal points for the leather goods manufacturing units. Industrial gloves are primarily produced in Beleghata while the footwear units are mainly located at Batanagar, Nungi, Janbazar, Rajabazar and College Street areas with Janbazar, Rajabazar and College street being the hub of micro and household units.

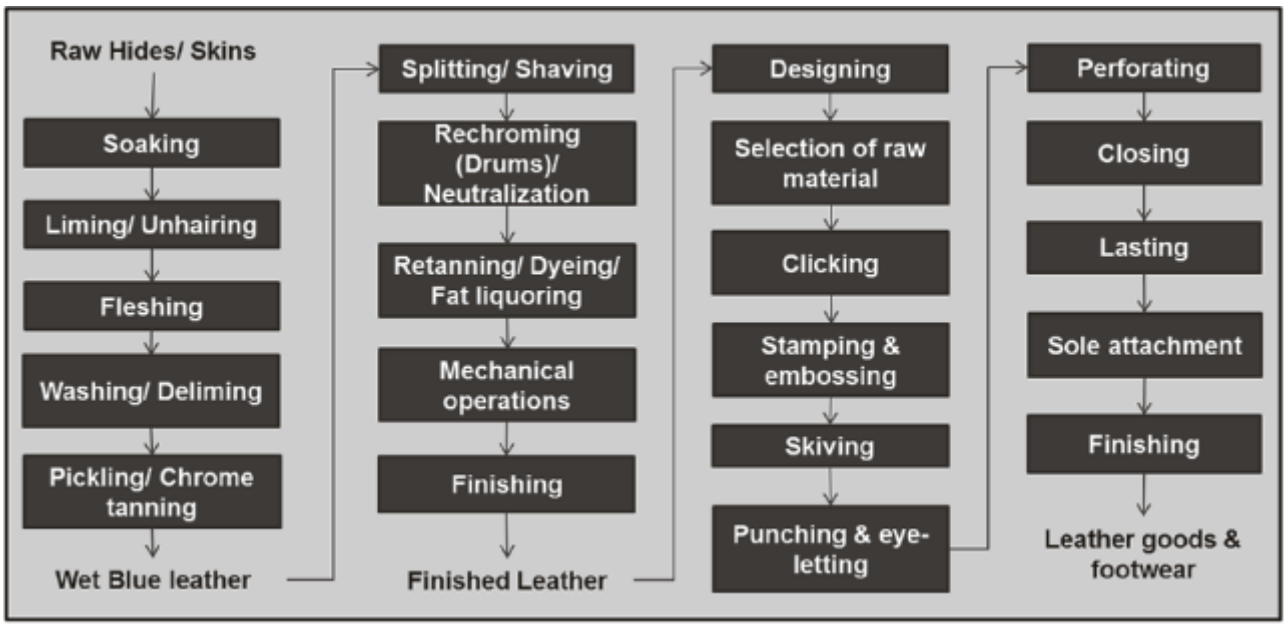
12.4.1. Value chain activities in the cluster

The leather and leather products industry in Kolkata includes the following key activities, which have been detailed in this section:

I. Manufacture of finished leather from raw hides & skins

II. Manufacture of leather products

The high level value chain associated with both these key activities has been depicted in the chart below.



I. Manufacture of finished leather

The leather and leather processing industry involves the conversion of animal rawhide and skin to leather. This process involves the following four main stages:

- Collection of carcass and its preparation
- Tanning
- Crusting
- Finishing

Collection of carcass and its preparation

This stage involves the collection of animal carcass (hides and skin), the basic raw materials for the leather industry as by-products of the meat, dairy and wool industries and its preparation for tanning. The pelts of big and full grown domestic animals such as cows, buffalos, horses are called hides while those of small animals such as sheep, goat and deer are called skins. Hides and skins are different from each other in terms of weight, size and thickness with hides being the larger, heavier and thicker. The raw hides and skins are preserved temporarily by the application of common salt on the flesh side of the hide/ skin. This process reduces the moisture content of the hide/ skin preserving it temporarily by delaying the putrefaction process so that it can reach the tanneries in proper condition.

Tanning

A number of processes can be used for preparation of the raw hides &skins for tanning depending on the type of product to be manufactured but the main processes include the following:-

- Soaking- Initially the carcasses are sorted according to different grades depending on size and quality. At this stage, the carcasses are said to be in a 'cured' condition. These are then taken in wet or dry salted condition and rehydrated to a state called 'green' condition while removing salt, dirt, dung, blood etc. which adhere to the skins.

- Liming- The process of liming is a combination of chemical and physical action on the skin with an intention of removing hairs and fatty substances from the hides and skin, ensuring swelling and plumping of protein fibres present in the hides & skins and proper penetration of pre-tanning , tanning and post tanning chemicals into the leather in subsequent operations.
- Fleshing- After liming, the hides & skins are called pelts. The hairs are then removed from the pelts and the pelts fleshed and scud mechanically to obtain a clean pelt. Then the pelts are weighed and the pelt weight is noted. The subsequent addition of chemicals up to the tanning stage is based on this pelt weight.
- Washing/ Deliming- Deliming is carried out in order to remove the alkali introduced during the liming operation and to bring down the swelling and plumping of pelt to the desired level by using weak acids/ acid salts.
- Pickling- Pickling is carried out with the help of salts and acids to neutralize the effect of the alkali used in the previous stages and arrive at a desired pH value in order to prepare for the tanning process. The acid used also helps in the splitting of fibre bundles while the salt is added to prevent acid swelling.
- Tanning- The conversion of putricible hides and skin to imputricible leather by using different chemicals is called tanning. The method of chrome tanning is used more often and since the processed leather is blue in colour, it is called 'wet blue' at this stage.
- Splitting/ Shaving- In order to reduce the water content of the leather, the leather is then sammed. This is followed by splitting and shaving to achieve uniform thickness and the required condition.

Crusting

- Neutralization- It is carried out to remove the combined acid in leather by using mild alkalies and other auxiliaries in order to bring the leather to the right pH condition for subsequent processes.
- Retanning- Since a single tanning cannot achieve the desired properties, the leather needs to go through multiple processes of tanning depending on the type of characteristic required.
    - o The colour of the leather at this stage is a reflection of the material used for tanning. By dyeing, it is imparted the desired colour thus enhancing its value by subjecting it to the required dyestuff.
    - o In order to soften the leather and make it waterproof, it is exposed to an oil emulsion. The oil used can be of vegetable, animal or synthetic origin. This process is called Fat liquoring

- Mechanical operations- At the end of these operations, the leather is sammed to remove excess moistures and set to have a smooth grain & remove wrinkles. The leather is then dried, conditioned and staked to soften it further. The next operation involves trimming the leather to give it the required shape which is followed by buffing in order to remove excess flesh adhering to the flesh side of leather. The leather is then toggled or nailed to remove stretchiness and then taken for finishing

Finishing

The process of finishing is carried out to enhance its aesthetic appearance and also to cover the natural and other defects present in leather like scratch mark, pox mark, flay cuts, bacterial damage etc. The finishing operation also makes the leather water repellant to a certain extent. Finally the leather is either ironed or plain plated, measured and then sorted according to different grades and sent to leather goods and leather footwear manufacturing units.

II. Manufacture of leather products

Post receipt of finished leather, the same is converted into various leather products with primary focus on leather goods, gloves and footwear. However, it should be noted that in certain instances, the tanneries may have forward-integrated into production of leather products while in other cases the leather product manufacturing units may be sourcing leather from the tanneries. The processes involved in the manufacture of leather products have been detailed below:-

- Designing- The product to be manufactured is designed depending on either market demand or buyer choice. Based on this and the different sizes to be produced, the requirement for raw material is estimated.
- Selection of raw material- Based on the type of product to be manufactured and the various components which make up the product, different types and grades of leather are selected. This is done primarily to optimize the use of high quality, high value leather thereby reducing the cost of production.
- Clicking- Clicking is the process of cutting the required size of leather for the product from the whole area of leather available. For this process, it is necessary to ensure that the right type and grade of leather is cut for the right component. The lining material is also clicked at this stage.
- Stamping & embossing- At this stage, the different components are stamped and embossed according to the lot number, design number, size number and serial number so as not to mix up the different components leading to wastage in the later stages of assembling. Trademarks if applicable are also stamped at this stage.
- Skiving- During this operation, the thickness of certain edges of leather is reduced to allow seams to be produced without the bulkiness and ensuring a uniform thickness to each edge of the item produced. For footwear edge components, skiving is done to avoid discomfort during wearing the product.
- Punching and eyeletting- Carried out mainly for footwear to punch holes and to fix eyelets for inserting shoe laces. Eyelets prevent damage of the hole while tightening the laces. Besides, punching and eyeletting is also done both in footwear and leather goods for enhancing aesthetic appeal.
- Perforating- At times depending on the requirement, a series of small perforations of different sizes or shapes along the edges are made in shoes for aesthetic reasons. This is also done to cover certain defects in the finished leather and thereby enhancing the market value of the article. This is generally done manually.
- Closing- Closing is the process in which different components of the product are assembled and joined together. This operation is carried out by stitching and/ or pasting depending on the type of product being made. Synthetic adhesives are used for pasting.

- Lasting- Lasting is required only for manufacture of footwear. In this process, the two-dimensional leather is given a three-dimensional shape to fit the shape of the foot and retain the shape for the life of the footwear. Lasting is done by fixing the closed uppers over a last which is usually made of wood or plastic and fixing it by either adhesives or tacks.
- Sole attachment- For footwear where the sole is also of leather or of rubber, the margin of the leather upper and the inner side of the sole are roughened up for better penetration of the adhesive. For footwear which uses PVC, PU, TPR soles, the soles are cleaned by chemicals for penetration of the adhesives and to ensure a strong bondage between the upper and the sole. After applying the adhesive to the lasted bottom margin of the upper and the inside of the sole, it is allowed to dry and if required, a second coat of adhesive is applied and dried. For PU based adhesives, the applied adhesive is reactivated by heat to create stickiness. The upper and the sole are then pressed and if the required level of adhesion is achieved, the last is removed and the shoe is taken for finishing.
- Finishing- Carried out to enhance the aesthetic look of the product and cover any defects. As a part of this process, the product is also polished in order to get a shining appearance.

12.4.2. Existing level of technology adoption across the value chain

The units in the cluster vary widely in their technology adoption levels, with units ranging from high levels of automation to units with limited technology usage. The existing level of technology and the key observations and issues for the Kolkata units according to the manufacturing value chain is given in the table below.

Value chain	Current level of Technology	Key Observations/ Technology improvement opportunity
Collection of carcass and its preparation	• Sourcing of carcasses is done through: o Slaughterhouses o Collectors and traders	• A significant number of carcasses of fallen animals are not collected due to the wide geographical expanse of the region. Even after collection, inadequate cold chains in the region lead to hides and skins being spoilt while being transported over distances. • Improper flaying by individual collectors and traders due to limited knowledge of the process result in damages to the hides and skins which devalues the leather.
Soaking	• The hides and skins are soaked overnight in a solution of water, preservatives and a wetting agent	• Large quantities of salts are released with the "soak water" which contaminates the ground water
Liming	• Most of the units in the cluster use paddles for liming operation, with some of the units having shifted to the drum-based process	• Gradual shift observed in adoption of drum-based liming since it requires less water. Achieved through drums which revolve at different rpms depending on whether sharp liming is to be used or not • Further, it should be noted that the lime and sodium sulfate released with the liming water contaminate the ground water

Value chain	Current level of Technology	Key Observations/ Technology improvement opportunity
Fleshing	• Uniform thickness of hides ensured by passing through roller blades of fleshing machine	
Washing/ Deliming	• Wooden drums are used for this process	• Potential for adoption of metallic drums which have a longer life but require higher level of initial investment and may be viable only for units having higher scale of operations
Pickling	• Wooden drums are used for this process	• Potential for adoption of stainless steel drums which have a longer life but require higher level of initial investment and may be viable only for units having higher scale of operations
Tanning	• There are two types of tanning depending on the material used in the tanning process: ○ Vegetable tanning in which the tanning materials are from materials such as babul, wattle, myrabolan, etc. ○ Mineral tanning in which tanning is carried out by metals such as chromium, zirconium or alum.	• Among the various modes of tanning used, chrome tanning is the most commonly adopted process as it helps in reducing the tanning time while ensuring that the resultant leather is lighter & has better water proofing properties as compared to vegetable tanned leather. • However, the use of chrome tanning results in discharge of chrome along with effluent which contaminates the ground water. A chrome recovery plant can extract the chrome from effluents for purposes of re-use, but not all units have installed the same on account of capital investments required. Further, all the units use chrome III which can transform to chrome VI on reacting with oxygen under higher temperatures which is known to be carcinogenic. • Select units deploying the vegetable tanning process face issues related to disposal of solid wastes
Splitting/ Shaving	• Deployment of domestic technology for operations related to sammying, splitting and shaving	• Indigenization of technology by domestic equipment manufacturers has reduced the dependence on imports
Retanning	• Adoption of mineral / vegetable tanning, depending on the quality of the tanning needed	• Same as those observed for tanning
Mechanical operations	• Key machines used by cluster units include sammying machines, toggling machines, buffing machines, etc.	

Value chain	Current level of Technology	Key Observations/ Technology improvement opportunity
Finishing	• Adoption of manual spraying along with the more modern rotary spray dryers, depending on the size of the unit	• Most of the smaller units typically tend to use manual spraying with gradual shift noticed towards rotary spray dryer which serves the purpose of spraying followed by drying. Also leads to better quality of finish, which is critical for exports • Indigenization of the rotary spray dryer has resulted in greater level of demand for the same on account of cost reduction vis -à-vis imports. However, select units still import the rotary spray dryers on account of perceived better quality
Testing	• Limited no. of testing facilities for measuring toxicity, allergenic and carcinogenic etc. in the cluster, with individual units not investing in the same	• With the limited no. of testing facilities in the cluster and specifications for testing being determined by the respective buyers, most of the units send the sample to the appropriate testing labs (could include CLRI, Chennai or even SGS laboratory in Hong Kong)
Designing	• Micro and smaller units depend on existing outdated patterns for designing while the relatively larger units are increasingly adopting CAD systems for producing new designs in line with market requirements	• Inability of the micro and smaller units in upgrading their designs in line with market requirements. Perceived need for development of product designing ability through capacity development support, including training on use of CAD systems
Processes involved in leather product manufacture: Clicking, stamping & embossing, skiving, punching & eyeletting, perforating, closing, lasting, sole attachment, finishing	• Micro level units carry out these activities with the help of hand held tools with only the relatively bigger units automating their process for these activities	• Quality of footwear products impacted on account of use of hand-held tools and manual processes, especially related to double-stitching and sole pasting • Financial ability of micro units prevents them from procurement of automated machines which can help improve the quality of products, thereby resulting in better marketability of products. To addre ss the same, micro units have organized themselves into a co-operative to avail the benefits of cluster-based schemes of Ministry of MSME

12.4.3. Existing level of clean / green / energy efficient technology adoption

Based on interactions with various key stakeholders including the industry players, industry associations, etc., the key issues pertaining to adoption of clean / green / energy efficient technologies is presented in the table below:-

Parameters	Current level of Technology	Key Observations / Issues
Collection of carcass	• Use of Common salt for preservation purposes	• The Central Pollution Control Board has advised the industry not to use common salt for the preservation of raw hides/ skins but use alternatives as developed by CLRI. Although the vast expanse of the country restricts the usage of salt free preservation techniques, it can be implemented in the organized and mechanized slaughterhouses.
Water recycling	• Soaking: Dissolution & removal of salts added to hides & skins for preservation • Liming: Adoption of both paddle based and drum based processes • Tanning: Adoption of drum - based process	• Chances of depletion of groundwater on account of significant level of water consumption for processes related to soaking, liming and tanning. It is estimated that around 15-22 litres of water is used per kg of hide processed for pre-tanning processes with the tanning process consuming around 1-2 litres of water per kg of hide processed • Soaking: Reduction of water could be facilitated through salt-less curing of hides for which CLRI had developed a compound with similar properties of the salt being used for curing. However, the limited availability of the same prohibits the utilization of the same which can help in reducing water consumption in soaking process. Further, scope exists for adoption of counter current soaking technology to reduce water consumption • Liming: Potential for adoption of enzyme-assisted liming to reduce amount of sulphide discharged in effluents which makes its treatment easier • Potential for shifting liming process from paddle-based process to drum-based process to reduce the level of consumption of water
Tanning	• Around 90% of all units have adopted the chrome tanning process	• Potential for adoption of high-exhaustion chrome tanning process developed by CLRI which results in exhaustion of 90% of chrome while ensuring the required finish. This reduces the chrome discharge as part of effluent • Potential for performing vegetable tanning in dry drums or in vats without discharges
Re-tanning	• Around 90% of all units have adopted the chrome tanning process	• Dyeing: Potential for replacement of wooden drums by stainless steel drums which reduce dye & water consumption. However, this involves significantly higher level of investments and may be viable only for units having higher scale of operations

Parameters	Current level of Technology	Key Observations / Issues
Effluent treatment	• For purposes of recovery of chrome used in tanning, either the units have invested in chrome recovery plants or supply the water discharged after chrome tanning to some units which carry out the recovery of chrome on a charge basis • A CETP has already been established in the cluster for purposes of effluent treatment	• Potential for establishment of chrome recovery plants as part of common facility centres which can be used by the MSMEs, especially the micro and smaller units • Although a CETP has been established in the cluster, it has not been effective due to operational inefficiencies in terms of need for individual units to adhere to standard norms while sending their dis charges to the CETP to ensure effective treatment of the same

13. Impact of technology promotion for MSMEs in India

For purposes of assessing the high-level impact associated with technology promotion related interventions, both sector-agnostic and sector-specific, undertaken by the various Government agencies; we have primarily relied on feedback from primary interactions conducted by us as part of the cluster visits. These interactions have tried to encompass various stakeholders associated with the process of facilitating technology upgradation among MSMEs, including representatives from business / industry associations, business development service providers, technology / equipment providers, supporting Government agencies / institutions and the respective MSMEs themselves.

Key findings from the primary interactions with respect to perceived impact of technology promotion for MSMEs in India has been classified with respect to the i) sector-agnostic and ii) sector-specific interventions detailed in the earlier sections of the report.

13.1. Impact of sector-agnostic interventions for technology promotion among MSMEs

It has been observed that the interventions formulated and implemented by the Ministry of MSME for purposes of facilitating technology upgradation among MSMEs has been relatively more effective vis-à-vis interventions by other ministries like Science & Technology and Commerce & Industry which can be attributed to more-established institutional mechanism for implementation involving Office of Development Commissioner (MSME) and network of its offices around the country which help ensure effective linkage between the Centre and the States. Some of the schemes & programmes being implemented by Ministry of MSME which the MSMEs are aware of and / or availing along with the observations on the same gathered during primary interactions include the following:-

- Credit Linked Capital Subsidy Scheme for Technology Upgradation (CLCSS): Emerged as one of the key schemes & programmes which MSMEs have / plan to leverage to facilitate investment in technology upgradation across all sectors. The level of awareness about this capital subsidy scheme also seemed to be pretty high across all the clusters visited as part of the sector studies.

Impact of CLCSS:

- Since the inception of this scheme in the year 2000 and till August of 2007, the CLCSS scheme had been availed by 3,329 micro and small units and a sum of ₹ 103 Crore had been disbursed as subsidy.
- For the year 2010-11, 671 units had been disbursed subsidies worth ₹ 35.89 Crore

from the financial organizations of SIDBI, SBI, PNB, Canara Bankand TIIC till January 2011.

- Micro & Small Enterprise- Cluster Development Programme (MSE CDP): Observed that business / industry associations across all sectors had awareness about the potential of this scheme for facilitating investments in common facility centres using a cluster-based approach

Impact of MSE CDP:

- The different clusters which have been supported by the MSE CDP and the aggregate turnover before and after the intervention are given below:-

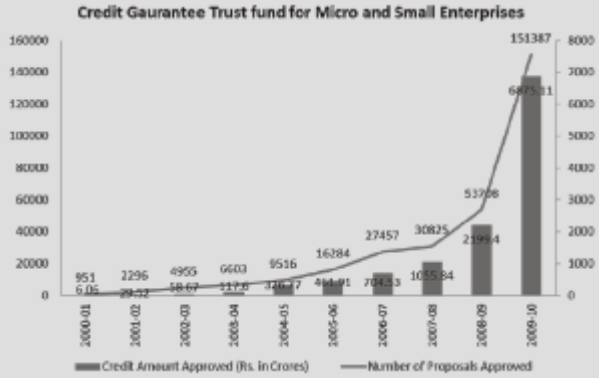
Sl	Clusters	Aggregate Turnover Before Intervention (Rs in Crores)	Aggregate Turnover After Intervention (Rs in Crores)
1	Bamboo Cluster Dimapur	0.11	1.39
2	Leather Goods Cluster Agra	200	265
3	Leather Goods Cluster Shantiniketan	2.5	5.5
4	Plywood Cluster Perambavoor	305	680
5	Rice Milling Cluster Karnal	1200	1300
6	Rice Flakes Cluster Ahmedabad	80	110
7	Rice Milling Cluster Kalady	2000	2890
8	Rubber Cluster Chenganacherry	300	500
9	Ball bearing Cluster Jaipur	108	200
10	Bell metal Cluster Khurda	20	24
11	Bell metal Cluster Hazo	2	5
12	Brass Utensil Cluster Pareo	30	36
13	Cotton Hosiery Cluster Kanpur	0.52	10
14	Diesel Engine Cluster Rajkot	4980	5000
15	Fan Industry Cluster Hyderabad	200	300
16	Foundry Cluster Ahmedabad	400	425
17	Plastic Cluster Aluva	70	350
18	Sewing Machine Cluster Ludhiana	365	425
19	Surgical Instruments Cluster Baruipur	5.2	100
20	Wet Grinder Cluster Coimbatore	225	350
21	White ware Cluster Khurza	123	283

- It can be observed from the table that across all the 21 clusters, the CDP interventions have contributed to an increase of 25% in the turnover of the cluster. Clusters such as the cotton hosiery cluster of Kanpur and the surgical instruments cluster of Baruipur have increased from ₹ 52 lakh to ₹ 10 Crore and from ₹ 5.2 Crore to ₹ 100 Crore respectively.

- Credit Guarantee scheme as part of CGTMSE scheme: Observed that MSMEs across multiple sectors had information about the applicability of this scheme for facilitating technology upgradation, especially in absence of ability to provide physical / marketable collaterals

Impact of CGTMSE:

- The CGTMSE scheme has been availed by a number of micro and small units with the number of beneficiaries increasing from 951 in 2000-01 to 1,51,387 in 2009-10. The amount of credit approved per proposal has also increased at a CAGR of 24% over the same period.



- National Manufacturing Competitiveness Programme (NMCP): Emerged that the pro-activeness of the respective business / industry associations and business development service providers in the respective clusters determined the level of success with respect to implementation of various modules of NMCP initiative, e.g. Drugs & Pharmaceutical cluster in Hyderabad and Engineering cluster in Chandigarh had already initiated modules related to lean manufacturing, design clinics, ICT promotion while some of the other clusters were in the process of submitting proposals for availing the interventions planned as part of NMCP initiative

Impact of NMCP:

- **Enabling Manufacturing Sector to be competitive through Quality Management Standard & Quality Technology Tools (QMS/QTT):** With a budgeted outlay of ₹ 50 Crore,[47] the scheme proposed to facilitate awareness programmes for MSMEs, development & introduction of relevant training courses covering 1800 polytechnics/ ITIs, implementation of quality management systems in select MSMEs (target of 100 MSMEs) etc. During the year 2008-09, the progress include: i) introducing training course in ITIs and ii) conducting around 65 awareness programmes on quality related technology issues through organizations such as Quality Council of India, MSME-DIs and autonomous bodies.[48]
- **Lean manufacturing:** Initiated with an objective of developing manufacturing competitiveness in around 100 min-clusters as part of a pilot project through application of lean manufacturing techniques with a budget of ₹ 300 Crore. Around 100 awareness programmes have been conducted across the country till date to make MSMEs aware of the potential of deployment of lean manufacturing techniques to facilitate productivity enhancement which has resulted in adoption of the same in around 133 operational clusters[49]
- **Design Clinic Scheme (DCS) for design expertise to MSMEs Manufacturing sector (DESIGN):** Launched with a budget of ₹ 73.58 Crore, out of which ₹ 49.08 Crore would be assistance from Government of India with the balance being contribution from the beneficiary MSMEs. The scheme targets to reach out to about 200 MSME clusters

[47] Source: http://nmcc.nic.in/NMCP.aspx
[48] Source: http://www.iipe.co.in/journal/sep9/DgcIMSME.pdf
[49] Source: http://www.lmcs-npc.gov.in/frmApprovedClusters.aspx

with support at 3 levels by conducting: i) design awareness seminars, ii) design awareness programmes, presently 6 of these have been completed at 6 different clusters and iii) design projects. By July 2010, 47 clusters had been approved for the scheme and in November 2010, 31 more clusters had been approved for the scheme.[50]

- **Entrepreneurial and Managerial Development of SMEs:** With a budgeted outlay of ₹ 66.5 Crore, the scheme initiated in 2007 aimed to set up 100 business incubators under technology institutions over the next 4 years. The number of institutions approved as business incubators during 2008-09, 2009-10 and 2010-11 are 25, 22, and 29 respectively, resulting in establishment of a total of 76 incubators.[51]
- **Marketing Assistance & Technology Up-gradation Scheme in MSMEs:** The scheme has a budgeted outlay of ₹ 26.5 Crore. Presently, 10 product groups have been identified for studies on packaging with identification of around 140 MSMEs for participation in industry fairs and exhibitions to identify technology upgradation potential.
- **Technology and Quality Upgradation Support to MSMEs:** This scheme has a budgeted outlay of ₹ 93.5 Crore and intends to cover the following:- i) awareness about need for energy efficient, clean development & product quality certification in 60 MMSE products, ii) development of energy efficient technology (EET) projects for 90 MSMEs in 30 clusters, iii) support to 300 MSMEs in developing bankable EET projects, iv) subsidizing EET projects of 390 MSMEs, v) establishment of 16 carbon credit aggregation centres etc.

From the above, it is observed that the interventions aimed at providing financial assistance for i) procurement of technologically superior plant & machinery& equipments or for establishment of common infrastructure and ii) capacity development / training on improving productivity / cost reduction are the ones which have had the maximum impact among the MSMEs in terms of intended target of facilitating technology upgradation. Some other key observations related to sectoral interventions include the following:-

- Limited progress in ensuring technology procurement / import, indigenization, commercialization and patenting by facilitating appropriate linkages with academic / research institutions, in spite of existence of requisite schemes & programmes of MoST aimed at addressing the same
- Potential for strengthening the mechanism whereby the technology incubators, tool rooms, training & testing centres, entrepreneurship centres established as part of various schemes & programmes of MoST & MoMSME are able to effectively link with the industry to address requisite technology gaps in a commercially viable manner

13.2. Impact of sector-specific interventions for technology promotion among MSMEs

In line with the findings for sectoral interventions, we observe that the sector-specific

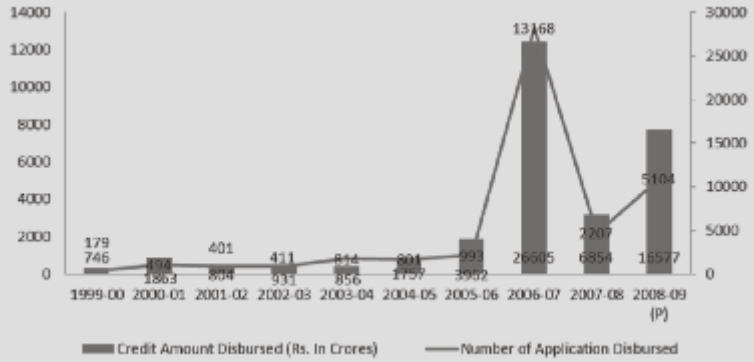
[50] Source: http://designclinicsmsme.org/about-dcs/cluster-information
[51] Source: http://www.dcmsme.gov.in/schemes/Institutions_Detail.pdf

interventions aimed at providing financial assistance for i) procurement of technologically superior plant & machinery& equipments or for establishment of common infrastructure and ii) capacity development / training on improving productivity / cost reduction are the ones which have had the maximum impact among the MSMEs in terms of intended target of facilitating technology upgradation. Select representative examples include the following:-

- Textiles – Technology Upgradation Fund Scheme (TUFS): Observed to have been leveraged by MSME units associated with the entire textile value chain, encompassing spinning, weaving, knitting, garment manufacturing etc., for purposes of investment in technology upgradation

Impact of TUFS:

- The TUFS scheme has disbursed over 24,500 loan applications amounting to ₹ 60,955 Crore over a time period of 1999-00 to 2008-09, as depicted in the chart alongside
- Further, it is observed that a majority of the loan applications (33%) have been from the spinning units with weaving units and garment manufacturing units accounting for 5% and 8% of the loan applications.



- Drugs & Pharmaceuticals - Interest subsidy for Schedule M compliance in line with GMP norms: Emerged as a key pre-requisite for ensuring compliance with mandatory regulatory norms of adopting Good Manufacturing Practices which involves significant investment in technology, equipments along with supporting systems & processes

Impact of Interest Subsidy scheme:

- It is expected that more than 3,000 MSME units will benefit from this scheme with financial outlay of ₹ 400 Crore to support investment required to ensure compliance with GMP norms, resulting in an additional turnover of ₹ 10,000 Crore annually for the MSMEs in the pharma sector.[52]

- Food Processing –Technology Upgradation/ Establishment/ Modernization of Food Processing Industries: Introduced to facilitate investment in technology upgradation related to food processing sector in order to improve productivity and cost-competitiveness

[52] Source: Press release on the Introduction of Department of Pharmaceuticals "Interest Subsidy Scheme for Schedule 'M' compliance" for SSI Pharma units dove-tailed with the Credit Linked Capital Subsidy Scheme (CLCSS) of MSME.

Impact of Technology upgradation / establishment / modernization of food processing industries :

- During the last financial year (2010-11), the Ministry had extended financial assistance to 545 units under the Scheme for Technology Upgradation/ Establishment/ Modernization of food processing industries in the country for which an amount of ₹ 92.87 Crore had been released as on March 4, 2011 against budgetary allocation of ₹ 106.01 Crore.[53]

- Leather - Integrated Development of Leather Sector (IDLS): Observed to have been leveraged by MSME units associated with both manufacture of finished leather as well as leather goods for purposes of investment in technology upgradation

Impact of IDLS:

- It is estimated that the IDLS scheme has generated additional investments of ₹ 716 Crore for modernization in addition to providing employment to 7,100 people and capacity addition to the extent of 320 million sq. feet of leather.

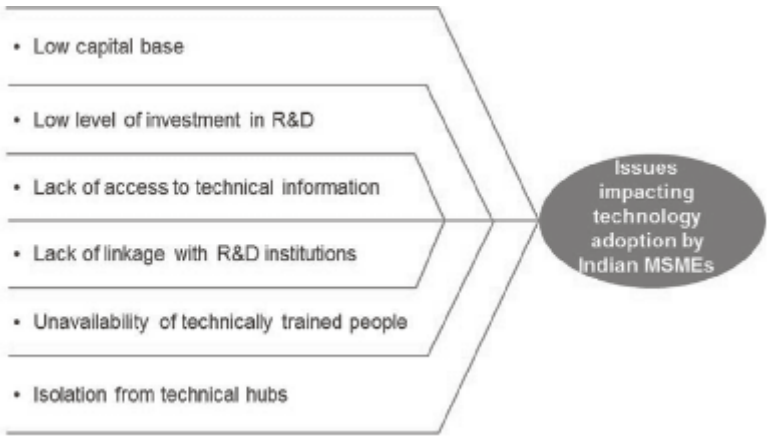
Further, it is observed that in spite of presence of implementing entities along with requisite sector-specific schemes & programmes aimed at facilitating technology procurement / import, indigenization, commercialization and patenting by developing linkages with academic / research institutions, limited progress has been achieved towards the same across all sectors with select successful case studies having been detailed below:--

- Food Processing: Institutions like Indian Institute of Horticultural Research (IIHR) have developed select technologies with the objective of enhancing productivity on account of shortage of skilled labour. IIHR has demonstrated new machines facilitating automated processing of areca nuts including husking, peeling, scraping, slicing, etc. which was earlier done manually
- Foundry: As part of the cluster development services project supported by SIDBI, The Energy and Resources Institute (TERI) have been providing Divided Blast Cupola (DBC) technology to the foundry units in the cluster by empanelling a select list of fabricators for manufacturing DBCs after providing them with requisite training and expertise
- Leather: CLRI has developed high-exhaustion chrome tanning process which results in exhaustion of 90% of chrome while ensuring the required finish along with development of a compound with similar properties of salt being used for curing which facilitates reduction in water consumed in the soaking process

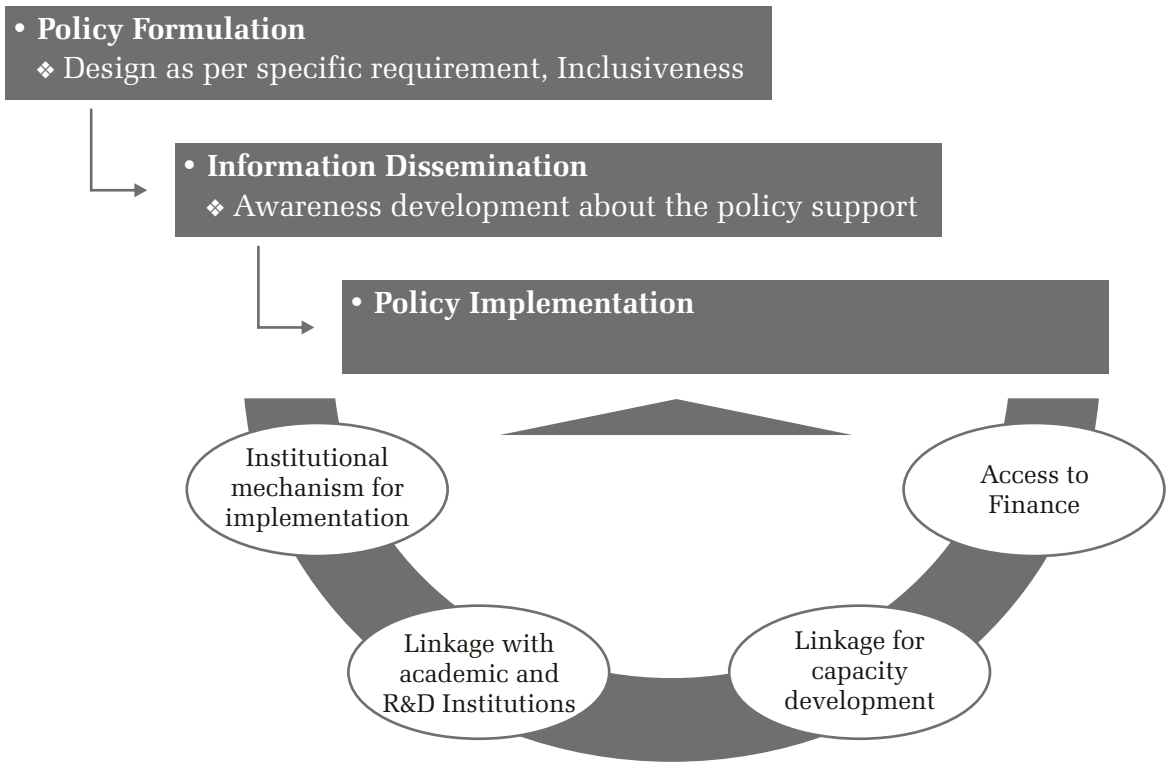
[53] Source: http://pib.nic.in/newsite/erelease.aspx?relid=70866

14. Issues Impacting Technology Adoption by MSMEs in India

Based on the primary interactions with the MSMEs and other key stakeholders associated with technology promotion during the cluster visits undertaken as part of this study, the key representative issues & constraints impacting MSMEs in their ability to make investments in technology upgradation / modernization for enhancing their competitiveness in the global markets is highlighted in the chart alongside.



For purpose of addressing issues impacting technology adoption by the MSMEs, a high-level value chain associated with delivery of intended benefits from the policies, schemes/ programmes formulated by Government agencies/ departments to support technology upgradation / modernization among MSMEs is detailed in the chart below.



14.1. Policy design & formulation

One of the key observations during the cluster visits undertaken as part of this study was the need for strengthening the existing mechanism for obtaining feedback from the MSMEs while designing and formulating policies aimed at technology promotion. This has been deemed critical in order to ensure that the actual and genuine requirements of the respective MSMEs are taken into cognizance at the policy design stage itself. Further, the specific inputs from MSMEs with respect to other aspects of policy design & formulation have been detailed below:-

- Lack of standardization of documents to be presented for purposes of availing the benefits under the respective schemes & programmes along with communication of the same. On account of the relatively low level of documentation maintained by MSMEs, this assumes significance to enhance coverage of target beneficiaries by preventing disqualification of those MSMEs who may not have select documents readily available with them. However, it should be noted that the minimum level of documentation to be requested should be commensurate with the underlying support being offered as part of the respective scheme while trying to ensure that this does not impede MSMEs from availing the benefits from a particular scheme
- Absence of a policy for empaneling reputed technical personnel & capacity development agencies with requisite experience in respective sector along with need for financial support to be offered towards reimbursement of consultancy charges for inputs required by MSMEs in terms of evaluation of various technologies available and capacity development interventions for the same
- Limited on-ground support to academic / research institutes to demonstrate the feasibility of adoption of indigenously developed technology on a commercial basis through a pilot project / site. This results in risk-averseness among the MSMEs with respect to respective technology adoption without assessing practical demonstration of the same, considering their limited financial ability & the higher risk associated with technology related investments.
- Absence of periodic updation of the list of equipment, machinery eligible for benefits under respective schemes & programmes aligned to the latest technology in line with the global trends which may reduce the intended impacts and may not yield much competitive advantage
- Limited support available to domestic equipment manufacturers/ fabricators for developing better quality and cost competitive equipments like tools, dies, moulds, jigs, fixtures, etc. along with indigenization of best-on-class technology available with foreign firms

Examples of issues related to policy design & formulation across individual sectors:

- **Textiles:** i) Need for periodic update of equipment/ machinery eligible for benefits under Technology Upgradation Fund Scheme (TUFS) for ensuring intended benefits, ii) Absence of empanelled technical experts for providing guidance in areas like effluent treatment, water conservation technology, etc. to the processing/ dyeing units, ii) Absence of adequate support to machine fabricators like knitting machine manufacturers for providing better quality & cost competitive machines to the knitwear manufacturers

- **Drugs & Pharma:** Lack of clarity on whether the investments made in respective equipment and technology by small and medium enterprises respectively are eligible for exemptions / benefits as part of various Government schemes & programmes like Credit Linked Capital Subsidy Scheme (CLCSS) and the proposed Pharmaceutical Technology Upgradation Assistance Scheme (PTUAS)
- **Food processing-** Fruits & Vegetables: Absence of a policy for empanelment of consultants for facilitating quality certifications related to ISO, HACCP, BRC, FSA / FSSR, SA etc., which is critical for MSMEs in this sector for catering to the export markets
- **Foundry:** Absence of a policy to support equipment manufacturers like Divided Blast Cupola fabricators for providing better quality and cost competitive furnaces to the casting manufacturers, especially those related to manufacturers using lower diameter furnaces
- **Ceramics:** Absence of a policy to support equipment fabricators like roller kiln fabricators for providing better quality & cost competitive machines to the ceramic tile manufacturers
- **Plastics:** i) Need for formulation of a policy for institutionalizing the mechanism for collection of household plastic waste for supply to recyclers to reduce wastage of plastic polymers and potential negative impact on environment, ii) Exploration of possibility of supporting MSMEs in making requisite investments in technology upgradation to move to higher-value added products for agriculture, infrastructure, medical equipment & automobile components along with respective capacity development support
- **Paper:** Need for formulation of a policy for a) institutionalizing the mechanism for collection of household paper waste for supply to paper manufacturers using waste paper as the key input which also reduces potential negative effect of forest degradation and b) facilitating adoption of gas-based boilers vis-à-vis coal-fired boilers through requisite financial incentives / subsidies
- **Engineering:** i) Absence of empanelled technical experts for providing guidance especially in the areas of plant layout, productivity and efficiency improvement, etc. ii) Absence of a policy for empanelling specialized operators who can be utilized for select high-skill operations along with a mechanism for compensation of the operator charges. For e.g. Programmers for CNCs and VMCs are needed only for development of new programmes for limited duration (not full-time) and thus they can be empanelled for the cluster with sharing of costs across units in the respective cluster on a time sharing basis
- **Electronics:** Need for formulation of a policy for institutionalizing the mechanism for collection of e-wastage for supply to recyclers to ensure optimum utilization of e-wastage & avoid potential negative impact on environment. It should be noted that only an estimated 10% of e-waste finds its way to the recycler due to absence of an efficient collection scheme
- **Leather:** Need for formulation of a policy for institutionalizing the mechanism for collection of hides and skin. This would need to be supported by i) increasing

awareness levels of collectors and traders at the village level for ensuring proper flaying methods being used along with ii) improvement in infrastructure at the dead animal collection centre to ensure prevention of damages to the hides and skin during the collection stage

14.2. Information dissemination

Another key issue impacting higher level of technology adoption among the MSMEs is the lack of adequate information on the various schemes & programmes being implemented by Government to support technology adoption among MSMEs. Identification of single point of contact for information dissemination along with timely availability of information emerges as one of the main issues resulting in utilization levels of these schemes & programmes which may be lower than the actual level of requirement. The specific issues related to information dissemination include addressing the following key information requirements:

- Eligibility criteria for purposes of qualifying to receive the intended benefits from respective schemes & programmes along with the details of documentation to be submitted
- Specific benefits accruing from respective schemes & programmes along with comparison of the same in case of availability of multiple schemes & programmes for the same purpose
- Identification of a mechanism / single point of contact to act as source of information on all applicable schemes & programmes specific to the respective requirement to ensure delivery of intended benefits to the target beneficiary
- Mechanism for facilitating technology transfer through joint ventures / strategic collaborations, patenting process, IPR protection, etc.

Issues related to information dissemination impacting multiple sectors:

- **Environment friendly technology:** Lack of adequate mechanism for dissemination of information related to various aspects associated with adopting "environment friendly" technologies and availing carbon credits in specific sectors viz. food processing, foundry, plastics, paper, etc.
- **Patenting & IPR:** Lack of adequate mechanism for dissemination of information related to various aspects of patenting and IPR, especially in high-technology oriented sectors viz. drugs and pharma, electronics, etc.
- **Quality certifications:** Lack of adequate mechanism for dissemination of information related to quality certifications including the benefits of being certified, the applicability, the process of application and the process of certification for select sectors viz. food processing (certifications like ISO, HACCP, BRC, FSA/ FSSR, SA, etc.), leather sector (certifications like ISO and SA) and the engineering sector (NABL accreditation for inputs, instrument calibration) etc.
- **Eligibility of technology / equipments for respective schemes & programmes:** Lack of clarity in whether investments in setting up i) collection centres for slag (for supplying to the cement manufacturers) for foundry clusters as part of Common

Facility Centre in the cluster, ii) setting up Common Facility Centres for select value chain activities like preparation of body for wall and floor tiles in the ceramics cluster and iii) granulators / incinerators as part of Common Facility Centres in plastic processing / paper manufacturing clusters would qualify as investments under MSE Cluster Development Programme (MSE CDP) being operated by Ministry of MSME

Examples of issues related to information dissemination across individual sectors:

- **Textiles:** i) lack of clarity whether MSE Cluster Development Programme (MSE CDP) operated by the Ministry of MSME which could be leveraged to establish a) CETPs for the dyeing and processing units which have not been able to attain zero discharge of effluents and b) Testing centres for enhancing quality of chemicals being used, ii) Lack of adequate awareness on eco labels, quality certifications and manufacturing principles like six sigma, cost reduction and lean manufacturing which may adversely affect the quality, delivery schedules and competitiveness of the units. Although workshops are being conducted by institutions/ agencies like Consumer Unity and Trust Society (CUTS), South India Textile Research Association (SITRA) and United Nations Environment Programme (UNEP) on such issues, there is a need for greater level of interventions related to information dissemination.
- **Drugs & Pharmaceuticals:** Lack of clarity in terms of the mechanism of organization of MSMEs into groups in terms of minimum numbers, need for synergies in production processes / products manufactured etc. in order to avail the benefits available under the interventions supported by National Manufacturing Competitiveness Programme (NMCP), which are implemented through the Office of Development Commissioner (MSME)
- **Food processing-Fruits & Vegetables:** Lack of adequate mechanism for dissemination of information related to various aspects associated with technology adoption including associated sector-specific financing scheme for facilitating technology upgradation
- **Electronics:** Lack of formal database repository of technologies available along with corresponding vendors in the electronics sector. This is especially relevant for the special purpose machinery which is specific in terms of functionality and applications and could be one of the key intervention areas for process automation
- **Leather:** i) Lack of adequate level of awareness about requisite compliance with standards and regulations like eco-bans and eco-labels which may adversely affect exports, ii) Limited awareness of modern technology and IT solutions, poor inventory management, absence of knowledge of key manufacturing principles like six sigma, lean manufacturing etc. resulting in lower productivity and production inefficiencies, iii) Limited awareness about mechanism for availing schemes and programmes of different government agencies, especially among micro units. For e.g. the MSE Cluster Development Programme (MSE CDP) can be leveraged by micro units to set up common facilities at cluster level including designing centre, shoe pasting, double stitching machines etc.

14.3. Institutional mechanism for implementation of Government schemes & policies

On account of the multiple stakeholders usually involved with implementation of respective Government schemes & programmes, the delivery of the intended benefits are often delayed on account of procedural delays, lack of clarity in the delivery mechanism, lack of accountability etc. This is another major issue which impacts the optimum utilization of intended benefits on account of delays in disbursement of the same which impacts the viability of the investments made by the MSMEs. Key issues associated with the institutional mechanism for implementation of respective Government schemes & programmes include the following:-

- Presence of individual schemes & programmes with similar objectives under the administrative control of different Government ministries / agencies / entities with relatively lower level of co-ordination resulting in sub-optimal utilization of funds and implementation mechanism along with issues in ensuring accountability for implementation and monitoring among the concerned stakeholders.

Multiplicity of schemes offering similar support across sectors: Results in sub-optimal utilization of existing schemes & programmes along with lack of clarity among the associated stakeholders. Select examples include

- Technology incubators are being promoted as part of interventions by i) DoST (MoST) through NSTEDB as part of scheme for Technology Business Incubators, ii) MoMSME through NSIC as part of scheme related to Training cum Incubation Centres on PPP basis, iii) MoMSME through Office of Dev. Comm. (MSME) as part of NMCP initiative aimed at supporting entrepreneurial & managerial development through incubators
- Tool rooms cum training centres are being promoted as part of interventions by MoMSME directly through i) Office of Dev. Comm. (MSME) in form of financial assistance to states / state agencies for setting up mini tool rooms & training centres or as part of ii) NMCP initiative for mini tool rooms & training centres in PPP mode
- Assistance for establishment of common facility centres is available as part of initiatives of i) DIPP as part of IIUS, ii) MoMSME through SFURTI initiative and iii) MoMSME through the Office of Dev. Comm. (MSME) as part of the MSE CDP programme
- Training infrastructure upgradation at entrepreneurship development institutions available as part of interventions by MoMSME directly through i) scheme for assistance to training institutions or ii) through Office of Dev. Comm. (MSME) as part of scheme related to strengthening of training infrastructure of existing & new Entrepreneurship Development Institutions
- Subsidized financing for technology adoption is available from sectoral schemes & programmes like Credit Linked Capital Subsidy Scheme (CLCSS) being operated by MoMSME, along with sector-specific interventions like Technology Upgradation Fund Scheme (TUFS) for the textile sector.

- Absence of a formal mechanism to assign roles & responsibilities to stakeholders associated with implementation of respective schemes & programmes. Further, lack of any provision for fixing the service level norms for the associated stakeholders impacts the ability to allocate accountability for overall execution of the respective schemes & programmes
- Absence of adequate monitoring mechanism for the respective schemes & programmes in order to trace the delays in making disbursements along with formulation of mechanism to identify the key reasons for the delays and communicate the same to the respective applicant
- Need for exploring the possibility of routing incentives offered as part of respective Government schemes & programmes to the equipment/ technology/ service provider directly rather than MSMEs first having to incur the expenses/ make investments and then having to claim the same from the Government

Examples of issues related to institutional mechanism for implementation of Government schemes and policies across multiple sectors:

- Need for adequate coordination among Government departments / agencies / institutions while formulating mechanism for delivery of benefits / incentives by optimally leveraging existing schemes vis-à-vis formulation of new schemes with similar objectives: As part of the MSE Cluster Development Programme (MSE CDP) being operated by Ministry of MSME, 70% of the cost of project of maximum value of ₹ 15 Crore is provided as grant by Government of India. However, MSMEs are of the opinion that they need further support on account of issues faced in raising the balance funds (30% of project cost) on their own which could be provided by administrative department / State Government in form of grants for this existing scheme vis-à-vis formulation of a separate scheme aimed at cluster development. For this purpose, the administrative department could route support extended by it to MSMEs in the sector by funding a part of the balance project cost – could be Department of Pharmaceuticals for drugs & pharmaceutical sector, Department of Chemicals & Petrochemicals for plastics sector, Department of Industry Policy & Promotion for paper & leather etc.

Examples of issues related to institutional mechanism for implementation of Government schemes and policies across individual sectors:

- **Drugs & Pharma:** i) Multiplicity of similar schemes being operated by various Government departments / agencies / institutions results in lack of clarity among MSMEs in understanding its applicability, benefits and mechanism for delivery thereby impacting the potential impact. Department of Pharmaceuticals (DoP) had proposed a Pharmaceutical Technology Upgradation Fund (PTUF) to incentivize investment in requisite quality certifications which was rejected by the Planning Commission as it would serve the same purpose as Credit Linked Capital Subsidy Scheme (CLCSS) being operated by Ministry of MSME. Instead, DoP was asked to refine CLCSS in collaboration with other ministries to ensure inclusion of such

machineries & equipments to aid acquisition of quality certifications as part of the scheme. Further, DoP has gone ahead with the proposed Pharmaceutical Technology Upgradation Assistance Scheme (PTUAS) aimed at technology upgradation for medium sector players only to meet the requirements of adherence to GMP / GLP norms while limiting the benefits available to smaller units to CLCSS. This has resulted in confusion among the small and medium units in terms of mechanism for availing benefits as part of the respective schemes.

14.4. Linkage with academic / research & development oriented institutions

On account of historically lower level of investments being made by MSMEs in technology along with primary reliance on self-innovation for the same, it is observed that the requisite level of linkages have not been established with academic / R&D institutions for purposes of technology development / indigenization in line with specific requirements of the MSMEs. This is especially critical for the micro and small enterprises which would find it difficult to invest in imported technology and are forced to depend either on i) locally available technology which may not always measure up to the global standards or ii) outdated technology imported once the same has become obsolete elsewhere. This could be attributed to the i) presence of limited number of well-equipped academic / research institutes which are focused on developing technologies aligned to MSME-specific requirements along with ii) absence of requisite incentives to these institutions to facilitate investment in R&D for MSMEs.

Further, there is lack of adequate forum for MSMEs to interact with such academic / research institutions in order to communicate the specific technology requirements that they may have in order to facilitate technology development aligned to their specific requirements.

Examples of issues related to linkage with academic/ research & development oriented institutions across individual sectors:

- **Textiles:** Presence of limited number of well-equipped academic / research institutions providing support in areas like i) effluent treatment and ii) water conservation technology for processing/ dyeing. Although institutions like SITRA, BTRA, etc. have contributed in developing and indigenizing select technologies, there is a need for more effective collaboration between the MSME units and the relevant academic/ research institutions
- **Food processing- Fruits & Vegetables:** Absence of adequate support from academic/ research institutions in areas like productivity improvement, packaging, food testing, etc. Institutions like Indian Institute of Horticultural Research (IIHR) have developed select technologies with the objective of enhancing productivity on account of shortage of skilled labour. IIHR has demonstrated new machines facilitating automated processing of areca nuts including husking, peeling, scraping, slicing, etc. which was earlier done manually. However, these interventions have been very limited and there is a need for more effective collaboration between MSME units and the relevant academic/ research institutions.

- **Foundry:** Presence of limited number of well-equipped academic/ research institutions like TERI, NIFFT, etc. providing cost effective technology in areas like pollution control and energy conservation. For e.g. As part of the pollution control initiative, the Venturi scrubber based pollution control technology has been developed by TERI in association with SDC. However, adoption of the same is very capital intensive and is considered to be economically unviable for small and medium size foundry units.
- **Ceramics:** Presence of limited number of well-equipped academic/ research institutions like CGCRI providing cost effective technology for purpose of productivity improvement / cost reduction. For e.g. there is a scope for indigenizing technology for equipments like automated hydraulic presses to enable the fabricators to provide cost competitive technology to ceramic tile manufacturers who are currently dependent on the imported machinery
- **Plastics:** Lack of adequate support from academic/ research institutes for developing cost effective technology. Although institutes like CIPET has been providing support to the industry, there is a need for more support from such institutes to the industry in order to resolve and address the technology related issues faced by the MSME units. For e.g. there is a scope for indigenizing technology for manufacturing moulds and equipments like "hot-runner" based moulding machines to enable the plastic manufacturers to reduce plastic wastage and lower costs associated with mould sourcing
- **Paper:** Although institutes like CPPRI has been providing support to the industry, there is a need for more support for the industry from academic and research institutes in order to resolve and address the technology related issues faced by the MSME units. For e.g. there is a scope for indigenizing technology for equipments like shoe-press machines and online testing tools to enable the paper manufacturers in reducing coal consumption and improving productivity through reduction in rejection levels
- **Engineering:** i)Lack of adequate support from academic/ research institutes in capital intensive activities like product designing and prototyping. Although, select institutes like CMTI and CSIO provide support to the industry, there is a need for greater level of linkages with these institutes which provide product development support in line with the market trends, ii) Absence of adequate support from well-equipped tool rooms having requisite technical capabilities and ability to manufacture complex tools, moulds, dies, jigs, fixtures etc.
- **Leather:** Although institutes like CLRI has been providing support to the industry, there is a need for further support for the industry from relevant academic and research institutes in order to resolve and address the technology related issues faced by the MSME units, especially those related to compliance with environmental norms. For e.g. While CLRI had developed a compound with similar properties of the salt being used for curing to reduce water consumption during curing, the limited availability of the same prohibits the utilization of the same at a commercial level

14.5. Linkage with capacity development facilitating agencies

Inability of MSMEs to continuously upgrade skill and knowledge associated with the respective technologies adopted by them across various sectors is one of the key issues impacting their ability in achieving global competitiveness. The same may be attributed to the risk perception among the MSMEs associated with attrition of resources that have been imparted training along with the absence of institutions with requisite level of orientation towards MSME-specific training requirements. Though the institutions aimed at capacity development of the industry may be accessible to MSMEs in terms of geographic presence, MSMEs are of the opinion that these capacity development facilitating agencies may not always be in sync with their specific skill development requirements in terms of the curriculum, trainers, infrastructure etc. A key reason for the same could be the absence of requisite incentives to these institutions in developing training modules for MSMEs as the scale of business may not justify the investments needed to be made by these institutes on their own. In addition, the other key issues impacting linkages of MSMEs with capacity development facilitating agencies include:

- Absence of a formal database repository of experienced resources from the industry that may be willing to support the MSMEs in various capacity development initiatives for purposes of ready access.
- Presence of limited number of dedicated capacity development institutes/ agencies focused on the respective sector. Further, there is a lack of adequate formal database repository for the same for purposes of ready access.
- Lack of adequate forum for MSMEs to interact with these capacity development institutes / agencies in order to provide their inputs in terms of course curriculum development, practical training facility, etc.

Examples of issues related to linkage with capacity development facilitating agencies across individual sectors:

- **Textiles:** Absence of adequate capacity development institutes/ agencies like National Institute of Fashion Technology (NIFT), National Institute of Design (NID), etc. focused on augmenting design capabilities of the textile manufacturers. Further, courses offered in most of the other institutes are not aligned to the fashion trends in vogue globally
- **Engineering:** Presence of limited number of dedicated capacity development institutes/ agencies like CMTI focused on augmenting skill sets of MSME sector. Presently, the engineering units are facing a shortage of CNC and VMC machine operators and thus special focus is required for developing such skills. To address the same, select SMEs have started designing courses to be rolled out by the ITIs in the geographic vicinity along with provision for facilitating practical training for the same in their respective units

14.6. Lack of access to finance

Low capital base along with inability to secure working capital for expanding scale of operations on their own is a key deterrent for MSMEs in making investments in technology upgradation, unless the same is driven by specific business requirements impacting the viability of the operations. Key issues related to availing finance for making any investment in technology upgradation includes the following:-

- Limited availability of financing without recourse to physical collaterals, which often results in inability to secure financing in absence of development of alternative products like factoring, purchase order based financing etc. and relative risk-averseness of the banks and financial institutions in advancing credit in absence of any underlying marketable collateral
- Absence of subsidies / benefits in terms of interest rate cuts, higher moratorium periods, level of documentation to be complied with etc. while availing credit. Even in case where these benefits may be available, the delay in disbursement of benefits forming part of applicable Government schemes & programmes causes the MSMEs to make the requisite investment upfront using own resources is an area of concern and also impacts the viability of investments made by MSMEs in technology upgradation
- Absence of adequate access to finance for technology upgradation with respect to establishment of common facility centres, even after leveraging MSME CDP, on account of the need to invest around 30% of the project cost by an association of MSMEs which may be cost-prohibitive in the event of significantly higher level of investments. This may result in lack of adequate infrastructure facilities in common facility centres in terms of presence of requisite machineries/ technologies which are capital intensive & difficult for MSMEs to acquire on their own on account of limited scale of operations which render investments in such technologies unviable without adoption of a cluster-based approach.

Examples of issues related to lack of access to finance across individual sectors:

- **Textiles:** Absence of adequate financial support in terms of incentives to the equipment manufacturers / fabricators for providing better quality and cost competitive indigenized technology. For e.g. knitting machinery manufacturers need support in terms of finance for providing best-in-classupdated machinery to knitwear manufacturers, who primarily rely on imported machinery currently
- **Foundry:** Lack of adequate financial support to equipment manufacturers and fabricators for providing better quality and cost competitive indigenized technology. For e.g. Fabricators manufacturing Divided Blast Cupolas (DBC) need support in terms of finance for providing better quality furnaces to the foundry manufacturers
- **Ceramics:** Inadequate financial support to equipment manufacturers and fabricators for providing better quality and cost competitive indigenized technology. For e.g. Fabricators manufacturing roller kilns need support in terms of finance for providing better quality kilns to the ceramic manufacturers

- **Plastics:** Lack of adequate financial support to mould & die manufacturers to invest in technology upgradation impacts their ability to meet the domestic requirements in a cost effective manner, resulting in reliance on imports from China which are relatively cheaper
- **Engineering:** Lack of adequate financial support to tool & equipment manufacturers impacts their ability to invest in CNC machines which in turn has an adverse impact on the quality of tools & equipments manufactured by them for use by MSMEs

15. Best practices associated with S&T policies & programmes facilitating technology upgradation among MSMEs

In line with our assessment of policies and programmes in place in India for promoting technology promotion among MSMEs in India and cluster-based findings with respect to technology-adoption related issues among MSMEs, we have summarized the key reasons for the lack of technology upgradation among MSMEs across the respective stages of technology adoption in the table below. Further, we have also mapped the best practices adopted globally to address the representative issues identified in the Indian context.

Stage of technology adoption	Issues impacting technology adoption by MSMEs	Identified best practices to resolve the issues
Technology development	• Development of innovative and cost-effective technology on account of limited linkage between the R&D agencies and industry	• Promote linkage between MSMEs and academic/ research and development institutions for providing MSMEs access to technical experts/ consultants and facilities of the institutes • Provide financial incentives for promoting linkages between MSMEs and academic/ research and development institutions • Strengthen the policy framework to support the commercialization of research driven technology development
Technology identification & selection	• Identifying the appropriate technologies, corresponding vendors and the mechanism of technology adoption	• Establish a mechanism for identification of appropriate technology and corresponding provider • Develop schemes and programmes for supporting demonstration projects and disseminate the findings to prove the viability of new technologies
Technology adoption	• Absence of institutional mechanism to support and guide the MSME in technology adoption • Lack of access to finance specifically for technology adoption	• Establish dedicated technology transfer and commercialization agencies to support technology adoption by MSMEs • Ensure access to finance focused on technology adoption
Supporting mechanisms	• Limited awareness of the Government schemes and programmes available to support technology adoption • Lack of mechanism to source feedback from MSMEs in terms of support required from Government to ensure higher level of technology adoption	• Develop a single window for providing MSMEs with all relevant information including information on all applicable schemes and programmes specific to the respective requirement to ensure delivery of intended benefits • Ensure that MSME interests are considered from the earliest stages of policy formulation and development

This section details the best practices adopted by respective Governments, development agencies, quasi-Government agencies and public enterprises globally to address the technology adoption related issues faced by MSMEs which are also in-line with the issues faced by MSMEs in India detailed in the table above.

15.1. Technology Development

15.1.1. Promote linkage between MSMEs and academic/ R&D institutions for providing MSMEs access to technical experts/ consultants and facilities of such institutes

Lack of access to state-of-art research and testing equipment & systems, technical know-how and expertise in conducting R&D impacts the ability of MSMEs in undertaking product development through technology innovations. However, there have been select examples of MSME clusters such as the Route 128 of Boston, the Baden Wurttemberg region of Germany, the Italian industrial districts and Western Jutland of Denmark which have been at the forefront of industrial development and innovation. The primary reason for this is that the MSMEs of these regions have been successful at establishing linkages with the academic/ R&D institutions of the region[54] and have been able to leverage the research findings and knowledge of these institutions to innovate and develop new technologies.

Some of the ways in which the linkage between academic/ R&D institutes and industries can be beneficial for R&D of technology include (i) providing general support to the industry through manpower and facilities, (ii) conducting contract research on behalf of a firm/ unit, (iii) operating specialized research centres on specific areas of research, and (iv) formation of research consortia where the internal R&D unit collaborates with the University to carry out R&D activities, etc. In order to promote linkages between academic/ R&D institutes and industries in terms of providing manpower and facilities, there have been various schemes and programmes introduced by Governments such as the Technology for Enterprise capability Upgrading (T-UP) scheme and the Facility Sharing Programme under the GET-Up programme of Singapore. Besides, there are also instances of joint partnerships between public and private entities to conduct contract research on behalf of firms such as the BioConnection Company of Netherlands and research consortia of universities, public sector R&D institutions and industries such as the Cooperative Research Centres (CRCs) of Australia. The salient features of these initiatives are given below:-

Singapore: T-UP scheme under the GET-Up Programme

- The Growing Enterprises with Technology Upgrade (GET-Up) programme was developed to address the need for access to R&D facilities and promote linkages with research personnel for the MSMEs
- It was jointly developed by SPRING Singapore, the enterprise development agency of Singapore; A*STAR institutes - the lead agency for developing science and technology of Singapore; the Economic Development Board; IE Singapore and Infocomm Development Authority
- The GET-Up programme has various components one of which is the Technology for Enterprise Capability Upgrading (T-UP) scheme which aims to help MSMEs to identify

[54] Source: Joint study by Acs, Audretsch & Feldman and independent study by Feldman

critical technologies and build in-house R&D capabilities relevant to their operations with support & guidance from a designated subject expert and promote linkages between the researchers in these institutes and the MSMEs for technology transfer

- Under the scheme, grants are provided to MSMEs to engage local and overseas experts from polytechnics, research institutes, universities and the industry to help MSMEs access the pool of R&D talent and expertise and build their internal capabilities
- A key feature of this scheme is that the expert selected is seconded to the MSME unit and the grant is for covering a part of the salary and the related costs of the expert up to 2 years. After the 2 year period when support is extended by the programme, there is an option for companies to retain the seconded staff on a full time basis if there is a mutual agreement
- Since its launch in 2003 till April 2009, 208 researchers had been seconded to 138 local companies. Out of them 23 researchers joined their designated companies at the completion of their secondment

Singapore: Facility Sharing Programme under the GET-Up Programme

- Under this scheme, MSMEs are given access to the state-of-the-art R&D facilities of the institutes under the Agency for Science, Technology and Research (A*STAR), Singapore's lead agency for promoting science, technology and research for failure analysis, prototyping and solution formulation
- Under the A*STAR, there are presently 14 research institutes and six consortia and centres which are equipped with advanced and high end equipment and facilities which can be used by MSMEs. However, it should be noted that the MSMEs may use these facilities only when the A*STAR research institute is not using it.
- As a part of this programme the institutes under the A*STAR would also provide training and certification to the personnel of the MSMEs in order to effectively use the facilities. This is mandatory for MSMEs who are interested to use these equipment/ facilities with specific training courses designed depending on the type of equipment/ facility being used

Netherlands: BioConnection

- MSMEs in the drugs and pharmaceuticals sector face a number of challenges during the clinical development phase of product development due to the following reasons:(i) this phase requires high capital and resources for acquiring and setting up highly specialized machinery and technology (ii) the SMEs are averse in investing during this stage since the risk of failure is high at this phase and (iii) the units have limited experience in the clinical development phase and expertise of how to bring the lead products into production.
- To address these issues, the company BioConnection, a joint initiative between the Dutch government agencies of Dutch Ministry of Economic Affairs, the regional government, the municipality and privately owned pharmaceutical industries including Merck & Co was established in 2005.
- The company has made its laboratory facilities, specialized equipment, knowledge and

expertise accessible for MSMEs for formulation development, process and analytical development, clinical trial material support, production of small scale clinical batches, and scaling up to large scale commercial production thus helping the MSMEs to overcome the above constraints and helps in reducing time and money required in this phase of drug development.

- The facilities for production comply with the Clinical Good Manufacturing Practices (cGMP), HSE standards and with the US Food & Drug Administration (FDA) and the European Medicine Agency (EMEA)
- BioConnection also provides the necessary linkages to the raw material and intermediate product suppliers and service providers related to laboratory operations and clinical development through its network which further assists the MSME in focusing on the product development process
- Specific service of BioConnection can be availed by MSMEs or they can approach the company for assistance across the complete clinical development phase
- A case study highlighting the services availed by an SME based in Israel from BioConnection and the reason for doing so are given below:-

Biokine of Israel had been in the process of developing a key molecule in the regulation of different cancer diseases and used the facilities of BioConnection for availing state-of-the-art development services and cGMP manufacturing facilities. BioConnection was selected by Biokine because of its ability to provide various services required for product development such as formulation development, process and analytical development, production of clinical trial material and/ or optimization and commercial scale-up which would reduce the time-to-market for Biokine while ensuring cGMP compliance from the development stage itself.

Australia: Cooperative Research Centres (CRCs)

- A CRC is a collaborative partnership between public funded R&D organizations, universities, industry associations and large/ small private sector organizations in order to promote linkages between public R&D institutes and end-users by ensuring that technology research being carried out is in-line with industry requirements for subsequent commercialization
- The linkage is ensured by the fact that any CRC formed has to include at least one Australian end-user who can be from the public/ private/ community sector and at least one research institute affiliated to an university
- A key feature of the programme is that it allows the end-user to help plan the direction of R&D initiatives. From a private sector organization's perspective, the CRC allows it to access inter-disciplinary research teams who would work on resolving their technological issues and technology R&D needs while sharing the risks of the developmental project
- Engaging SMEs for CRCs is a priority for the programme and in 2007-08, there were about 800 SMEs who were directly involved in CRCs and many more involved indirectly as part of industry associations/ companies which were established to facilitate their involvement

- The programme started in 1991 and is administered by the Commonwealth Department of Innovation, Industry, Science and Research and till date has established 186 CRCs and has been financially supported by the Australian Government (invested $ 3.3 bn) and participants in CRCs (invested $10.8 bn in cash or in-kind)
- For ensuring proper monitoring of the activities of the CRCs, a CRC Committee is in place which decides on the funding for the project, reviews its performance and takes decisions on terminating, redirecting or accelerating projects thus ensuring accountability of the research conducted. The committee members are drawn from a wide range of expertise across education, research management, industry sector experts etc.

15.1.2. Provide financial incentives for promoting linkages between MSMEs and academic/ research and development institutions

The ability of MSMEs to upgrade its technology and conduct necessary R&D for improvement of its processes/ products is severely hampered by the lack of finance for such activities. Further, the support available from academic / R&D institutions is also limited for MSMEs with most of these institutions focusing on undertaking research & development projects only for larger enterprises on account of relatively better chance of commercialization and the associated financial benefits from the same. In order to ensure that the academic/ R&D institutes collaborate and support MSMEs in addressing their technology upgradation related interventions, Governments across the World have taken a number of initiatives to provide access to finance for MSMEs through grants, soft-loans and other innovative means such as the Co-operative Research Projects (CRAFT) / Collective Research Projects of the European Union and the Innovation Voucher Schemes of Netherlands.

European Union: Cooperative Research Projects (CRAFT) / Collective Research Projects

- The Co-operative Research Projects (CRAFT) supports groups of SMEs with no or inadequate research facilities in engaging third parties like academic/ R&D institutes to carry out research on their behalf on a specific technological requirement/ issue. On the other hand, the Collective Research Projects is carried out by third party research agencies for industry associations whose members are mostly SMEs. However, it should be noted that the larger firms are allowed to participate in these projects subject to their participation having a positive impact on technology adoption among SMEs
- In order to attract more SMEs to avail these schemes, the projects considered need not be associated with very high level of technology novelty / innovation. This is evident from the fact that this programme provides for funds for projects in the range between €0.5 mn to €2 mn.
- A key feature of this programme is that the SMEs participating in the project are the sole owners of the IP developed as a result of the project. On the other hand in order to attract the research organizations to undertake such projects, the programme provides for 100% reimbursements of the project related costs of the third party researchers
- Further, the projects are also designed in such as manner so that the application process involves less documentation and administrative requirements

- Highlights of 2 representative CRAFT projects for 2 different sectors have been presented below:-

Substrates which are used for growing mushrooms and other mycelium products often get contaminated leading to wastage. In order to resolve this issue, 10 SMEs including mushroom growers, brewery representatives, manufacturers of moulds and 2 research organizations came together to develop a method of producing substrates which would eliminate risks of contamination, reduce water and energy consumption and require less labour. With financial support amounting to over € 1 mn out of a project cost of around € 1.95 mn from the EU as a part of the CRAFT project, the project partners developed a new machine which produces high quality and contamination-free substrates. The machine also produces the substrates faster than the earlier process and requires less energy and water and manpower. A prototype has already been developed and the SME project partners are going to produce the machine on a production scale.	In leather production, the stage of tanning involves exposing the hides/ skins to chemicals in closed drums which leads to a blind process without any monitoring resulting in inconsistencies and inefficiencies. In order to resolve this issue; 10 SMEs, 2 large companies involved in leather tanning & processing and 3 research providers got together to devise ways and means to achieve a compact, convenient and better process control. With a grant of € 220,000 from the EU, the project resulted in developing a compact and reliable, on-line, battery operated pH and temperature measurement module to fit into existing equipment. It also went onto design an off-line colour measurement system to analyses solutions from the drums as an indicator of the colour take-up of the hides being processed.

Netherlands: Dutch Innovation Voucher Schemes

- The Dutch Innovation Voucher Scheme was introduced in 2004 in order to promote linkages between SMEs and R&D institutes so as to stimulate innovation and R&D in SMEs
- Under the scheme, a voucher is issued to an SME for redeeming against the R&D services availed by an SME from knowledge/ academic institutions. The validity of the voucher is limited to one year
- The voucher helps the SMEs in approaching public knowledge institutions for either enhancing or developing new products/ processes/ applications/ practices/ operations/ new technology innovation capabilities
- For the R&D institutes, most of whom are reluctant in conducting projects for SMEs because of the risks involved in terms of financial ability to pay for the R&D undertaken on their behalf, the voucher covers the costs of the R&D services provided
- The vouchers can be redeemed at any of the enlisted 281 knowledge institutions of the country, with the list being readily available on the web.
- In 2010-11, a budget of €41 mn had been earmarked for 6285 public vouchers to be used for public funded R&D institutes and 2000 private vouchers to be used by private R&D institutes. The high demand for the vouchers is reflected by the fact that by May all the vouchers had been allocated.

- The impact of this voucher scheme is reflected in a study finding which found out that 58% of the participating SMEs would not have started the cooperation and linking with the R&D institute without the voucher
- Based on the success of this scheme, similar schemes have been rolled out in the UK, Ireland and Belgium and a scheme called the KVoucher which was started by seven European countries with financial support from the European Union. Singapore also provides Innovation Voucher Schemes on similar lines.

15.1.3. Strengthen the policy & regulatory framework to support the commercialization of research driven technology development

Although a significant number of technology-based research ideas and intellectual property are generated at research institutes and academic institutions/ incubators, it is observed that the commercialization rates of the same are very low. A key reason for this is the limited collaboration between research institutes and end-users/ industry due to lack of incentives for research institutes to collaborate with MSMEs often resulting in research developed not being in-line with industry and market requirements. In order to address this issue and support and promote the commercialization process, various Governments across the globe have enacted various legislations like the Bayh-Dole Act (1980) also called the Patent and Trademark Law Amendments Act of the U.S. In line with this Act, Japan also enacted 2 laws in 1998 and 1999 in order to ensure legislative support for the commercialization of research conducted in the Government-owned Universities. Highlights of these policy and regulatory framework related changes to facilitate greater level of commercialization of research-based technologies through incentives to R&D related agencies and its personnel have been detailed below.

US: The Bayh-Dole Act

- Before the enforcement of this Act, the concerned federal agency sponsoring the research studies would have ownership of inventions emanating from the federally funded/ supported universities, small businesses and non-profit organizations and would make the technology available through non-exclusive licenses to companies/ individuals who wanted the same with no benefit accruing to the concerned technology developers from commercialization
- It was realized that due to the above model, the federal government was having limited success in commercialization with less than 5% of the 28,000 patents owned by the federal government being licensed to industry for commercialization.[55]
- The Bayh-Dole Act was thus passed in 1980 which allowed Universities and small business to retain ownership of inventions made under federal funding while allowing the technology owner to hold exclusive licensing rights as long as they ensured that the technology was commercialized for the benefits of the public. This licensing right ensured requisite incentives for academic and research driven institutes to undertake technology development in partnership with the small businesses in line with their requirements to augment their revenue stream through potential commercialization rights
- A key feature of the Act stipulates that in the marketing of the inventions for identifying a suitable organization for transferring of the technology, the Universities must give

preference to small businesses provided the selected firms have the requisite capabilities of commercializing the invention. The Act also states that the revenue remaining after offsetting the expenses incurred in development and commercialization should be used to further support R&D or education at the University aimed at promoting R&D.

- The Act also has a provision by which the Universities must share with the inventor(s) a portion of the revenue generated by licensing of the invention, thereby providing incentives to the researchers to invest their time in developing technology in line with industry requirements which can be commercialized easily.
- As a result of the Act, the annual number of patents granted to universities had risen from 177 in 1974 to more than 3,900 by 2003 while contributing to gross license income of around $1.3 bn for the Universities.[56]

The Bayh-Dole Act paved the way for colleges and universities to be actively involved in transfer of technology they invented, through technology transfer offices set up for this purpose, with development of additional revenue stream which could be invested in various other R&D projects of the University in a sustainable manner. Currently, the technology transfer offices established by the Universities perform a range of highly specialized services such as patenting, formation of University-industry partnerships and facilitating the transfer of research findings to small businesses. One such technology transfer office was the Wisconsin Alumni Research Foundation (WARF) of the University of Wisconsin- Madison (UW-Madison) which was also one of the earliest technology transfer offices established in any university in US. Key highlights of the activities and achievement of WARF has been given below:-

The WARF is an independent, not-for-profit foundation which supports research being conducted at the UW-Madison and carries out commercialization of the University's research by patenting and subsequent licensing the technologies to companies with a focus on small businesses. WARF has re-invested the revenues realized from such technology commercialization back into the research activities and has contributed to funds of around $1.07 bn for supporting over 55,000 research projects till date (since 1925) with the contribution in recent years being around $45 mn annually. It has processed more than 6,000 inventions created by UW-Madison researchers, 1,900 of which have been patented. WARF has also completed over 1,600 licensing agreements with companies all over the World, and offers more than 1000 technologies for licensing and holds equity in 40 spin-off companies. In 2010, the UW-Madison was the fourth highest amongst all US universities in registering patents with a total of 136 patents.

Japan: Law to promote the Transfer of University Technologies

Japan also found itself in a similar situation faced by US prior to 1980 with limited technology transfer from Universities to the industry. A need was felt for introducing incentives and changing the legal framework which would promote the commercialization of technology inventions of Universities. Thus in 1998, the Law to promote the Transfer of University Technologies or the TLO (Technology Licensing Offices) Law was passed which legitimized and

[55] Source: http://www.ucop.edu/ott/faculty/bayh.html

[56] Source: Report titled " Intellectual Property- Complex link between Science and Business- A Eurocentric view" by Joseph Strauss

facilitated the transfer of University inventions to the industry through contracts. The salient features of the TLO Law and the activities and achievement of the TLOs are given below:-

- The Law led to the establishment of TLOs either as independent for-profit corporations(as joint-stock company/ limited private company) or as independent foundations or as an internal department of Universities so as to be able to receive royalty revenues, hold equity in start-ups and hire staff from outside the government pool and without conforming to Government hiring rules and compensation levels
- Although the law did not change the ownership of the university inventions which were funded by the Government, it allowed inventors to voluntarily assign the inventions not associated with national importance to the TLO who would then negotiate the transfer of the IP rights to the industry.
- The TLO law was followed by the Industrial Revitalization Law in 1999 which was based on the Bayh-Dole Act of the US and allowed the Universities and private firms to own the technology and inventions developed by them but supported by Government funds, as long as the same not associated with national importance. With the Universities having ownership to its inventions, accessibility of TLOs to such University inventions also increased.
- The TLOs could be either affiliated to national universities or private universities and could serve multiple universities, research centres, etc. in a given geographical location. These TLOs received subsidies of approximately $180,000 annually for up to 5 years from the Government which cannot be used to make salary payments or professional fee payments
- Although the TLOs originated as primarily licensing and patenting offices, they have evolved to provide a wide range of services which include providing information on patenting, licensing, technology trends and directions, coordination of joint research between Universities & Industry, technology evaluation, business incubation, technology consulting, attracting funding for research, etc.
- The different approaches followed by the TLOs include the following:- (i) provide support for commercialization when approached by an inventor/ university, (ii) identify industry needs and search for existing technology which fits the need and then commercialize the technology and (iii) identify need of the industry and guide new research of Universities in order to meet the specific requirements
- With the growing role of these TLOs in technology commercialization, a number of such TLO have been established with the number of TLOs rising to 39 in 2005 from just 5 in 1998. In 2003, there were 35 TLOs who had applied for 1679 Japanese patents at an average of 48 patents per TLO.

15.2. Technology Identification & Selection

15.2.1. Establish a mechanism for identification of appropriate technology and corresponding provider

One of the key constraints faced by the MSMEs in undertaking technology upgradation includes absence of requisite information about the appropriate technology and the corresponding source/ provider, including ability to evaluate similar or alternate technologies

in terms of fitment with specific requirements, likely impact, pricing and level of customization required for alignment with existing legacy systems. The traditional approach for addressing the same includes organization of trade fairs or techno-marts by government agencies and/ or industry associations where prospective buyers of technology can meet technology sellers/ providers and receive information and demonstrations on new technologies. However, these interventions are usually one-off and lack the institutionalization of mechanism of continuous interactions between technology providers and seekers. This institutionalization of formal mechanism for continuous interactions has been achieved in Korea through the Technology Commercialization Mart in the 21st century (TCM21) initiative.

Korea: Technology Commercialization Mart in the 21st century (TCM21)

- KTTC, the primary technology transfer and commercialization organization of Korea started the TCM21 initiative, a mechanism which helps in the identification of appropriate technology for prospective buyers and facilitates their meeting with the corresponding technology developers
- It is a forum by which prospective buyers can learn about new technologies developed at public / private sector universities, R&D institutes and large/ medium/ small enterprises and technologies being offered by foreign technology transfer agencies, evaluate the different options available and decide on the appropriate technology and its source/ provider with the guidance and support of technology transfer experts and industry experts from KTTC.
- TCM21 which was started in 2001 with initial model providing for sharing of only the technologies developed by individuals and companies with potential technology seekers. However, with time it has expanded to include technologies from universities, public funded research institutes, large/ small companies and can include both domestic and foreign technologies
- New technologies which have been developed are evaluated first by KTTC's in-house experts and specialists and then evaluated by external experts & specialists in order to ensure an objective evaluation of the technologies since the technologies selected are better marketed through this mechanism and thus have a higher chance of being commercialized. The external experts are drawn from research institutes, industries and may include patent agents, venture capitalists and market analysts and are selected by KTTC depending on the type of technology and the sector
- After the evaluation process, technologies with high commercial potential are identified, registered and stored in an on-line technology database. Associated information about the technology such as detailed analysis of the technology, the benefits provided by the technology, its commercial viability and validity are also updated in the database against the technology identified.
- KTTC on behalf of the Ministry of Commerce, Industry and Energy (MoCIE) has been developing the technology database since the year 2000 and till end of year 2003 had 13,000 registered technologies and 900 technologies with in-depth market analyses. Further, market trends for 203 technology fields and around 5,000 company details are also provided as part of this database. The database can be accessed through the KTTC web-site and prospective buyers need to register to have access to the database

- Simultaneously, after the evaluation stage, a meeting is also held once a week in which a basic presentation of the selected technologies is given to prospective buyers which also serves as a platform where these buyers can meet the technology developers. If the prospective buyer wants to discover more about the technology, he is provided more detailed reports regarding the technology and can interact with the developer regarding the technology. Registration by the prospective buyer on the web-site of TCM21 for attending the meeting provides them with benefits of discounted/ flexible pricing when procuring the technology. Further, the technologies selected are also promoted by KTTC through various mediums like newspapers, daily mailers, e-mails, etc.
- Potential financers of the transfer of the technology such as banks, venture capital organizations and other investment organizations also attend this weekly meeting. On account of the 2 stage technology evaluation process ensuring objectivity and the sharing of viability & commercial potential of the technology with the potential financier during these meeting sessions, it is observed that a higher proportion of technology transfer applications are provided financing support.
- One of the key benefits realized through TCM21 includes reduction of time and resources to be committed by the MSMEs in identifying an appropriate technology, in searching for the right source/ provider of the technology and in securing the requisite financing for adopting new/ upgraded technology

KTTC: Facilitating identification of best-in-class international technologies for purposes of transfer

KTTC has an extensive network of 23 organizations in 11 countries including technologically advanced countries such as China, Russia, Germany and US which are involved in identifying appropriate technologies for the country and also facilitating technology transfer by foreign agencies to Korea.

In 2002, KTTC's overseas partner in the US, the Competitive Technologies Inc. (CTT) organized presentations of advanced technologies from foreign countries to prospective buyers in Korea. Around 200 prospective buyers attended the presentations which were followed by individual one-to-one meetings between technology owners and buyers for discussions on technology transfer and related negotiations.

15.2.2. Support demonstration of technologies and information dissemination on viability of the same prior to adoption

Some of the key concerns among MSMEs which result in their averseness in adopting new technologies include i) lack of awareness about new technologies available, ii) inability to evaluate the same along with the perception that investments in new technologies would not be justified by the Return-On-Investment (ROI) on account of limited scale of operations, iii) lack of trust in vendors, manufacturers, external consultants etc. for technology evaluation on account of perception that they may be biased towards certain technologies on account of vested interest and iv) issues with respect to compatibility of new technologies with their existing setup which may result in further investments.

In order to resolve these issues and adverse perceptions among MSMEs, there is a need for demonstrating the viability of new technologies through pilot projects/ sites for them to be accepted and adopted by MSMEs. In this regard, various Governments have developed schemes and programmes focused on supporting demonstration projects to prove the viability of new technologies. The Technology Insertion, Demonstration and Evaluation (TIDE) programme of the US is an instance of such an intervention with salient features of the same having been detailed below.

US: TIDE programme

- The TIDE programme was established by the Defense Appropriations Act with the objective of demonstrating cost savings, improved quality, greater efficiency & productivity and higher ROI achieved by applying and using commercially available advanced technologies and associated IT tools by SMEs. These SMEs were primarily engaged in manufacture of components and equipment for the US defense industry.
- The $5 mn[57] programme funded by the federal government was managed by the Software Engineering Institute (SEI), a federally funded R&D centre operated by the Carnegie Mellon University (CMU) which coordinated the activities of a number of other research institutes and the SME participants
- The support offered by TIDE personnel included study of the processes and operations of the SME units to identify technology intervention requirements, identification and guidance in selection of the appropriate technologies, acquisition and customization to meet specific requirements along with practical demonstration of the customized technology along with associated benefits
    - For purposes of technology selection from among the available options, the TIDE team along with representatives from the respective SME jointly followed a systematic approach based on the PECA methodology[56] and the Analytical Hierarchical Process in which potential technologies are compared in pairs to prioritize and evaluate the requirements for the technologies in order to arrive at the optimum technology serving the specific requirements, a SME manufacturer of multi-axis rotational devices used in navigation testing systems needed to improve its engineering capabilities and customer responsiveness. To achieve this, TIDE personnel integrated a finite element analysis (FEA) tool into their CAD system along with optimization of their work process to leverage the new application. The demonstration project resulted in reduction of (i) design errors by 90%, (ii) assembly rework by 25%, (iii) assembly time by 15%, (iv) stress analysis cost by 30%, (v) drafting time by 25% and (vi) total engineering cycle time by 10%. This resulted in a 100% ROI with an actual cost savings of $ 135,000 in the first year of implementation. The guidance provided by TIDE also helped the unit in assessing and selecting other software applications to complement their CAD systems
    - Tooling a small manufacturer of tools for the powdered metal industry needed to improve throughput by reducing product delivery cycle time. In order to do so,

[57] Source: http://www.sei.cmu.edu/newsitems/dtiderelease.cfm

[58] Source: PECA is a selection methodology which includes the steps of Plan, Establish criteria, Collect data and Analyze Data

TIDE personnel provided technical consultancy and helped the company select and implement a manufacturing execution system (MES) with e-commerce capability. The demonstration project resulted in (i) an increase of production capacity by 10%, (ii) reduction of engineering change turn-around of 50-70%, (iii) reduction of repeat order entry time of 25% and (iv) saved machine operators 30-60 minutes associated with document search time on a daily basis Highlights of technology demonstration for two of the identified SMEs have been presented below.

Magdic Precision Tooling a small manufacturer of tools for the powdered metal industry needed to improve throughput by reducing product delivery cycle time. In order to do so, TIDE personnel provided technical consultancy and helped the company select and implement a manufacturing execution system (MES) with e-commerce capability. The demonstration project resulted in (i) an increase of production capacity by 10%, (ii) reduction of engineering change turn-around of 50-70%, (iii) reduction of repeat order entry time of 25% and (iv) saved machine operators 30-60 minutes associated with document search time on a daily basis	Carco Electronics, a SME manufacturer of multi-axis rotational devices used in navigation testing systems needed to improve its engineering capabilities and customer responsiveness. To achieve this, TIDE personnel integrated a finite element analysis (FEA) tool into their CAD system along with optimization of their work process to leverage the new application. The demonstration project resulted in reduction of (i) design errors by 90%, (ii) assembly rework by 25%, (iii) assembly time by 15%, (iv) stress analysis cost by 30%, (v) drafting time by 25% and (vi) total engineering cycle time by 10%. This resulted in a 100% ROI with an actual cost savings of $ 135,000 in the first year of implementation. The guidance provided by TIDE also helped the unit in assessing and selecting other software applications to complement their CAD systems

- Demonstration projects like the ones detailed above were supported by publications, training courses and workshops for purposes of information dissemination on the viability of adopting the same. As a part of the programme, a 10 course training programme called the Foundations of Information Technology was conducted which covered basic concepts in hardware and software component selection, systems management and other related issues. Another key mechanism used for dissemination of information on the success of these demonstration projects included sponsorship for a conference titled 'TIDE Conference 2002' which included sessions related to technology adoption, associated risks & pitfalls along with potential benefits of successful adoption. The TIDE Conference was attended by 132 people most of whom were from the small businesses in the region. Feedback from the participants highlighted the fact that around 85% of the attendees would be willing to attend similar conferences in the future and be associated with such demonstration projects
- In addition to the above initiatives, a number of technical reports have also been published and the findings reported at different forums and conferences such as the Defense manufacturing Conference (DMC) 2002 and the International Conference on

COTS-based Software Systems for purposes of informing the potential users of the viability of adoption of such technologies demonstrated through the pilot projects

- As a result of the TIDE demonstration projects, the knowledge and understanding generated has helped other SMEs in the defence sector to successfully adopt these new technologies

15.3. Technology Adoption

15.3.1. Establish dedicated technology transfer and commercialization agencies to provide support & guidance to MSMEs in technology adoption

One of the key roles played by Governments in facilitating technology upgradation among MSMEs has involved technology adoption through the support extended to research-oriented agencies, institutes and universities in the public sector. However, there has been an increase in focus on technology commercialization and transfer in order to ensure greater level of technology adoption among the MSMEs to ensure their competitiveness. One of the key reasons for focus on commercialization and transfer is the fact that it is the most cost intensive component of the technology development life-cycle, accounting for around 70-85% of the total cost of bringing a product to market with the research phase accounting for 5-10% only and the development phase for the balance 10-20%. Further, it is observed that it is the commercialization phase where most technology projects fail due to various reasons which include lack of finance for commercialization (the valley of death), lack of partners for commercialization, inadequate information about market needs, lack of guidance in IP related issues and commercialization mechanism, etc.

Transfer of existing technologies to MSMEs is also associated with its own challenges in form of limited capabilities in identifying the appropriate technology along with the respective source, uncertainty about the nature of partnerships (joint venture/ strategic alliances), lack of clarity about the mechanism of technology acquisition (licensing/ sub-contracting/ acquisition of company/ foreign purchase, etc.), apprehensions about integration of the new technology with the existing legacy systems and the high cost of acquisition. Thus, a key pre-requisite for technology adoption among the MSMEs includes additional support during the crucial technology transfer and commercialization phase which can include establishment of technology transfer and commercialization agencies such as the Korea Technology Transfer Centre (KTTC) and the Steinbeis Foundation of Germany.

Korea: Korea Technology Transfer Centre (KTTC)

- Korea Technology Transfer Centre, the primary technology transfer and commercialization organization of Korea was set up in 2000 under the Ministry of Commerce, Industry & Energy (MOCIE) as a result of the passing of the Technology Transfer Promotion Law with the aim of providing technology transfer services, technology appraisal services and promoting mergers & acquisitions of technology based companies and laboratories
- It manages a network of research centres, universities, corporates, investment companies and professionals; which includes the Technology Licensing Offices (TLOs)

housed at various Universities, the Regional Technology Transfer Centres (RTTCs) which are techno-parks, the National Technology Bank. Through this network, KTTC coordinates the commercialization of technology developed at / indigenized by universities and research institutes.

- In terms of technology transfer services, the role of KTTC includes the following:-
  - o Identifying and reviewing the appropriate technology to transfer, identifying the potential partners to source the technology from, estimating the commercial viability of the technology and identifying the market/ industry trends.
  - o In order to facilitate international technology transfer, the centre also plays a major role in importing foreign technologies and exporting domestic technologies along with support in resolving associated compatibility and legal issues.
  - o According to the requirements of the companies involved in the technology transfer, KTTC also provides support and guidance in selecting the appropriate mechanism of technology transfer (licensing/ sub-contracting/ stock purchase, etc.) and the nature of partnership. It also provides support in negotiations and contracting for technology transfer
  - o Depending on a strategic need for a specific technology, the Centre even purchases certain technologies to resell it or promote its commercial use, as required

- In order to facilitate access to finance for such technology transfers, KTTC facilitates adoption of an objective credit worthiness-based evaluation by financing institutions & banks through the following technology appraisal services:
  - o Commercial and technical feasibility assessment to ascertain the commercial potential, the economic advantages and technical feasibility of a technology including early-stage technologies which takes into consideration target market size, entry barriers, expected profitability and commercialization expenses, technological advantages and nature of competition.
  - o Valuation of a technology which includes estimation of future cash flows generated which forms the basis for determination of commercial value associated with transfer / sale of technology

- The Centre also provides seed money for the development of technology with potential for growth at an early stage of development. In this regard, KTTC operates various financing schemes for business incubation, research & business development along with investment in equity of start-ups in order to support their growth and development.
- Other key services provided by KTTC includes the following:- i) facilitating mergers and acquisitions (M&A) involving technology based companies and laboratories, ii) policy advocacy in technology commercialization along with development of technology commercialization infrastructure in association with Government and iii) training to technology transfer and valuation agents and professionals in order to strengthen the technology commercialization system in Korea.

- Since its establishment, KTTC has licensed over 200 technologies to 160 organizations, performed feasibility and valuation of 300 technologies and performed M&A in 20 cases

Germany: Steinbeis Network

- The Steinbeis Foundation is a private network of institutes which supports the transfer of academic findings and knowledge to industry by providing consultancy services, R&D, technology evaluation reports, technology transfer services and training & further education through a fee-based / revenue-sharing model.
- The network comprises of a total of 810 enterprises comprising Transfer Centres, Research Centres, Consulting Centres and Transfer Institutes with a turnover of €124 mn in 2010
- These enterprises established as centres as detailed above, continuously evolve with each centre being set up to resolve a specific technology adoption/ transfer/ commercialization issue followed by subsequent closure once the underlying issue has been resolved
- The objective of the Steinbeis Transfer Centres is to facilitate technology transfer through Steinbeis' network in order to transfer research results to the industry. They work as independent & decentralized units and are set up close to their customers to understand their specific requirements. Each Centre is established as a "centre of excellence" in a particular area and works directly with the industry partners in facilitating technology transfer
- Based on industry and market trends, the Steinbeis Research Centres carry out research which is either contracted or market and transfer-oriented, encompassing a wide range of disciplines including life sciences, process engineering, miniaturization, embedded systems, industrial sensors, etc.
- The Steinbeis Consulting Centres provide consulting services on new technologies; processes, methods & systems to be followed for facilitating technology adoption; marketing; new product development along with technology evaluation and training
- The Steinbeis Transfer Institutes provide knowledge and technology transfer via training and degree programs. The Steinbeis Transfer Centre for Identification Media & Identification Management jointly with Atlantik Elektronik Gmbh commercialized a street lighting system based on LED and photovoltaic technology. The benefits of the new system included (i) reduction in electricity consumption by 45%-100% resulting in shorter payback period, (ii) being more eco-friendly, (iii) reduction in costs associated with laying electric cables for connectivity, and (iv) doubling the lifespan as compared to conventional street lights. The success of the product has resulted in the product being chosen for the "Light for Africa" project. The lighting systems have been modified to adapt to the needs of the Light for Africa project needs.

The case study presented below highlights the impact of Steinbeis network on one of the SMEs, viz. Atlantik Elektronik Gmbh.

The Steinbeis Transfer Centre for Identification Media & Identification Management jointly with Atlantik Elektronik Gmbh commercialized a street lighting system based on LED and photovoltaic technology. The benefits of the new system included (i) reduction in electricity consumption by 45%-100% resulting in shorter payback period, (ii) being more eco-friendly, (iii) reduction in costs associated with laying electric cables for connectivity, and (iv) doubling the lifespan as compared to conventional street lights. The success of the product has resulted in the product being chosen for the "Light for Africa" project. The lighting systems have been modified to adapt to the needs of the Light for Africa project needs.

15.3.2. Ensure access to finance focused on facilitating technology adoption

Lack of access to finance remains a key constraint to technology adoption by MSMEs globally impacting their competitiveness, growth and development. In a study conducted by the IFC, it was observed that around 45%-55% of the SMEs in the emerging markets do not have access to formal institutional loans, with the corresponding figure for micro enterprises estimated at around 65%-72%. The lack of access to finance impacts the SMEs in a number of ways which include constraints in technology adoption, product and process improvement, access to better facilities of R&D, access to markets, etc. Although a number of Governments have developed various financial instruments and established institutions and agencies to support SMEs in accessing finance, most of these instruments and agencies are not exclusively focused on technology adoption. However, Korea Technology Finance Corporation (KOTEC) is an instance of an institution which aims to support the SMEs in accessing finance through the Technology Credit Guarantee which it administers to facilitate the financing of technology based enterprises.

Korea: KOTEC and the Technology Credit Guarantee

- KOTEC is a non-profit financial guarantee institution established in 1989 under the special enactment of "Financial Assistance to New Technology Businesses Act" later revised as "Korea Technology Finance Cooperation Act" in 2002
- KOTEC provides guarantees to SMEs primarily through the Technology Credit Guarantee and conducts technological appraisals to support SMEs in obtaining financing
- Under the Technology Credit Guarantee, KOTEC provides guarantees against lending by financial institutions to SMEs for purposes of technology adoption. Banks which are approached by a SME who needs financing but is unable to provide satisfactory collateral refer the SME to KOTEC. KOTEC carries out an appraisal of the SME's application for loans and accordingly extends guarantee to the bank for issuance of the loan. The scheme allows a maximum credit guarantee of 85% of the loan amount
- KOTEC also provides technology appraisal to SMEs according to a Technology Appraisal Certification System for loans, guarantees and investments. The agency also appraises IP, collateral value of technology and assesses monetary value of technology transfer for supporting SMEs in applying for financing. In order to conduct objective and fair

evaluation of technologies, the Technology Appraisal Centres (TAC) were established by KOTEC and till date has conducted more than 275,000 cases of technology evaluations.

- In order to ensure transparency of the guarantee appraisal process, KOTEC launched the Cyber Branch Office and has developed a self-diagnosis service based on a credit assessment simulation model available at these offices in which an applicant SME can feed in its financial information and after an evaluation based on the data provided will receive its credit status. The whole process and the final results are fully disclosed through the internet. Besides KOTEC also provides business and technological consultancy services to SMEs in developing strategies for technology transfer, identifying source and recipient for transfer of a technology and resolving technological issues through technology acquisition
- Since its inception, KOTEC has provided more than $167 bn[59] worth of guarantees to SMEs. More than 80% of the total guarantee amount was given to SMEs who intended to develop or apply new technologies through the Technology Credit Guarantee Scheme.
- Although the credit guarantee scheme has been successful in supporting SMEs in developing or adopting new technologies, it maintains a default rate of 4% which is considered to be high by international standards. However, the same has been persisted with in order to ensure improvement in the credit environment for the SMEs aiming to adopt new technologies. Further, in order to reduce the default rates, the guarantee scheme is now extending special focus on specific SME categories like i) those adopting high potential technologies, ii) sectors which have been identified as the top 10 next generation growth sectors by the Government, and iii) sectors which have been identified as the six promising industries for future growth by the Government

15.4. Supporting Mechanisms

15.4.1. Develop a single window for providing MSMEs with all relevant information including details of applicable schemes and programmes specific to the respective requirement

It has been observed that MSMEs globally have not been able to optimally leverage the respective Government schemes and programmes available for their benefit in terms of access to finance, markets, capacity development etc. on account of the following reasons: (i) inadequate information dissemination of the schemes, policies, funding and technical expertise available due to the geographical spread of the MSMEs and/ or, (ii) the heterogeneous characteristic of MSMEs which results in varying capabilities of searching, identifying and evaluating the appropriate schemes which would address their needs. To resolve this, Governments have tried to implement the concept of "Single Window" services and Help-Desk services with varying functions and responsibilities for providing relevant information and business services to MSMEs from one single point or "window" such as the ones provided by Standards, Productivity and Innovation Board's (SPRING Singapore) Enterprise One network and the theme based Help-Desks set up by the EU. The salient features of the Enterprise One network and the theme based Help-Desks are given below.

[59] Source: http://www.kotec.or.kr/about/about02_02.asp

Singapore: Enterprise One

- SPRING Singapore, a statutory board under the Ministry of Trade and Industry of Singapore is the enterprise development agency of Singapore and provides support and resources to SMEs in financing, capability upgradation, management development, technology adoption, and accessing new markets.
- In 2010, SPRING Singapore was involved in 66,310[60] instances of business related enquiries, facilitation and assistance generated from an estimated 148,000[61] SMEs in Singapore.
- In order to provide relevant information to SMEs on how to start, grow and sustain businesses, SPRING Singapore manages the EnterpriseOne network which provides a wide range of information on government assistance programmes, regulations and e-services for businesses from 52 partners which includes public and private entities.
- One of the components of this network is the EnterpriseOne portal, an interactive web portal, which provides a single point of access to a wide range of information and services related to SME business and operations and include:-
  - (i) Government assistance provided through schemes and policies including the target beneficiaries, intended application of the benefits, terms of the assistance, stakeholders, eligibility criteria, process of application along with the requisite forms for the process and expected timelines for each stage
  - (ii) Possible sources of funding classified according to loans and equities, types of loans and equities, the different schemes and programmes offered by the Government for each type of funding
  - (iii) Information on different themes such as joint ventures, patenting process, IPR issues, import/ export, recruitment and training, etc. along with the key requirements and application process, expected time required and costs involved
  - (iv) Database of different business networks including Enterprise Development Centres (EDCs) which provide business advisory services along with repository of business consultants and service providers such as list of patenting agents, IP service providers, etc.
  - (v) Guides on how to apply for different licenses, permits and government assistance are accessible as separate links
  - (vi) Resource library which is a repository of books and publications related to different business, laws and policies, organizations and associations, etc.
  - (vii) Select transactional facilities such as applying and receiving licenses/ permits/ approvals
  - (viii) Search facility which tries to identify the need of the SME and accordingly directs them to the appropriate options for Government schemes & programmes, funding options, e-services, licenses & permits.

[60] Source: http://www.spring.gov.sg/AboutUs/PI/Pages/assistance-rendered-smes.aspx
[61] Source: Singapore SME Development survey 2007

(ix) Channel for feedback which accepts comments and suggestions on the comprehensiveness of the site and whether the information provided is updated or not. The feedback is received and managed by a designated Helpdesk with defined service levels and escalation steps

(x) Link to the Pro-Enterprise Panel under the Ministry of Trade & Industry which calls for the SME industry to review Government rules and submit proposals and means of improving schemes, policies and rules related to business in a advocacy role for the industry

- The network also provides assistance through a call centre which receives voice calls as well as responds to email enquiries on any queries related to business. A comprehensive FAQ section is also provided for better query resolution
- In 2010, while there were more than 8.5 million average number of hits per month on the associated portals and websites of EnterpriseOne and SPRING website, there were 129,366[62] average unique visitors to the above websites and portals. The portal is also being extensively used by SMEs for license related transactions and every year more than 85,000 license transactions are now being performed via the portal

European Union: IPR Help-Desk

- The EU has established the European IPR Helpdesk under the Seventh Framework Programme (FP7) to provide information, advice and training related to Intellectual Property and Intellectual Property Rights from a single point of contact in order to raise the awareness of European SMEs in IPR related areas
- The information and services provided by the IPR Helpdesk include (i) helpdesk services through e-mail and voice mail to resolve any queries regarding IP through a panel of legal experts and consultants focused on IP related issues, (ii) training for SMEs on IP management, technology transfer etc., (iii) portal for accessing knowledge repository and (iv) newsletter and periodicals to raise the awareness levels related to IP
- The Helpdesk responds within 3 days of posting an enquiry. The services provided by the European IPR Helpdesk is free of charge for current and potential beneficiaries of EU funded projects, focusing on the programmes of Research and Technical Development (RTD) and Competitiveness and Innovation Programmes (CIP)

European Union: CEN-CENELEC SME Help-Desk

- The EU has also set up the CEN-CENELEC SME Help-Desk in order to provide information and other services related to European standards and standardization in order to raise the awareness of European SMEs in standardization related issues. Standards are technical documents which are to be used as guidelines/ rules/ definitions implementation of which although voluntary aims to create a European internal market and position European goods with a specific level of quality and performance
- The Help-Desk provides information and tools required to access the European Standardization System of the European Committee of Standardization (CEN) and the

[62] Source: http://www.spring.gov.sg/AboutUs/PI/Pages/assistance-rendered-smes.aspx

European Committee for Electro-technical Specification (CENELEC)

- The Help-Desk provides information and services through the following:- (i) brochures and presentations, (ii) dedicated web-page, (iii) consultation with appropriate technical experts via e-mail, and (iv) training and capacity building of SMEs through workshops and web-based e-learning on matters related to standardization
- The services of the Help-Desk are provided free of charge and are offered either on-line or over the telephone. The Help-Desk responds within 5 days of posting of an enquiry

15.4.2. Ensure that MSME interests are considered from the earliest policy and regulation development and formulation stage

It has been observed that although benefits of policies and regulations are enjoyed by companies of different sizes, MSMEs due to their smaller size, limited resources and lack of access to finance are more vulnerable to being affected by the cost of regulatory compliance than larger companies. This is substantiated by a finding from Europe that on average, a medium size enterprise may spend up to € 4 per employee and a small size enterprise may spend up to € 10 per employee for complying with regulations as compared to larger companies which spend only € 1.[63]

Thus, the "Small Business Act (SBA) for Europe" a comprehensive SME policy framework was adopted by the European Union in 2008 containing a set of common principles including the principle of "Think Small First", application of which would ensure that policies which are developed at the EU and the national level would be more focused on SME needs and help reduce the higher level of regulatory compliance costs, including those respect to technology adoption. The underlying concept of this principle is that for business regulations, SMEs should be considered to be the "prime customers", which while being helpful to the SMEs would also be beneficial for the large companies.

Among the EU member states, UK has taken various steps to integrate the "Think Small First" principle which include: (i) the Small Firms Impact Test (SFIT), a mandatory process which different Govt. agencies have to go through when developing policies/ schemes/ programmes relevant for SMEs (ii) Common Commencement Dates and (iii) Small Firms Consultation Database for consulting the SMEs. The salient features of the above measures have been given below:-

UK: Small Firms Impact Test (SFIT)

- The SFIT helps in identifying and analyzing the cost-benefit and impact on SMEs of any proposed Government initiative and helps in examining whether any exemptions, partial or complete can be extended or whether any alternative approach is appropriate for SMEs.
- The SFIT is mandatory part of the impact assessment process for all proposed Government initiatives which have a potential regulatory compliance related impact on SMEs
- In order to ensure that the SME interests are considered from the earliest stages of policy

[63] Source: Expert Group of EU Report titled "Models to reduce the disproportionate regulatory burden on SMEs"

and regulation formulation stage, the SFIT process begins when ideas and options are first developed, well before the publication of any consultation document and is considered right through the finalization phase of the policy/ regulation

- Any impact assessment of policies and regulations which do not comply with a SFIT is considered as deficient. To ensure compliance with SFIT, the Enterprise Directorate which works under the Department of Business Innovation & Skills for the development of policies to boost enterprises, start-ups and small business growth has the authority to advise the Secretary of State for Business Enterprise and Regulatory Reform against giving policy clearance to any policy proposal where adequate SFIT hasn't been carried out
- The key stages of the SFIT include (i) Development & Options stage which involves initial interaction with SMEs and their representative bodies to identify/ verify the likely impact and solutions of the policy/ scheme, (ii) Consultation stage which is applicable when the estimated impact on SMEs is expected to be more and needs a more detailed analysis of the associated cost-benefit. This is also a stage when options such as simplified inspection, less frequent reporting, granting complete/ partial exemptions or any other alternative approach for SMEs are explored and (iii) Final proposal stage in which the feedback from the SMEs are evaluated and wherever possible incorporated in the proposed policy/ scheme/ programme
- Further, since 2008-09, it has been mandatory for the policy makers to fill up a new section in the Explanatory Memorandum section of the legislation prior to tabling the same for approval. This memorandum includes information on whether and in what way the legislation will impact SMEs, on steps taken to minimize the impact on the SMEs and the basis for the final decision on the initiatives to be taken to assist the SMEs and how the decision was taken

A case study on how the SIFT was applied to minimize the effect of legislation on SMEs is given below:-

The European Commission (EC) food hygiene regulations required that all food businesses most of whom were SMEs, implement food management systems based on Hazard Analysis Control Points (HACCP). This would have a significant impact on the SMEs since it would increase costs of compliance for the SMEs. The Food Standards Agency of UK which was responsible of implementing the regulations recognized this and ensured that the cost impact of the regulation was minimized through various measures which included (i) negotiations with the concerned EC agency to be more flexible in the implementation of the regulations, (ii) working directly with the SMEs to develop innovative schemes to help SMEs comply with the regulations, (iii) launching an information dissemination campaign through a Safer Food, Better Business (SFBB) programme which ensured that SMEs following the guidelines would be complying with the HACCP requirements, (iv) testing of SFBB on a pilot basis on 50 small caterers on parameters such as user-friendliness and feedback sought and the approach improved accordingly and (v) a formal consultation phase with over 1000 SMEs across UK. The various rounds of consultations with managers and staff resulted in improvements in the programme delivery mechanism such as including pictorial depiction of practical good hygiene practices.

UK: Common Commencement Dates

- In order to provide greater legislative certainty, the UK has launched the Common Commencement Dates (CCD) an innovative concept by which a few dates are fixed per year for the start of business related legislation and policy
- Most UK laws and regulations affecting business come into force on either of the two dates of 6 April and 1 October every year. These dates are preceded by the publication of guidance material and other information dissemination measures
- This allows SMEs to better prepare, adapt, and assimilate the changes in policy. It also raises their awareness of new and changed policies since now they have to be attentive for only 2 dates in a year in order to be updated about any Government policies likely to impact them

UK: Small Firms Consultation Database

- For securing the views and opinions of SMEs and getting their feedback regarding major legislation, UK has established the Small Firms Consultation Database, a list of SMEs who have agreed to be contacted for consultation and feedback on draft policy and regulations
- The database allows the Enterprise Directorate to contact SMEs on behalf of the source Department of the proposed policy. The database is used for identifying and recruiting participants for the focus groups, test panels and workshops during the consultation phase of the SFIT
- As a part of this initiative, the list of organizations and individuals which the policy making body of the Dept. of Business, Innovation and Skills will be consulting is also published while suggestions from anyone else who would want to be a part of the consultation process are also considered. The Government commits to respond within 90 days on the suggestion
- In order to grow the list in order to include more respondents, the Database asks for references of SMEs from its members who are interested to join
- Details on the proposed consultation sessions which are to be held across the country on proposed policy/ regulations are also published in the newsletters of the database to ensure participation of the listed names. Feedback and suggestions are solicited through discussions in person/ over phone/ in focus group discussions/ through postal or online questionnaires/ written submissions

For developing a new Skills Strategy for the country, the Department of Business, Innovation and Skills called for consultation on developing a simplified further education and skills funding systems and methodology. It received 575 responses to the documents and questions posted on the website from colleges, training organizations, individuals and different types of employers. Besides it organized discussions with representative groups and 2 technical funding meetings with colleges and training organizations including local area authorities based on the Small Firms Consultation Database. It also held a discussion organized by an independent research company to get opinion and feedback from 30 individual learners. Various responses were summarized and the department revised its policy accordingly to incorporate the suggestions wherever possible. A case study on how consultation was carried

out to include feedback of SMEs while developing a scheme which would impact SMEs is given below:-

For developing a new Skills Strategy for the country, the Department of Business, Innovation and Skills called for consultation on developing a simplified further education and skills funding systems and methodology. It received 575 responses to the documents and questions posted on the website from colleges, training organizations, individuals and different types of employers. Besides it organized discussions with representative groups and 2 technical funding meetings with colleges and training organizations including local area authorities based on the Small Firms Consultation Database. It also held a discussion organized by an independent research company to get opinion and feedback from 30 individual learners. Various responses were summarized and the department revised its policy accordingly to incorporate the suggestions wherever possible.

16. Proposed Policy and Institutional Framework

In spite of the various technology upgradation related interventions targeted at MSMEs currently underway in India as detailed in earlier sections of the report, the cluster-level findings highlight the fact that MSMEs continue to face technology adoption related issues across all sectors. These have been detailed in the table below in terms of potential for adoption of specific technologies in the respective sectors which can facilitate the following:- i) productivity / quality improvement, ii) compliance with environmental norms in terms of effluent treatment, water conservation etc. and iii) energy conservation. However, it should be noted that these perceived technology requirements are not exhaustive and highlight only the key observations based on the cluster visits undertaken as part of this study.

Sector	Better productivity / quality control	Clean / green technologies	Energy efficient technologies
Textiles	• Deployment of "open width" circular knitting machines • Automated machines for cutting & screen printing	• Air flow and pad-batch technology for processing to reduce water consumption • Effluent treatment plants	
Drugs & Pharmaceuticals	• Compliance with GMP / GLP norms • Automation of material handling & packaging process	• Multiple Effect Evaporator (MEE) for effluent treatment for effective recovery of salts, solvents etc.	• Solar-based water demineralization technology vis-à-vis existing ion-exchange based technology
Food Processing – Fruits & Vegetables	• Automation of preparatory activities like sorting, grading, cleaning and drying • Automated packaging and labeling machines	• Effluent treatment plants with reverse osmosis facility	• IQF technology for freezing
Foundry	• Establishment of sand testing facilities • Automation of material handling processes	• Adoption of venturi-scrubber in melting & casting process	• Deployment of energy-efficient Divided Cupola furnaces vis-à-vis conventional cupolas
Ceramics	• Digital printing on tiles • Automation of sorting and packing processes	• Effluent treatment plants	• Adoption of roller kiln technology vis-à-vis tunnel kiln technology for firing
Plastics	• Adoption of twin-screw technology • Multi-layer films for packaging & lamination • Automation of material handling and sorting & packing processes	• Eco-friendly plasma nitriding process for surface treatment • Adoption of "hot runner" moulds to reduce plastic wastage	• Deployment of chillers vis-à-vis cooling towers • Adoption of solvent-less technology for lamination

Sector	Better productivity / quality control	Clean / green technologies	Energy efficient technologies
Paper	• Slotted type screening system in cascade arrangement to remove unwanted impurities • Automatic blending & mixing arrangements to ensure consistency • Adoption of automated rewinders and cutters	• Deployment of medium & high consistency hydra pulper to reduce water consumption • Effluent treatment plants	• Deployment of conflow type refiners • Flash steam in dryers by cascade heating arrangement / adoption of shoe-press machines • Replacing low pressure boilers with high pressure ones
Engineering	• Multi-station bolt maker & nut former machine for fasteners • Automation of material handling processes		
Electronics	• Automation of material handling & packing processes	• E-waste management through recycling	
Leather	• Deployment of metallic drums for washing / deliming • Rotary spray dryers for spraying & drying processes • Automation of finishing activities associated with production of leather goods	• Water consumption reduction through i) salt-less curing of hides or counter-current soaking technology, ii) enzyme assisted liming and iii) replacement of paddles with drums for liming • Effluent treatment plants along with high-exhaustion chrome tanning process to reduce chrome discharge in effluents	

An analysis of the above table highlights the fact that additional support is required by the MSMEs in order to facilitate the process of technology upgradation on a continuous basis in order to ensure global competitiveness while ensuring requisite compliances. Based on a review of the international best practices associated with facilitating technology upgradation among the MSMEs, it is evident that when Government would have to plays a pro-active role in ensuring establishment of requisite eco-system, in form of enabling policy and institutional framework, to support and hand-hold MSMEs across all stages of technology adoption life cycle MSMEs grow. The proposed policy & regulatory framework along with the institutional structures to support the same in the Indian context have been detailed herein.

16.1. Policy & regulatory framework

Recommendations on the requisite policy and regulatory framework to facilitate technology upgradation among the MSMEs have been highlighted along the following key dimensions: i) modification / strengthening of existing schemes & policies and ii) need for introduction of additional schemes and policies.

16.1.1. Modification / strengthening of existing schemes & policies

Interventions related to modification / strengthening of existing schemes & policies typically address the following stages of the technology adoption value-chain: i) technology identification & selection and ii) technology adoption.

Technology Identification & Selection

For purposes of making the MSMEs aware of the latest technologies available globally in their respective sectors, the typical existing mechanism involved includes:

- Business development initiatives of respective technology providers which may be limited to only well-established & technologically-superior clusters having requisite market potential & culture of investing in technology upgradation
- Technology adoption by relatively larger players in the cluster / region which has a rub-off effect through demonstration of benefits realized.

However, the feedback from cluster visits suggest that business development initiatives of technology providers is usually restricted to technologies which may result in upgradation from existing levels for Indian MSMEs but is relatively dated & obsolete as per global standards. This can be attributed to the demand for cost-effective technologies by the MSMEs on account of limited availability of finance, without focusing on achieving operational excellence in absence of understanding of financial benefits from doing the same. Another key observation during the cluster visits is related to the adoption of state-of-art technology facilitating increased productivity / cost reduction by larger players which is usually very capital-intensive and may not be affordable for Indian MSMEs without i) financing support from Government or ii) indigenization resulting in cost reduction. Considering the same, the following interventions are recommended:-

- Findings from cluster visits undertaken as part of this study indicate that the desired impact of various financing schemes undertaken by Government in form of TUFS (Textiles), Scheme for Technology Upgradation/ Establishment/ Modernization of Food Processing Industries (Food Processing), Integrated Development of Leather Sector (Leather) may not have been realized on account of the lack of requisite mechanisms for securing feedback from industry on the updation of sector-specific technologies to be made eligible for financing support as part of these schemes. In light of the same, a nodal agency in line with the role played by KTTC in Korea as detailed in section 15.3.1 of the report, should be considered for purposes of identification of the technology upgradation requirements among MSMEs through interactions with industry associations / business member organizations in the key clusters identified for each focal sector.
- Additionally, existing schemes aimed at facilitating greater level of interaction among technology providers and seekers in form of support for MSMEs to attend buyer-seller meets, trade fairs, exhibitions etc. should be scaled up. This should encompass financial support offered to business member organizations (industry associations) in respective clusters to participate in exposure trips related to technology exhibitions / demonstrations in countries engaged in production of state-of-art machinery for the respective sector (e.g. Italy for Leather and Ceramics, Germany for Engineering etc.)

with costs for the same being partially funded through Government support. The feedback from such attendees could be leveraged in identifying potential technologies to be included in the list of those eligible for financial benefits.

- Further, the proposed nodal agency on the lines of KTTC in Korea should be created with a mandate of assessing the viability of adoption of such technologies by MSMEs and providing feedback in terms of its inclusion in the list of technologies eligible for financial benefits under various Government financing schemes. This could either be in its "as-is" stage or the need for further indigenization for which the requisite linkages with R&D agencies / institutions should also be facilitated by this nodal agency.
    - For an "as-is" adoption, technologies / technology providers can be empaneled for supply along with provision of demonstrating the respective technology and its benefits in common facilities being established in clusters through Government schemes like MSE-CDP, IID etc. This empanelment should ensure that no second-hand technology / machinery is eligible for any financial assistance to be offered by Government, with the administration of the contracting process and administration of the same in terms of framing of service level agreements & monitoring of the performance of the empaneled technology providers to be awarded to independent management agencies.

Technology Adoption

Post identification & selection of technologies, it is observed that technology adoption among MSMEs is impacted on account of i) lack of information of the mechanism for securing transfer of technology (licensing / outright purchase / joint ventures) from technology source, ii) absence of single point of contact in form of dedicated agencies to guide MSMEs in terms of negotiations, contracting with focus on ensuring knowledge transfer / capacity augmentation for spare part production and routine operation & maintenance, addressing issues related to patenting, IPR etc. for the transfer of existing technologies and iii) access to finance in form of Government support. In order to address the same, it is proposed that:

- Administration of financing support through i) sectoral schemes like CLCSS and CGTMSE along with support from Technology Development Board and ii) sector-specific ones like TUFS for Textiles, IDLS for Leather, MoFPI scheme for Food Processing, Interest Subsidy for Drugs & Pharmaceuticals may be considered for administration through the envisaged nodal agency in order to facilitate better coordination among the associated ministries / departments. Further, amalgamation of existing schemes may be considered to establish a sectoral "MSME Technology Acquisition Fund" applicable for MSMEs on the lines of the "Technology Credit Guarantee Fund" operated by KOTEC in Korea as detailed in section 15.3.2 of the report. Further, the administration of financial benefits available through such schemes should be routed through an online platform which would help in ensuring greater level of transparency and quicker response to the applications received from MSMEs
- Standardization of documentation required to be submitted by MSMEs for availing the benefits under the respective sector-specific and sector-agnostic financial schemes & programmes should be undertaken to ensure that those are in line with the stipulations of the MSMED Act 2006 in terms of minimum level of documentation to be maintained

by MSMEs for registration and carrying out their operations

- Increased focus on involving private sector participation in establishing requisite R&D related infrastructure like business incubators & technology parks along with common facilities which can help serve the purpose of practical demonstration of technology in MSME clusters through a PPP mode, as is being done for tool rooms & incubators as part of NMCP, training cum incubation centres being established by NSIC etc.
    - The envisaged regulation in line with Bayh-Dole Act in US has the potential of encouraging private sector participation in technology development and commercialization. Considering the same, existing schemes & programmes like NMITLI which promotes joint technology development between CSIR and industry partners, establishment of TBIs and STEPs with industry participation as part of NSTEDB's intervention should be scaled up in order to strengthen the industry-academia linkage

16.1.2. Need for introduction of additional schemes & policies

Interventions related to introduction of additional schemes & policies typically address the issues related to development of cost-effective and innovative technology through requisite incentives to create a favourable innovation eco-system linking R&D agencies / institutions with industry requirements.

Technology Development

Based on findings during our cluster visits, the key issues related to development of new technologies in R&D centres, academic institutes like universities etc. along with availability of the same to the MSMEs encompass the following:-

- Lack of incentives for R&D / academic entities to invest in indigenization of existing technologies to ensure requisite customization and affordability or development of new technologies specific for MSMEs on account of underlying market risks along with absence of mechanisms to promote practical demonstration of commercial viability of such technologies impacts acceptability among MSMEs on account of higher level of "risk-averseness"
- Development of technology which is not in line with / does not take cognizance of industry requirements, which may be attributed to lack of effective linkage of industry with such agencies & centres
- Lack of investment by MSMEs themselves in R&D to develop new technologies on account of risk-averseness, lack of finance, resources and facilities in terms of R&D infrastructure.

The following additional schemes and policies may be considered to develop and strengthen the requisite R&D eco-system to support the MSMEs in technology upgradation:

- Regulatory support through enactment on the lines of Bayh-Dole Act of US which can provide the requisite impetus to the R&D eco-system to address the requirements of MSMEs in terms of incentives for i) entities engaged in R&D and technology development through ownership of the inventions made as part of Government funded

projects while retaining the rights to commercialize the same to develop additional revenue streams and ii) researchers through right to share of revenues generated from technologies developed by them which has been successfully commercialized.

- Policy support in form of introduction of schemes and programmes to support technology upgradation among MSMEs through focus on the following:-
  - o Incentives for MSMEs undertaking technology upgradation to engage with publicly-funded R&D agencies for access to support in terms of infrastructure and resources for conducting R&D and capacity development related to the same in line with the financial support available for the same as part of GET-Up programme in Singapore as detailed in section 15.1.1 of the report
  - o Incentives for R&D/ academic agencies to support MSMEs in the indigenization of existing technologies, resolving technology related issues and improvement of product/ process in terms of improving quality/ reducing costs on the lines of the CRAFT project in European Union and innovation Voucher Scheme in Netherlands and other European Union countries as detailed in section 15.1.2 of the report
  - o Collaborative technology development involving R&D agencies / institutions from public & private sector and MSMEs (primarily as industry associations) like Cooperative Research Centres in Australia as detailed in section 15.1.1 of the report, with financial support from Government aimed at supporting the costs incurred by the R&D agencies / institutions in supporting the MSMEs, subject to evaluation of the impact of the same through objective evaluation by a competent and professionally-qualified board of subject-matter experts

16.2. Institutional structures and mandates

In order to implement the proposed policy and regulatory framework, it is felt that strengthening of co-ordination is required among the associated Government stakeholders in form of representatives from Ministry of MSME, Ministry of Science & Technology and the respective sector-specific ministries / departments associated with key MSME sectors. For facilitating the same, it is proposed to establish a nodal agency in India on the lines of KTTC in Korea, as highlighted in section 15.3.1 of the report, to focus exclusively on facilitating technology upgradation of MSMEs with all the requisite empowerments. The mechanism for establishment and empowerment of this proposed nodal agency has been detailed below:-

- Considering the fact that the focus of Government ministries / departments like MoST and respective sector-specific line ministries is not limited to growth & development of MSMEs only; it is proposed that there should be greater level of co-ordination among the associated Government ministries / departments for facilitating technology upgradation among the Indian MSMEs across multiple sectors. The same is proposed through creation of an inter-ministry committee, drawing in representatives from associated Government ministries / departments, which would be responsible for drawing up policies & programmes for facilitating technology upgradation among the MSMEs along with monitoring of its implementation.

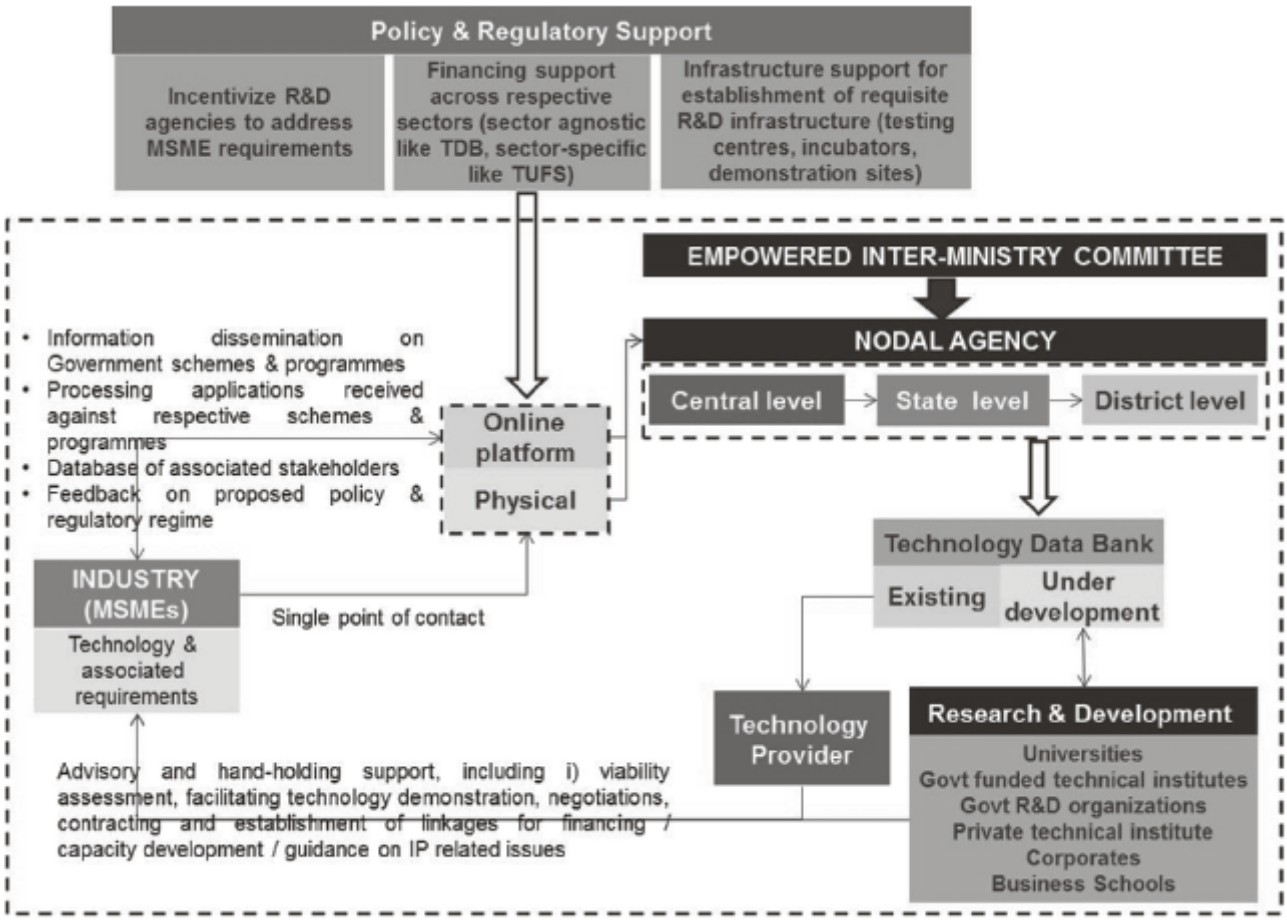
- This proposed inter-ministry committee should be chaired by the Secretary of Ministry of MSME (MoMSME) and draw joint secretaries from the following key ministries / departments like Ministry of Science & Technology (Department of Science & Technology, Department of Scientific & Industrial Research etc.), Ministry of Commerce & Industry (Department of Industrial Policy & Promotion), Ministry of Textiles, Ministry of Food Processing Industries, Ministry of Chemicals & Fertilizers (Department of Pharmaceuticals and Department of Chemicals & Petrochemicals), Ministry of Communication & Information Technology. This mechanism would ensure that the policy makers associated with development of the key MSME sectors in the country are adequately represented.
    - Presence of joint secretaries from the respective ministries / departments would ensure that the requisite decision-making authority rests with this empowered committee for purposes of policy formulation and monitoring implementation of the same through requisite coordination among the associated ministries / departments
    - Chairmanship of this proposed committee should rest with MoMSME in line with the dedicated focus of this ministry on overall growth & development of MSMEs across multiple sectors, including promotion of technology upgradation among the MSMEs
    - In case the policies relate to MSMEs in a particular sector which is not represented in the above-specified list of line ministries / departments, joint secretaries from the respective ministries / departments could be invited as special attendees to the deliberations of this committee

- Identification of a nodal agency as a Secretariat to this empowered committee with requisite empowerment in form of legislative support / Government notification to implement the decision taken by the proposed inter-ministry committee for facilitating technology upgradation among the MSMEs. As a Secretariat to the inter-ministry committee, the nodal agency will prepare background papers for consideration, issue notices of meeting, record minutes and update the committee on status of implementation of committee decisions. In line with the exclusive focus of MoMSME on facilitating growth & development of MSMEs, this nodal agency should be under the control of MoMSME while being empowered to retain requisite operational flexibility in fulfilling its mandate.
    - For this nodal agency, it is proposed that a Governing body structure should be adopted on the linesof “Board of Directors” of a company in terms of providing strategic insights to the nodal agency in implementing the decisions taken by the inter-ministry committee. A key constituent of this Governing body should be the Development Commissioner (MSME) to ensure effective implementation at the state and district level by leveraging the network of offices and autonomous bodies under its control. This would also ensure that the existing infrastructure available with Ministry of MSME in form of i) tool rooms, ii) technology development centres, iii) training institutes, iv) testing centres and v) development institutes can be adequately leveraged for purposes of facilitating

technology upgradation and associated initiatives for MSMEs. Further, this association will also help the nodal agency to effectively liaison with the Directorate of MSMEs or equivalent designations at the state-level and respective in-charges of District Industries Centre (DIC) along with the key cluster-level associations at the district level

- The nodal agency should be authorized to draw in representatives from the existing agencies / entities, both public and private, associated with technology upgradation among MSMEs through deputation / secondment. Representative list of agencies / entities whose resources could be drawn into this nodal agency include CSIR, NRDC, TIFAC, NSTEDB, TDB, etc. along with sector-specific entities like NIPER (Drugs & Pharmaceuticals), CFTRI & NIFTEM (Food Processing) , CGCRI (Ceramics), CIPET (Plastic), CPPRI (Paper) etc. Further, sector-specific subject matter experts from the private sector with experience in technology promotion among MSMEs could be empanelled for support on a case-to-case basis.

The proposed mandate of this nodal agency along with the linkages with the associated eco-system has been highlighted in the chart below.



The key functional mandate for this nodal agency to be established as the secretariat to the empowered committee would include the following:-

- Serving as a single point of contact with MSMEs / industry associations of MSMEs in understanding the specific technology requirements of the MSMEs. With the proposed physical presence at district and state-level, this model would ensure optimum avenues of interaction between the MSMEs and the nodal agency. This physical presence can also be supplemented with an online platform which would permit the MSMEs and their industry associations to highlight their technology requirements across multiple sectors
- Development of a technology data-bank, as in the case of TCM21 initiative undertaken by KTTC in Korea and detailed in section 15.2.1 of the report,to be made available through the online platform referred above, along with the physical presence at the state and district levels, for ready reference of MSMEs. This could include i) maintaining list of technology providers for specific technology requirements identified by MSMEs along with ii) scanning of globally available technologies which can be potentially deployed by MSMEs. Further, this nodal agency should establish linkage with the R&D focused entities to identify technologies currently under development which could be successfully commercialized for adoption by MSMEs and maintain the same in this technology repository. Since this nodal agency envisages involvement of representatives from MoST, existing data-banks like NISSAT and that owned by NRDC could be integrated to have one consolidated repository of technologies available for adoption by MSMEs.
- Offering advisory services and hand-holding support for purposes of technology transfer, involving both existing and under-development technologies, typically for a group / cluster of MSMEs by leveraging representatives of entities like NRDC along with sector-specific subject matter experts that may require to be engaged for the same.
    - For the existing technologies, the support could include i) establishing contact with respective technology providers, ii) viability assessment, iii) facilitating technology demonstration, iv) identifying optimum technology transfer mechanism (licensing, outright purchase etc.), v) negotiations, vi) contracting including exploring avenues of empanelment, and vii) establishment of linkages for financing / capacity development / guidance on IP related issues etc.
    - For technologies under development / indigenization in line with industry requirements, the support could include i) viability assessment, ii) facilitating technology demonstration, iii) negotiations, iv) contracting, and v) establishment of linkages for financing / capacity development / guidance on IP related issues etc.

- Information dissemination on all Government schemes & programmes available for promoting technology adoption among MSMEs could be achieved through the envisaged online platform on the lines of the EnterpriseOne initiative in Singapore as detailed in section 15.4.1 of the report, including eligibility criteria and process for availing benefits with requisite documents to be submitted along with provision for tracking status of submitted application aimed at ensuring greater transparency and

reduced processing time. The presence of representatives from MoST and respective line ministries in the empowered committee would ensure that the applications received for their respective sectors are appropriately routed for processing with the nodal agency suitably empowered to coordinate with the respective ministries / departments in case of any delays. The provision for submitting applications in person should also be supported by this model with the state and district level presence facilitating the same.

- In line with the best practices identified earlier, the envisaged online platform could also serve as a i) medium for securing feedback from MSMEs on proposed policy and regulatory framework prior to enactment in line with SFIT initiative in UK as detailed in section 15.4.2 of the reportand ii) database of key stakeholders like business member organizations, business development service providers, technical experts / consultants, training experts / institutes etc. for MSMEs in the respective sectors.

17. Appendices

17.1. Appendix 1: Tip Sheets

Based on the detailed sector-specific analysis as highlighted in the respective chapters in the report earlier, we have developed the summary "Tip Sheets" highlighting the findings from the respective cluster visits conducted for each of the identified sectors.

17.1.1 Textile (Tirupur)

Process steps	Existing technology deployed by a majority of units	Issues/ observations w.r.t existing technology	Potential for deploying better/ cleaner technology	Availability of technology	Tech transfer required (Y/N)?	Potential gains
Knitting	• Circular knitting machines- single jersey, double jersey, manual/ electronic jacquard, ribbed circular, etc.	• Deployment of indigenous machines with relatively dated technology vis-à-vis imported machines • Reliance on imported machinery from China, Taiwan, Germany	• Open width circular knitting machines – Potential for self-correction to improve product quality	Intl.	Y	• Less shrinkage and straight knitting lines leading to better quality • Faster downstream processes such as cutting leading to time and cost savings
Processing	• Conventional open winch; Gradual shift to soft flow technology • Larger units have individual ETPs for water treatment and solid waste management. Smaller units are dependent on CETPs • Manual colour matching	• Existing technology leads to higher water consumption resulting in depletion of ground water • Inadequate functioning of CETPs resulting in non-compliance with zero discharge requirements leading to possible closure of units • Manual process results in higher instances of colour-mismatch leading to wastage of effort and resources	• Air flow, Pad -batch – Business compulsion on account of growing concerns about impact of the industry on environment	Intl.	Y	• Reduced consumption of water • Reduced discharge of effluent
			• Spectro-photometer - Potential for self-correction to ensure better colour matching	Intl.	Y	• High accuracy of colour matching
Finishing	• Automated machines	• At par with requisite standards				
Printing	• Flat-bed manual screen printing	• Automated screen printing deployed by relatively larger units	• Automated screen printing through establishment of CFCs	Natl./ Intl.	Y	• Better quality of product
Garment manufacturing	• Cutting using mix of manual and semi-automated technology • Stitching- Automated single/ double needle machines; medium and larger units also use flat lock, over lock machines, etc.	• Manual cutting is preferred when lot sizes are small but it leads to higher level of wastage vis-à-vis deployment of automated machines	• Automated machines for cutting - Potential for self-correction to ensure reduced level of wastage	Natl./ Intl.	Y	• Lower level of wastage • Better quality of product

Natl. – National players; Intl. – International players

	Current status	Issues/ observations w.r.t technology adoption	Potential measures to increase technology adoption/ absorption
Technology adoption/ absorption mechanism	• Trade fairs and technology exhibitions are the primary sources of information for MSMEs in order to identify the modern technologies which they can adopt, in addition to business development initiatives of respective OEMs and their vendors • Based on the above, individual MSMEs procure the machinery from OEMs/ vendors directly • OEMs/ vendors provide training to select operators on Train-the-Trainers mode	• Reliance on word-of-mouth and informal information about upgraded technology, without obtaining practical demonstration of the same impacts technological assessment	• Potential for BDS/ Industry association to maintain inventory of latest technology and corresponding providers as a ready reference for the same • Intervention required includes creation of the initial database and periodic updation of the same
Key critical success factors for technology adoption	**Availability of technology related database** • Reliance on technology and related plant & machinery as defined in the eligible list of technologies under TUFS **Availability of infrastructure (CFCs, Testing labs, etc.)** • Various stand-alone private labs are available • CFC has been established recently with only computer facilities for designing **Availability of technical assistance** • Textiles Committee under the Ministry of Textiles • BDS providers **Capacity development** • NIFT-TEA Knitwear Fashion Institute • PIAM • SIHMA Institute of Fashion and Apparel Training • ATDC • BDS providers **Availability of support for R&D, capacity development, technical assistance** • SITRA • SVPITM	**Availability of technology related database** • Limited awareness about upgraded technology **Availability of infrastructure** • Absence of CFCs having modern technologies which are capital intensive and not required by MSMEs on a continuous basis • Absence of testing labs in a CFC **Availability of technical assistance** • Limited technology experts for providing guidance on effluent treatment, water conservation **Capacity development** • Courses offered by capacity development agencies have limited alignment with industry requirements • Limited awareness of requisite regulations (eco-labels, REACH), quality certifications, manufacturing principles(e.g. six sigma, cost reduction), modern technology and IT systems **Availability of support for R&D, capacity development, technical assistance** • Limited number of well-equipped academic/ R&D institutes providing support in (i) effluent treatment (ii) water conservation technology for processing/ dyeing	• Potential for BDS/ Industry Associations to facilitate infrastructure upgradation by availing respective schemes and provide linkages for R&D, technical consultancy, capacity development and awareness of requisite environment related regulations, quality certifications, manufacturing principles, modern technology and IT systems • Intervention required on an on-going basis through better information dissemination and establishment of required linkages
Schemes available and those availed	• Main schemes which MSMEs in the cluster are aware of/ availing include the following:- Sector specific- **MoT** - Financing support through TUFS Sector agnostic- **MoMSME** - Financing support through CLCSS and CGTMSE - Establishment of CFC through MSE-CDP - Operations improvement through NMCP • Besides a no. of other schemes of the **MoT** are available for the cluster members as detailed in section 3.3 • In addition, a no. of other schemes by the MoST and MoMSME is available for the cluster members as detailed in section 2.2	• Limited awareness of requisite support available for adoption of environment friendly technologies, IPR related issues and quality certifications due to lack of adequate mechanism for information dissemination	• Potential for greater information dissemination for ensuring greater outreach of these schemes among the target beneficiaries through support of BDS/ Industry association • Intervention required on an on-going basis through better information dissemination

17.1.2 Drugs & Pharmaceutical (Hyderabad)

Process steps	Existing technology deployed by a majority of units	Issues/ observations w.r.t existing technology	Potential for deploying better/ cleaner technology	Availability of technology	Tech transfer required (Y/N)?	Potential gains
Raw Material	• Reliance on internal/ external testing labs	• Testing labs may not be GLP compliant and do not always use state -of-art testing equipment like spectrometers, high-performance liquid chromatography machines etc.	• GLP compliant testing labs which ensure deployment of state -of-art testing equipment- Business compulsion on account of need for complying with required quality norms but costs are prohibitive	Local / Natl./ Intl.	Y	• Assurance of quality of raw materials and compliance with requisite norms
Chemical Processing **Filtration** **Purification** **Drying** **Milling**	• Reliance on indigenous technology & equipment provided by local manufacturers • Manual processes for material movement	• Technology and equipments used may not always be the "best in class" • Processes are not in -line with lean manufacturing principles • Loss of by -products during chemical processing • Absence of focus on recovery of filtrate and solvent during the production cycle resulting in significant wastages • Production facilities and processes may not be compliant with GMP norms • Scope for automation	• Potential for technology upgradation through self -correction in order to enhance efficiency & productivity • Deployment of lean manufacturing principles-Potential for self -correction in order to enhance efficiency & productivity • Recovery of by-products during chemical processing - Potential for self -correction in order to recover some additional revenue from by-products • Recovery of filtrate and solvent during chemical processing - Potential for self -correction in order to reuse the filtrate & solvents in the production cycle • Deployment of GMP norms - Business compulsions in order to comply with required manufacturing norms but costs are prohibitive • Special purpose machines for automation of material handling facilities - Potential for self -correction in order to increase efficiency and productivity	Natl. / Intl. Natl./ Intl. Local / Natl. Local / Natl. Natl./ Intl. Natl./ Intl	Y Y Y Y Y Y	• Better efficiency and productivity • Better efficiency and productivity • Recovery of by -products leading to additional revenue • Cost savings through reuse of the filtrate & solvents in the production cycle • Improved productivity and cost reduction • Greater efficiency & productivity
Packing	• Manual process	• Scope for automation	• Automation of the process - Potential for self-correction in order to improve efficiency	Natl./ Intl.	Y	• Greater efficiency • Ensure quality control

Process steps	Existing technology deployed by a majority of units	Issues/ observations w.r.t existing technology	Potential for deploying better/ cleaner technology	Availability of technology	Tech transfer required (Y/N)?	Potential gains
Testing of finished product	· Reliance on internal/ external testing labs	• Testing labs may not be GLP compliant which do not always use state-of-art testing equipment like spectrometers, high-performance liquid chromatography machines etc.	• GLP compliant testing labs which ensure deployment of state-of-art testing equipment- Business compulsions on account of the need to comply with required quality norms but costs are prohibitive	Local / Natl./ Intl.	Y	• Assurance of final product in line with buyer specifications
Effluent treatment	• Disposal of effluent generated from the process without ensuring optimum recovery of water, solvents, salts and organic elements	• Wastage of organic materials which can be a source of additional revenue • Loss of water & solvents which can be re-used in the production cycle • Salts are released contaminating the ground water	• Treatment of effluent through Multiple Effect Evaporator (MEE) - Business compulsion on account of growing concerns of the impact of industry on the environment	Local / Natl./ Intl.	Y	• Effluents treated through MEE can recover i) organic materials which can be sold to cement industry for kiln preparation and ii) water & solvent for re-use • Adherence to applicable norms & regulations
			• CETP at the cluster level to facilitate adherence to applicable norms- Business compulsion on account of growing concerns of the impact of industry on the environment	Local / Natl./ Intl.	Y	

Natl.- National players; Intl.- International players

	Current status	Issues/ observations w.r.t technology adoption	Potential measures to increase technology adoption/ absorption
Technology adoption/ absorption mechanism	• Trade fairs and technology exhibitions are the primary sources of information for MSMEs in order to identify the modern technologies which they can adopt, in addition to business development initiatives of respective OEMs and their vendors • Based on the above, individual MSMEs procure the machinery from OEMs/ vendors directly • OEMs/ vendors provide training to select operators on Train-the-Trainers mode	• Reliance on word-of-mouth and informal information about upgraded technology, without obtaining practical demonstration of the same impacts technology assessment	• Potential for BDS/ Industry association to maintain inventory of latest technology and corresponding providers as a ready reference for the same • Intervention required includes creation of the initial database and periodic updation of the same
Key critical success factors for technology adoption	**Availability of technology related database** • None **Availability of infrastructure (CFCs, Testing labs, etc.)** • Testing labs are not GLP norms compliant and do not use state-of-art testing equipment and technology **Availability of technical assistance** • BDS providers • Some spill-over of knowledge occurs due to presence of large organized players in the cluster **Capacity development** • Lack of agencies formally linked to the cluster for development of manpower • BDS providers **Availability of support for R&D, capacity development, technical assistance** • NIPER • IDPL	**Availability of technology related database** • Limited awareness about upgraded technology **Availability of infrastructure** • Lack of GLP compliant testing facilities results in lack of credibility in raw materials and final products of the cluster **Availability of technical assistance** • Limited technology experts for providing guidance on process improvement and resolving technical issues **Capacity development** • Limited awareness about measures to ensure environmental compliance, water conservation and manufacturing principles such as six sigma **Availability of support for R&D, capacity development, technical assistance** • Limited number of well-equipped academic/ R&D institutes for providing guidance on effluent treatment, water conservation, re-use and recycle of by products, solvents and filtrate	• Potential for BDS/ Industry Associations to facilitate infrastructure upgradation by availing respective schemes and provide linkages for R&D, technical consultancy, capacity development and awareness of GLP, GMP, norms manufacturing principles, modern technology and IT systems • Intervention required on an on-going basis through better information dissemination and establishment of required linkages
Schemes available and those availed	• Main schemes which MSMEs in the cluster are aware of/ availing include the following:- Sector specific- **MoCF-DOP** - Financing support through Interest subsidy for Schedule M compliance in line with GMP norms Sector specific- **MoST-DST** - Financing support through DPRP Sector agnostic- **MoMSME** - Financing support through CLCSS and CGTMSE - Establishment of CFC through MSE-CDP - Operations improvement through NMCP • Besides a no. of other schemes by the MoCF-DOP are available as detailed in section 4.3 • In addition, a no. of other schemes by the MoST and MoMSME is available for the cluster members as detailed in section 2.2	• Limited awareness of requisite support available from various Government agencies for securing certifications, operations improvement, ensuring environmental compliance, patenting, etc. due to lack of adequate mechanism for information dissemination	• Potential for greater information dissemination for ensuring greater outreach of these schemes among the target beneficiaries through support of BDS/ Industry association • Intervention required on an on-going basis through better information dissemination

17.1.3 Food Processing– Fruits & Vegetables (Pune)

Process steps	Existing technology deployed by a majority of units	Issues/ observations w.r.t existing technology	Potential for deploying better/ cleaner technology	Availability of technology	Tech transfer required (Y/N)?	Potential gains
Preparatory activities like Sorting / Grading, Cleaning & Drying	• Reliance primarily on manual processes for preparatory/ preliminary activities	• Units investing in automation primarily relying on imported machinery • Reluctance among suppliers of imported technology in establishing local presence for ensuring operation & maintenance support on account of concerns on potential market size through sale to MSMEs - impacts adoption among the MSMEs	• Scope for automation in select preparatory activities- Potential for self-correction in order to improve productivity and addressing shortage of skilled labour	Intl.	Y	• Improved productivity • Address shortage of skilled labour
Batching - blending spices for pickle preparation	• Primarily reliance on manual processes for batching process • Some of the medium and larger units have automated facility for batching	• Scope for automation	• Automated facility for batching- Potential for self-correction in order to reduce production cycle time	Natl./ Intl.	Y	• Reduced production cycle time
Freezing – for frozen fruits / vegetable products	• For preparation of value added frozen fruits/ vegetable products, most of the units typically employ conventional 'Blast' freezing technology • Some of the larger units have shifted to energy efficient 'Individual Quick Frozen' (IQF) technology for this purpose	• Scope for introduction of energy efficient technologies like IQF on a larger scale	• IQF technology- Potential for self-correction in order to increase efficiency of freezing process	Natl./ Intl.	Y	• More energy efficient process vis-à-vis 'blast freezing' technology
Packaging	• Most of the small units do packaging manually	• The smaller cluster units do not have adequate scale of operations to justify the investment in technologies for automated packaging	• Automated packaging facility like Automated Form Filling & Sealing machines, etc.- Potential for self-correction in order to ensure hygiene and enhance productivity	Natl./ Intl.	Y	• Enhances productivity and ensures hygiene packaging by

Process steps	Existing technology deployed by a majority of units	Issues/ observations w.r.t existing technology	Potential for deploying better/ cleaner technology	Availability of technology	Tech transfer required (Y/N)?	Potential gains
			• Aseptic Packaging / Controlled Atmosphere Packaging (CAP) / Modified Area Packaging (MAP) - Business compulsion in line with end-user requirements to ensure requisite hygiene compliances			manual intervention • Increased product shelf life
Labeling / Bar coding	• Most of the small units do not have the facility for labeling and bar coding	• Impacts ability to target exports or even supply to well-established domestic retail chains	• Automated labeling/ bar coding systems- Business compulsion for meeting requirements for supplying to retail chains / organized buyer in domestic markets and exports	Natl./ Intl.	Y	• Increases the chance of supplying to retail chains and key buyers in domestic / export markets
Water Pollution & Effluent Treatment	• Most of the units do not have facilities for processing of solid waste and treatment of water for reuse in the manufacturing process	• Scope for investing in effluent treatment technology	• ETP with RO facility- Business compulsion on account of growing concerns about the impact of the industry on environment	Natl./ Intl.	Y	• Effluent treatment and treatment/ recycling of water

Natl.- National players; Intl.- International players

	Current status	Issues/ observations w.r.t technology adoption	Potential measures to increase technology adoption/ absorption
Technology adoption/ absorption mechanism	• Word-of-mouth and informal information is the primary source of information for MSMEs in order to identify the modern technologies which they can adopt, in addition to business development initiatives of respective OEMs and their vendors • Based on the above, individual MSMEs procure the machinery from OEMs/ vendors directly • OEMs/ vendors provide training to select operators on Train-the-Trainers mode	• Reliance on word-of-mouth and informal information about upgraded technology, without obtaining practical demonstration of the same impacts technology assessment	• Potential for BDS/ Industry association to maintain inventory of latest technology and corresponding providers as a ready reference for the same • Intervention required includes creation of the initial database and periodic updation of the same
Key critical success factors for technology adoption	**Availability of technology related database** • None **Availability of infrastructure (CFCs, Testing labs, etc.)** • Limited presence of testing facilities like in NAFARI **Availability of technical assistance** • NHB • BDS providers **Capacity development** • NHB • BDS providers **Availability of support for R&D** • NAFARI	**Availability of technology related database** • Limited awareness about upgraded technology and the corresponding providers **Availability of infrastructure** • Limited facilities/ absence of CFC in the cluster **Availability of technical assistance** • Limited capability of resolving technical and operational issues **Capacity development** • Limited awareness about measures to improve energy efficiency, environmental compliance, packaging/ labeling and manufacturing principles such as six sigma **Availability of support for R&D** • Limited well equipped R&D/ academic institutes providing support in (i) energy efficiency, (ii) hygienic packaging etc.	• Potential for BDS/ Industry Associations to facilitate infrastructure upgradation by availing respective schemes and provide linkages for R&D, technical consultancy, capacity development and awareness of requisite environment related regulations, quality certifications, manufacturing principles, modern technology and IT systems • Intervention required on an on-going basis through better information dissemination and establishment of required linkages
Schemes available and those availed	• Main schemes which MSMEs in the cluster are aware of/ availing include the following:- Sector specific- **MoFPI** - Financing support through Scheme for Technology Upgradation/ Establishment/ modernization of Food Processing Industries Sector agnostic- **MoMSME** - Financing support through CLCSS and CGTMSE - Operations improvement through NMCP • Besides a no. of other schemes by the **MoFPI** are available for the cluster members as detailed in section 5.3 • In addition, a no. of other schemes by the MoST and MoMSME is available for the cluster members as detailed in section 2.2	• Limited awareness of requisite support available from various Government agencies for investing in energy efficient technologies, packaging, labeling/ bar coding, ensuring environmental compliance, etc. due to lack of adequate mechanism for information dissemination	• Potential for greater information dissemination for ensuring greater outreach of these schemes among the target beneficiaries through support of BDS/ Industry association • Intervention required on an on-going basis through better information dissemination

17.1.4 Foundry (Rajkot)

Process steps	Existing technology deployed by a majority of units	Issues/ observations w.r.t existing technology	Potential for deploying better/ cleaner technology	Availability of technology	Tech transfer required (Y/N)?	Potential gains
Pattern Making	• Outsourced to pattern makers who use the following:- - CAD/ CAM for pattern designing - CNCs/ VMCs for machining patterns	• At par with requisite standards				
Sand and Core preparation	• Based on size of castings, either green sand or Molasses sand is used- Sand samples are sent to outside labs for testing • For core preparation, typically resin coated sand is used	• Lack of adequate sand testing facilities in the cluster which can lead to improper sand preparation resulting in higher rejections of castings	• Sand preparation and laboratory facilities can be set up as CFCs- Potential for self-correction in order to reduce rejections	Natl./ Intl.	Y	• Reduced rejections of castings • Cost savings through benefit of aggregation
	• Dependence on fresh river sand	• Shortage of river sand resulting in need for reclamation of the same. Absence of a facility for reclamation of sand in most units	• Sand reclamation facilities can be set up as CFCs- Potential for self-correction in order to address fluctuations of supply of sand	Natl./ Intl.	Y	• Reduced dependency on suppliers & cost fluctuations
Melting & Casting	• Conventional cupola for melting purposes	• The conventional cupolas are energy inefficient	• Divided blast cupola (DBC) – Potential for conversion of the conventional cupolas according to DBC design – Business compulsion to reduce energy consumption levels	Natl./ Intl.	Y	• Cost savings through reduced coke consumption • Increased melting efficiency leading to reduced heat & melting loss
	• Conventional dry system for removal of flue gases produced during melting	• Limited effectiveness in reducing air pollution	• Venturi-scrubber – Business compulsion on account of need to adhere to environmental compliances	Natl./ Intl.	Y	• Greater efficiency in removal of flue gasesleading togreater environmental compliance
	• Slag produced during melting is disposed for land fill		• Potential for utilizing slag by supplying it for the manufacture of cement – Potential revenue augmentation	Natl./ Intl.	N	• Better utilization of waste and potential for earning revenue
Shot blasting Fettling/ Grinding	• Automatic Shot blasting & grinding machines	• At par with requisite standards				
Machining	• Lathe machines for machining	• Reliance on manual processes	• CNCs/ VMCs - Business compulsion to produce requisite quality as per market requirements	Natl./ Intl.	Y	• Increased productivity • Better machining quality

Natl. – National players; Intl. – International players

	Current status	Issues/ observations w.r.t technology adoption	Potential measures to increase technology adoption/ absorption
Technology adoption/ absorption mechanism	• Word-of-mouth and informal sources of information is the primary source of information for MSMEs in order to identify modern technologies which they can adopt • Demonstration for DBC set up by BDS provider	• Reliance on word-of-mouth and informal information about upgraded technology leads to limited awareness of upgraded technologies • Limited awareness about viability of adopting DBC with lower diameters	• Potential for BDS/ Industry association to maintain inventory of latest technology and corresponding providers as a ready reference for the same • Intervention required includes creation of the initial database and periodic updation of the same • Establishment of linkage with technology providers of DBCs with lower diameters
Key critical success factors for technology adoption	**Availability of technology related database** • None **Availability of infrastructure (CFCs, Testing labs, etc.)** • Limited testing facilities- Primary reliance on in-house testing **Availability of technical assistance** • IIF • BDS providers **Capacity development** • None **Availability of support for R&D** • Limited	**Availability of technology related database** • Limited awareness about upgraded technology and the corresponding providers **Availability of infrastructure** • Limited testing facilities lead to products having to be sent to other Natl./ Intl. labs which increases cost of compliance **Availability of technical assistance** • Technical assistance is sought on an individual basis by the units themselves **Capacity development** • Limited awareness about measures for improving energy efficiency and reducing pollution **Availability of support for R&D** • Limited number of well-equipped academic/ R&D institutes providing support in (i) energy efficiency, (ii) pollution control	• Potential for BDS/ Industry Associations to facilitate infrastructure upgradation by availing respective schemes and provide linkages for R&D, technical consultancy, capacity development and awareness of requisite environment related regulations, quality certifications, manufacturing principles, modern technology and IT systems • Intervention required on an on-going basis through better information dissemination and establishment of required linkages
Schemes available and those availed	• Main schemes which MSMEs in the cluster are aware of/ are availing include the following:- Sector agnostic- **MoMSME** - Financing support through CLCSS and CGTMSE - Operations improvement through NMCP • In addition, a no. of other schemes by the MoST and MoMSME is available for the cluster members as detailed in section 2.2	• Limited awareness of requisite support available from various Government agencies for investing in energy efficient technologies, establishing CFCs with testing facilities, ensuring environmental compliance, etc. due to lack of adequate mechanism for information dissemination	• Potential for greater information dissemination for ensuring greater outreach of these schemes among the target beneficiaries through support of BDS/ Industry association • Intervention required on an on-going basis through better information dissemination

17.1.5 Ceramics (Morbi)

Process steps	Existing technology deployed by a majority of units	Issues/ observations w.r.t existing technology	Potential for deploying better/ cleaner technology	Availability of technology	Tech transfer required (Y/N)?	Potential gains
Floor/ wall/ vitrified tiles						
Preparation of the body	• Ball mills along with grinding media for grinding & preparation of slip/ slurry • Spray dryer is used for conversion of slip/ slurry into granules/ ceramic powder	• Manufacturers of wall & floor tiles typically outsource it on account of significant investment along with limited usage of the same which would result in sub-optimal capacity utilization on self-operation • Vitrified tile manufacturers conduct it in-house to ensure control on quality & strength of the body material				
Pressing	• Automatic hydraulic press	• Absence of local equipment fabricators leads to reliance on imports from Italy & China				
Glazing	• Bell Flow method for applying glaze material on the tiles	• The units do not have facilities for treatment of water associated with Bell Flow method	• ETP for treatment of water - Business compulsion on account of growing concerns about impact of the industry on environment	Natl./ Intl.	Y	• Potential for re-using the water in the manufacturing process
Printing	• Automatic Screen printing	• Limited range of colour options and quality	• Digital printing – Potential for self-correction to improve product quality	Intl.	Y	• Wider range of colour options & improved print quality
Firing	• Most units have shifted from conventional tunnel kiln technology to energy efficient roller kiln technology	• At par with requisite standards				
Squaring/ Sizing	• Automated squaring/ sizing line	• Absence of local equipment fabricators leads to reliance on imports from Italy & China				
Sorting & Packing	• Reliance on manual processes	• The cluster units are facing a labour shortage	• Automated/ semi-automated sorting and packing – Potential for self-correction in order to improve efficiency	Intl.	Y	• Greater efficiency • Address labour shortage

Process steps	Existing technology deployed by a majority of units	Issues/ observations w.r.t existing technology	Potential for deploying better/ cleaner technology	Availability of technology	Tech transfer required (Y/N)?	Potential gains
Sanitary-ware						
Preparation of the slip/ slurry	• Ball mills along with grinding media for grinding & preparation of slip/ slurry	• At par with requisite standards				
Casting	• For preparation of green pieces, slip is poured into POP moulds for getting the desired shape	• Scope for automation of the process	• Automated pressure castings (APC) - Potential for self -correction in order to improve productivity	Natl./ Intl.	Y	• Greater productivity • Enhanced finishing reduces manual effort in finishing
Glazing	• Manually by using hand spray gun & diaphragm pump	• Scope for automation	• Mechanized robots for spraying – Potential for self-correction to improve productivity but high costs are an impediment	Intl.	Y	• Greater productivity
Firing	• Conventional tunnel kiln technology	• Takes relatively longer duration vis-à-vis roller kiln technology	• Roller kiln technology - Potential for self-correction in order to improve energy efficiency	Natl./ Intl.	Y	• More energy efficient • Shorter duration
Sorting & Packing	• Reliance on manual processes for most of the units	• The cluster units are facing a labour shortage	• Automated/ semi-automated sorting and packing - Potential for self-correction in order to improve efficiency	Intl.	Y	• Greater efficiency • Address labour shortage

Natl. – National players; Intl. – International players

	Current status	Issues/ observations w.r.t technology adoption	Potential measures to increase technology adoption/ absorption
Technology adoption/ absorption mechanism	• Word-of-mouth and informal information is the primary source of information for MSMEs in order to identify the modern technologies which they can adopt, in addition to business development initiatives of respective OEMs and their vendors • Based on the above, individual MSMEs procure the machinery from OEMs/ vendors directly • OEMs/ vendors provide training to select operators on Train-the-Trainers mode	• Reliance on word-of-mouth and informal information about upgraded technology without practical demonstration hampers the units in evaluating different types of technologies and conducting a proper decision making process when acquiring new technologies	• Potential for BDS/ Industry association to maintain inventory of latest technology and corresponding providers as a ready reference for the same • Intervention required includes creation of the initial database and periodic updation of the same
Key critical success factors for technology adoption	**Availability of technology related database** • None **Availability of infrastructure (CFCs, Testing labs, etc.)** • None **Availability of technical assistance** • The OEMs provide technical assistance on their technologies **Capacity development** • None of the training/ academic institutes are linked to the cluster for developing capacity of the resources **Availability of support for R&D** • The CGCRI centre of Naroda supports the cluster	**Availability of technology related database** • Limited information about different types of technologies hampers the decision making process in upgrading to better technologies **Availability of infrastructure** • Limited testing facilities / absence of CFC in the cluster **Availability of technical assistance** • Limited capability of resolving technical and operational issues **Capacity development** • Limited awareness about measures to improve energy efficiency, environmental compliance and manufacturing principles such as six sigma **Availability of support for R&D** • Limited number of well-equipped academic/ R&D institutes providing support in (i) energy efficiency, (ii) product improvement etc.	• Potential for Industry Associations to facilitate infrastructure upgradation by availing respective schemes and provide linkages for R&D, technical consultancy, capacity development and awareness of requisite environment related regulations, quality certifications, manufacturing principles, modern technology and IT systems • Intervention required on an on-going basis through better information dissemination and establishment of required linkages
Schemes available and those availed	• Main schemes which MSMEs in the cluster are aware of/ availing include the following:- Sector agnostic- **MoMSME** Financing support through CLCSS and CGTMSE • In addition, a no. of other schemes by the MoST and MoMSME (e.g. NMCP) is available for the cluster members as detailed in section 2.2	• Limited awareness of requisite support available from various Government agencies for investing in energy efficient technologies, ensuring operational improvement etc. due to lack of adequate mechanism for information dissemination	• Potential for greater information dissemination for ensuring greater outreach of these schemes among the target beneficiaries through support of BDS/ Industry association • Intervention required on an on-going basis through better information dissemination

17.1.6 Plastics (Ahmedabad)

Process steps	Existing technology deployed by a majority of units	Issues/ observations w.r.t existing technology	Potential for deploying better/ cleaner technology	Availability of technology	Tech transfer required (Y/N)?	Potential gains
Mould & die preparation	• Manually operated lathes & machining centres for production of moulds & dies	• In-time availability of moulds & dies from local sources of requisite quality is a key issue, resulting in dependence on imports primarily from China	• Automated CNC / VMC machines for production of moulds & dies- Potential for self-correction in order to improve quality	Local / Natl. / Intl.	Y	• Better quality of moulds & dies
Raw Material Preparation **Extrusion / Moulding**	• Material handling is primarily manual • Extrusion: Primarily focused on production of mono layer films with single screw extruder, deployment of automatic sensor & cutter as per user specifications • Injection Moulding: - Single screw based moulding machines - Deployment of cooling tower to dissipate heat - Adoption of "cold runner" - Manual process of picking up finished good after moulding	• Productivity is impacted due to manual handling of raw material • Limited strength and precision as compared to twin screw technology • Limited strength & precision • Impacts product finish & level of energy consumption • Leads to wastage of plastic during processing • Scope for automation	• Automated material handling equipment- Potential for self-correction in order to improve productivity • Multiple extruders for producing multi-layer films for flexible packaging - Business compulsion on account of demand from user industry • Twin screw technology - Potential for self-correction in order to improve quality of product • Twin screw technology - Potential for self-correction to improve quality of product • Chillers for heat dissipation- Potential for self-correction to reduce energy consumption • Introduction of "hot runner"- Potential for self-correction to reduce plastic wastage • Automated material handling system for picking up finished goods - Potential for self-correction in order to improve efficiency	Local / Natl./ Intl. Natl. / Intl. Natl. / Intl. Natl. / Intl. Natl./ Intl. Natl./ Intl. Local / Natl./ Intl.	Y Y Y Y Y Y Y	• Better productivity and ease of operations • Meeting demands from packaging related user industry • Higher precision & strength and reduced energy consumption levels • Better precision & strength • Better finish and energy conservation • Reduce plastic wastage • Prevents wear & tear of tool moulds and improves productivity

Process steps	Existing technology deployed by a majority of units	Issues/ observations w.r.t existing technology	Potential for deploying better/ cleaner technology	Availability of technology	Tech transfer required (Y/N)?	Potential gains
Finishing	• Printing & Lamination: Primarily restricted to ability to use 4 colour ink; lamination primarily restricted to ability to use mono layer lamination	• Lesser number of colour combinations and impact on quality	• Deployment of 8 colour ink - Potential for self-correction in order to improve output and quality • Deployment of multi-layer lamination - Business compulsion on account of demand from user industry	Natl. / Intl. Natl. / Intl.	Y Y	• Reduce ink consumption, increase output & improve quality • Adherence to requirements of the packaging industry
Quality Assurance	• Reliance on in-house testing facilities	• In-house testing facilities, if available, may not meet standards as required by the end-customer resulting in higher level of rejections	• Better and adequate testing facilities- Potential for self-correction in order to reduce rejections, which could be facilitated through CFC model	Natl./ Intl.	Y	• Lower level of rejection
Packing	• Primary reliance on manual process, with automation for packing limited to extrusion based products for packaging industry	• Reliance on manual process may impact quality of packaging and also adherence to compliance norms (like food packaging)	• Automation in the process for counting, sorting and packing finished goods, especially for moulded products- Potential for self-correction in order to improve productivity; Business compulsion for units engaged in packaging of food / dairy products	Natl./ Intl.	Y	• Greater productivity

Natl.- National players; Intl.- International players

	Current status	Issues/ observations w.r.t technology adoption	Potential measures to increase technology adoption/ absorption
Technology adoption/ absorption mechanism	• Word-of-mouth and informal information are the primary sources of information for MSMEs in order to identify the modern technologies which they can adopt, in addition to business development initiatives of respective OEMs and their vendors • Based on the above, individual MSMEs procure the machinery from OEMs/ vendors directly • OEMs/ vendors provide training to select operators on Train-the-Trainers mode	• Reliance on word-of-mouth and informal information about upgraded technology without obtaining practical demonstration of the same impacts technology assessment	• Potential for BDS/ Industry association to maintain inventory of latest technology and corresponding providers as a ready reference for the same • Intervention required includes creation of the initial database and periodic updation of the same
Key critical success factors for technology adoption	**Availability of technology related database** • None **Availability of infrastructure (CFCs, Testing labs, etc.)** • Limited support from testing and development facilities in CIPET, Indo-German Tool Room **Availability of technical assistance** • BDS providers **Capacity development** • BDS provider • Lack of adequate capacity development agencies **Availability of support for R&D** • CIPET	**Availability of technology related database** • Limited awareness of modern technologies **Availability of infrastructure** • Limited testing facilities/ absence of CFCs in the cluster **Availability of technical assistance** • Limited capability of the units in resolving technical and operational issues • Limited awareness about the mechanism for availing carbon credits on deployment of "environment- friendly" technologies **Capacity development** • Limited awareness about measures to improve energy efficiency, environmental compliance and manufacturing principles such as six sigma **Availability of support for R&D** • Limited number of well-equipped academic/ R&D institutes providing support in (i) diversification to value-added products and (ii) energy efficiency improvement	• Potential for BDS/ Industry Associations to facilitate infrastructure upgradation by availing respective schemes and provide linkages for R&D, technical consultancy, capacity development and awareness of requisite environment related regulations, quality certifications, manufacturing principles, modern technology and IT systems • Intervention required on an on-going basis through better information dissemination and establishment of required linkages
Schemes available and those availed	• Main schemes which MSMEs in the cluster are aware of/ availing of include the following:- Sector agnostic- **MoMSME** - Financing support through CLCSS and CGTMSE - Operations improvement through NMCP • In addition, a no. of other schemes by the MoST and MoMSME is available for the cluster members as detailed in section 2.2	• Limited awareness of requisite support available from various Government agencies for investing in energy efficient technologies, establishing CFCs for processing plastic waste and testing facilities, operational improvement, etc. due to lack of adequate mechanism for information dissemination	• Potential for greater information dissemination for ensuring greater outreach of these schemes among the target beneficiaries through support of BDS/ Industry association • Intervention required on an on-going basis through better information dissemination

17.1.7 Paper (Vapi)

Process steps	Existing technology deployed by a majority of units	Issues/ observations w.r.t existing technology	Potential for deploying better/ cleaner technology	Availability of technology	Tech transfer required (Y/N)?	Potential gains
Re-pulping	• Low consistency hydra pulpers, mostly from domestic suppliers	• Low cleaning efficiency & high water and energy consumption	• Deployment of medium & high consistency hydra pulper to reduce water consumption, damage of fibres and energy consumption- Potential for self-correction in order to reduce water and energy consumption	Not available in paper clusters	Y	• Reduce water & energy consumption and damage of fibres
Cleaning of stock	• Turbo separators/ Centri cleaners/ Screens, mostly of domestic suppliers	• Low cleaning efficiency and high water consumption	• State-of-art modern turbo separators/ centri-cleaners/ screens- Potential for self-correction in order to increase efficiency of process	Not available in paper clusters	Y	• Greater removal of contaminants & impurities with less water and energy consumption
Refining	• Disc refining which operates at low consistency (2-3%)	• High energy consumption and poor fiber quality development due to high fibre cutting	• Deployment of conflow type refiners- Potential for self-correction in order to improve quality and reduce energy consumption	Not available in paper clusters	Y	• Reduce energy consumption and better fiber quality development
Fine screen	• Indigenous single stage hole type basket in screening system	• Poor cleaning efficiency and high water consumption	• Slotted type screening system in cascade arrangement- Potential for self-correction in order to improve efficiency	Not available in paper clusters	Y	• Better screening efficiency
Mixing	• Manually operated valves in blending and mixing	• Disproportionate mixing giving variation in quality of product	• Automatic blending & mixing arrangements- Potential for self-correction in order to improve quality	Not available in paper clusters	Y	• Uniform quality
Paper Making	• Open Head box	• Grammage and caliper variation; Limits machine speed	• Closed pressurized head-box- Potential for self-correction in order to improve quality and efficiency	Natl./ Intl.	Y	• Better regulation and high speed of machine
Wire section, Dryer section, Size Press, Calendar Rewinding	• Straight, open plain press with speed and moisture limitations	• Low production rate, and higher energy consumption in dryer section	• Double felted, blind drilled / vacuum suction process with high speed, high dryers capability- Potential for self-correction in order to improve productivity	Intl.	Y	• Higher productivity and less energy consumption
	• Conventional steam heated dryers	• Poor steam condensate removal system	• Flash steam in dryers by cascade heating arrangement / adoption of shoe-press machines - Potential for self-correction in order to improve efficiency	Natl./ Intl.	Y	• Economical usage of steam by better condensate removal system
	• Open or semi open type hood without pocket ventilation system and heat recovery system	• Inefficient system	• Closed hood with pocket ventilation and heat recovery system- Potential for self-correction in order to improve productivity	Natl./ Intl.	Y	• Productivity enhancement and optimal usage of steam
	• Use of multi-nip calendars	• Reduced paper bulk and machine speed limitations	• Adoption of single nip calendar with required properties at high machine speed- Potential for self-correction in order to improve productivity	Natl./ Intl	Y	• Higher speed can be achieved

Process steps	Existing technology deployed by a majority of units	Issues/ observations w.r.t existing technology	Potential for deploying better/ cleaner technology	Availability of technology	Tech transfer required (Y/N)?	Potential gains
	• Use of line shaft drive with gear box • Use of manually operated rewinders & cutters	• High power consumption and low machine speed • Poor reel/ sheet quality with higher level of rejection	• Adoption of A/c sectional drive- Potential for self-correction in order to improve productivity and reduce energy consumption • Adoption of automated rewinders and cutters- Potential for self-correction in order to improve quality and reduce rejections	Natl./ Intl Natl./ Intl	Y Y	• Enhanced speed & low power consumption • Producing quality reels & sheet with less rejection
Testing	• Post-production testing with limited in-process testing	• Higher level of rejections which can only be identified at end-of-line	• Online process quality monitoring technology to track level of moisture, thickness, GSM etc.- Potential for self-correction in order to reduce level of rejections	Natl./ Intl.	Y	• Reduced rejections at end of production process
Water treatment & recycling	• Lack of facilities for water treatment; Select units recycle water to a great extent through effluent treatment systems	• Scope for introduction of water treatment and recycling technologies	• Water treatment and recycling- Business compulsion on account of growing concerns of utilization of water and depletion of ground water • CETP at a cluster level- Business compulsion on account of growing concerns of impact of effluent discharge by industries on environment	Local/ Natl./ Intl. Natl./ Intl.	Y Y	• Re-use of water • Reduced effluent discharge
Boilers	• Low pressure steam boilers	• Low efficiency and produces high emissions	• High pressure boilers- Potential for self-correction in order to improve efficiency and reduce energy consumption	Natl./ Intl.	Y	• Co-generation of power can be a possibility

Natl.- National players; Intl.- International players

	Current status	Issues/ observations w.r.t technology adoption	Potential measures to increase technology adoption/ absorption
Technology adoption/ absorption mechanism	• Word-of-mouth and informal information are the primary sources of information for MSMEs in order to identify the modern technologies which they can adopt, in addition to business development initiatives of respective OEMs and their vendors • Based on the above, individual MSMEs procure the machinery from OEMs/ vendors directly • OEMs/ vendors provide training to select operators on Train-the-Trainers mode	• Awareness about upgraded technology available in the market for productivity enhancement / greater level of compliance with environment norms based on interactions among industry members – no external support for the same	• Potential for Industry association to maintain inventory of latest technology and corresponding providers as a ready reference for the same • Intervention required includes creation of the initial database and periodic updation of the same
Key critical success factors for technology adoption	**Availability of technology related database** • None **Availability of infrastructure (CFCs, Testing labs, etc.)** • Lack of optimum facilities which can be housed as common facilities like granulators, incinerators etc. **Availability of technical assistance** • Lack of technical assistance from institutes / BDS providers **Capacity development** • Limited presence of capacity development agencies **Availability of support for R&D** • CPPRI	**Availability of technology related database** • Awareness about upgraded technology and the corresponding providers restricted to knowledge assimilated through interactions with other manufacturers **Availability of infrastructure** • Limited testing facilities / absence of CFC in the cluster **Availability of technical assistance** • Presence of technical assistance may enhance ability to resolve techni cal and operational issues **Capacity development** • Limited awareness about measures to improve energy efficiency, environmental compliance and manufacturing principles such as six sigma **Availability of support for R&D** • Limited number of well -equipped academi c/ R&D institutes providing support in (i) effluent treatment (ii) water conservation technology and (iii) energy efficiency	• Potential for Industry associations to facilitate infrastructure upgradation by availing respective schemes and provide linkages fo r R&D, technical consultancy, capacity development • Intervention required on an on - going basis through better information dissemination and establishment of required linkages
Schemes available and those availed	• Main schemes which MSMEs in the cluster are aware of/ availing of include the following:- Sector agnostic- **MoMSME** - Financing support through CLCSS and CGTMSE - Operations improvement through NMCP • In addition, a no. of other schemes by the MoST and MoMSME is available for the cluster members as detailed in section 2.2	• Limited awareness of requisite support available from various Government agencies for investing in energy efficient technologies, operational improvement ensuring environmental compliance, etc. due to lack of adequate mechanism for information dissemination	• Potential for greater information dissemination for ensuring greater outreach of these schemes among the target beneficiaries through support of Industry association • Intervention required on an on - going basis through better information dissemination

17.1.8 Engineering (Chandigarh – Panchkula - Mohali)

Process steps	Existing technology deployed by a majority of units	Issues/ observations w.r.t existing technology	Potential for deploying better/ cleaner technology	Availability of technology	Tech transfer required (Y/N)?	Potential gains
Turning/ Milling/ Drilling/ misc. operations	• Lathe machines/ milling machines/ drilling machines and other machine tools; Select units have upgraded to CNCs/ VMCs	• Lower scale of operations is restricting a number of units from shifting to CNCs/ VMCs	• CNCs/ VMCs – Business compulsion to produce requisite quality as per market requirements	Local/ Natl./ Intl.	Y	• High part accuracy and consistency • Fast & consistent through-put of finished goods • Lower cost per unit product, subject to requisite scale of operations
Steel fabrication						
Cutting	• Manual cutting operations like sawing, chiseling, shearing • Loading sheets onto cutting bed done manually	• Limited quality achieved from cutting operations • Greater manual effort in loading	• CNC laser/ plasma/ flame cutting, water jet cutting • Vacuum loading systems - Potential for self-correction to improve productivity	Natl./ Intl.	Y	• Greater cut quality and accuracy • Greater productivity
Bending	• Rolling machines	• Limited accuracy	• CNC machine bending – Business compulsion to produce requisite quality as per market requirements	Natl./ Intl.	Y	• High dimensional accuracy & design flexibility
Assembling **Coating**	• Arc welding, CO_2 welding, MIG welding, TIG welding • Zinc coating, power coating	• At par with requisite standards • At par with requisite standards				
Fasteners						
Heading	• Hot forging for higher dia bolts; cold forging for lower dia bolts	• Most of the units use refurbished machinery or indigenously developed machinery which is cost-effective but not best-in-class	• Multi-station bolt maker & nut former machine – Potential for self-correction to enhance productivity	Intl.	Y	• Better quality, greater efficiency and higher productivity
Thread rolling	• Roll threading and cutting machines					
Nut preparation	• Lathes, milling and drilling machines					
Coating	• Hot-dip galvanizing or blackening					
Assembly	• Manually; Select units have automatic machines	• Potential for manual errors leading to re-work	• Automatic assembler of nuts and bolt - Potential for self-correction to enhance productivity	Natl./ Intl.	Y	• Reduction in manual errors and associated cost implications

Natl. – National players; Intl. – International players

	Current status	Issues/ observations w.r.t technology adoption	Potential measures to increase technology adoption/ absorption
Technology adoption/ absorption mechanism	• Trade fairs and technology exhibitions are the primary sources of information for MSMEs in order to identify the modern technologies which they can adopt, in addition to business development initiatives of respective OEMs and their vendors • Based on the above, individual MSMEs procure the machinery from OEMs/ vendors directly • OEMs/ vendors provide training to select operators on Train-the-Trainers mode	• Reliance on word-of-mouth and informal information about upgraded technology	• Potential for BDS/ Industry association to maintain inventory of latest technology and corresponding providers as a ready reference for the same • Intervention required includes creation of the initial database and periodic updation of the same
Key critical success factors for technology adoption	**Availability of technology related database** • None **Availability of infrastructure (CFCs, Testing labs, etc.)** • Lack of common facilities for processing/ testing **Availability of technical assistance** • BDS providers **Capacity development** • Limited linkages for capacity development through linkages with ITIs **Availability of support for R&D** • Limited	**Availability of technology related database** • Limited awareness about upgraded technology and the corresponding providers **Availability of infrastructure** • Limited testing facilities / absence of CFC with facilities like material testing, design centres, instrument calibration, etc. **Availability of technical assistance** • Limited capacity of resolving technical and operational issues **Capacity development** • Limited awareness about manufacturing principles like six sigma, lean manufacturing, etc. **Availability of support for R&D** • Limited no. of well-equipped academic/ R&D institutes providing R&D support for product development	• Potential for BDS/ Industry Associations to facilitate infrastructure upgradation by availing respective schemes and provide linkages for R&D, technical consultancy, capacity development and awareness of requisite quality certifications, manufacturing principles, modern technology and IT systems • Intervention required on an on-going basis through better information dissemination and establishment of required linkages
Schemes available and those availed	• Main schemes which MSMEs in the cluster are aware of/ availing include the following:- Sector agnostic- **MoMSME** - Financing support through CLCSS and CGTMSE - Operations improvement through NMCP • In addition, a no. of other schemes by the MoST and MoMSME is available for the cluster members as detailed in section 2.2	• Limited awareness of requisite support available from various Government agencies for investing in CFCs with design facilities, testing labs etc. and operational improvement etc. due to lack of adequate mechanism for information dissemination	• Potential for greater information dissemination for ensuring greater outreach of these schemes among the target beneficiaries through support of BDS/ Industry association • Intervention required on an on-going basis through better information dissemination

17.1.9 Electronics (Chandigarh – Panchkula - Mohali)

Process steps	Existing technology deployed by a majority of units	Issues/ observations w.r.t existing technology	Potential for deploying better/ cleaner technology	Availability of Technology	Tech transfer required (Y/N)?	Potential gains
Machining of metallic components	• Lathes, presses, drilling machines; Only larger units deploy CNCs/ VMCs	• Lower scale of operations is restricting a number of units from shifting to CNCs/ VMCs	• CNCs/ VMCs - Business compulsion to produce requisite quality as per market requirements	Local/ Natl./ Intl.	Y	• High part accuracy and consistency • Fast & consistent through-put of finished goods • Lower cost per unit product, subject to requisite scale of operations • Greater efficiency
	• Manual material handling processes	• Productivity is impacted due to manual handling of raw material	• Special purpose machines for automated material handling – Potential for self-correction to improve efficiency	Natl./ Intl.	Y	
Manufacture of plastic components	• Injection moulding machines	• See the comments in Plastics section				
Potting	• Manual processes	• Manual processes can lead to sub-optimal results in terms of uniformity of spread of resin • Some of the material used maybe of hazardous nature	• Automation of the process by deploying special purpose machines – Potential for self-correction in order to improve product quality	Natl./ Intl.	Y	• Greater product quality through uniformity of spread of resin
Assembly of components	• Manual process	• Scope for automation	• Special purpose machines – Potential for self-correction in order to improve efficiency and accuracy	Natl./ Intl.	Y	• Reduced time for assembling • Greater accuracy of process
Testing	• Visual testing and some measurement tests	• Since a no. of sub-components are sourced from outside vendors, ensuring requisite quality compliance is an issue				

Natl. – National players; Intl. – International players

	Current status	Issues/ observations w.r.t technology adoption	Potential measures to increase technology adoption/ absorption
Technology adoption/ absorption mechanism	• Trade fairs and technology exhibitions are the primary sources of information for MSMEs in order to identify the modern technologies which they can adopt, in addition to business development initiatives of respective OEMs and their vendors; Some exposure visits have been organized by recent BDS initiatives • Based on the above, individual MSMEs procure the machinery from OEMs/ vendors directly • OEMs/ vendors provide training to select operators on Train-the-Trainers mode	• Reliance on word-of-mouth and informal information about upgraded technology, without obtaining practical demonstration of the same • Lack of access to finance for micro units involved in manufacturing leather products due to lack of requisite documentation	• Potential for BDS/ Industry association to maintain inventory of latest technology and corresponding providers as a ready reference for the same • Intervention required includes creation of the initial database and periodic updation of the same
Key critical success factors for technology adoption	**Availability of technology related database** • Limited database as created by FREYA-IIDF **Availability of infrastructure (CFCs, Testing labs, etc.)** • Limited testing facilities • FREYA-IIDF, a CFC has been operational **Availability of technical assistance** • CLRI • BDS providers **Capacity development** • CLRI • Government College of Engineering and Leather Technology • BDS providers **Availability of support for R&D** • CLRI	**Availability of technology related database** • Limited awareness about upgraded technology and the corresponding providers **Availability of infrastructure** • Limited testing facilities lead to products having to be sent to other Natl./ Intl. labs which increases cost of compliance • Potential for greater utilization of FREYA-IIDF CFC facilities **Availability of technical assistance** • Limited linkages with leather technology experts for providing guidance on product and process improvement, effluent treatment, water conservation **Capacity development** • Limited awareness of requisite regulations (eco-labels, eco-bans), quality certifications, manufacturing principles(e.g. six sigma, cost reduction), modern technology and IT systems **Availability of support for R&D** • Limited number of well-equipped academic/ R&D institutes providing support in (i) effluent treatment (ii) water conservation technology and (iii) process improvement	• Potential for BDS/ Industry Associations to facilitate infrastructure upgradation by availing respective schemes and provide linkages for R&D, technical consultancy, capacity development and awareness of requisite environment related regulations, quality certifications, manufacturing principles, modern technology and IT systems • Creation of CFC with modern technologies for manufacture of leather products like footwear, exclusively for micro units • Intervention required on an on-going basis through better information dissemination and establishment of required linkages

17.1.10 Leather (Kolkata & Chennai)

Process steps	Existing technology deployed by a majority of units	Issues/ observations w.r.t existing technology	Potential for deploying better/ cleaner technology	Availability of technology	Tech transfer required (Y/N)?	Potential gains
Collection of carcass & its preparation and subsequent soaking	• Sourcing of carcasses is done through - Slaughterhouses - Collectors and traders	• Non-collection of a number of carcasses of fallen animals, inadequate cold chains, improper flaying lead to hides and skins being spoilt/ damaged reducing its value	• Establishment of cold chains, application of mechanized flaying- Potential for self-correction in order to increase value realized from the hides/ skins • Application of salt free preservation techniques such	Natl./ Intl. Natl./ Intl.	Y Y	• Reduced instances of lowering of product value due to damage to the hides/ skins • Reduced consumption of water resulting in reduced
	• Common salt is used for preservation which needs to be washed off at the tanneries by the process of soaking	• Significant amount of water is required for washing off the salt which leads to depletion of ground water and contamination of ground water by the salt being washed off	as dry method, using alternatives as developed by CLRI - Business compulsion on account of growing concerns about impact of the industry on environment			contamination of ground water
Liming	• Paddles; Gradual shift to drum-based process	• Chemicals used with water contaminate the ground water when released after the process	• Drum-based - Business compulsion on account of growing concerns about higher level of water consumption by the industry	Natl./ Intl.	Y	• Reduced consumption of water; Reduced contamination of ground water
Fleshing	• Fleshing machines	• At par with requisite standards				
Washing/ Deliming Pickling	• Wooden drums	• Wooden drums have limited operational life	• Metallic drums- Stainless steel drums – Potential for self-correction in order to increase life of drums	Intl.	Y	• Increased life of drums and lower maintenance cost

Tanning/ retanning	• Chrome tanning; Vegetable tanning is also used but in a lower proportion • Operations of a CETP which was set up has been suspended now	• Chrome released in the process contaminates ground water • Chrome discharged can also convert into carcinogenic compounds • Vegetable tanning leads to issues of disposal of solid wastes • Inadequate functioning of CETPs	• Chrome recovery plants; Potential for setting up common chrome recovery plants- Business compulsion on account of growing concerns about impact of the industry on environment • High exhaustion chrome tanning process developed by CLRI- Business compulsion on account for need for reducing chrome discharge	Natl./ Intl. Natl./ Intl. Natl./ Intl	Y Y Y	• Extraction of chrome from the discharge and potential for re-use leading to reduced effluent discharge • Reduced chrome discharge • Compliance with zero discharge requirements
Leather processing	• Indigenized automated/ semi - automated machines	• At par with requisite standards				
Finishing	• Manual spraying; automated spraying using rotary spray dryers	• Manual spray drying leads to lower quality levels	• Rotary spray dryers – Potential for self-correction to improve quality of finishing	Natl./Intl.	Y	• Better quality of finishing
Testing	• Most of the units send their product samples to the appropriate testing labs (could include CLRI, Chennai or even SGS laboratory in Hong Kong)	• Limited no. of testing facilities for measuring toxicity, allergenic and carcinogenic etc.	• Laboratory facilities which can be set up as CFCs – Business compulsion of adhering to requisite standards as per demand of buyers	Natl./Intl.	Y	• Better testing facilities in the cluster could reduce costs and turn-around times
Leather goods Designing **Manufacturing of leather products**	• Outdated patterns; Gradual shift to using CAD systems for producing updated designs in-line with trends • Hand tools used by micro units; larger units have varying levels of automation	• Inability of the micro and smaller units in upgrading their designs in line with market requirements. • Quality of product gets impacted due to use of hand tools and manual processes	• Deployment of CAD systems- Potential for self-correction in order to improve designing capability • Machines for automation of various processes; Potential for establishing CFCs with necessary machines	Natl./Intl.	Y	• Better designs and better quality products would lead to better value-realization of products

Natl. – National players; Intl. – International players

	Current status	Issues/ observations w.r.t technology adoption	Potential measures to increase technology adoption/ absorption
Schemes available and those availed	• Main schemes which MSMEs in the cluster are aware of/ availing include the fo llowing: Sector specific - **MoCI-DIPP** - Financing support through IDLS Sector agnostic - **MoMSME** - Financing support through CLCSS and CGTMSE - Operations improvement through NMCP • Besides a no. of other schemes by the **MoCI-DIPP** are available for the cluster members as detailed in section 12.3 • In addition, a no. of other schemes by the MoST and MoMSME is available for the cluster members as detailed in section 2.2	• Limited awareness of requisite support available from various Government agencies for ensuring environmen tal compliance, investing in CFCs for designing and testing, operational improvement, etc. due to lack of adequate mechanism for information dissemination	• Potential for greater information dissemination for ensuring greater outreach of these schemes among the target beneficiaries through support of BDS/ Industry association • Intervention required on an on - going basis through better information dissemination

17.2. Appendix 2: List of key people met during cluster visits

17.2.1. List of people met in the Textile Cluster visit (Tirupur)

Sl. No.	Organization	Name of person met	Nature of Operations
1.	Vani Fabrics Pvt. Ltd.	T. Anand General Manager	Knitting unit
2.	Vani Fabrics Pvt. Ltd.	Supervisor	Knitting unit
3.	Winner Screen Printing	R. Balu & P.S.Mani Proprietor	Printing unit
4.	Apex Cluster Development Services	Shabeer Ahammed Cluster Development Manager	Cluster Development Agency (Facilitator Agency)
5.	Textiles Committee, Tirupur	G. Venugopal Quality Assurance Officer/ Cluster Development Agent	Govt. Agency
6.	Anikshay Finsol	S.Sridharan	Cluster Development Services-Financial services
7.	Vaigei Industries	Natrajan Director	Garment Manufacturer
8.	Jamara Textile Processing Pvt. Ltd.	R.Mahesh Director	Dyeing & processing unit
9.	Nuva Machine Works India Pvt. Ltd.	K.Sriram Executive Director	Dyeing & processing equipment manufacturer & supplier
10.	Warsaw International	Raja M. Shanmugham Partner	Garment manufacturer & exporter
11.	Apex Cluster Development Services	Shankar Moorthy Cluster Expert	Cluster Development Agency (Facilitator Agency)
12.	South India Textile Research Association	S.Kadirvel Assistant Director	Govt. R&D agency
13.	Textile Committee, Coimbatore	S.Periasamy Deputy Director	Govt. Agency
14.	SIDBI	B. Kiran Kumar DGM	MSME financing & development
15.	SIDBI	V Venkatasubramanian AGM	MSME financing & development

17.2.2. List of people met in the Drugs & Pharmaceutical Cluster visit (Hyderabad)

Sl. No.	Organization	Name of person met	Nature of Operations
1.	APITCO Ltd.	Capt. D. Pulla Reddy Chief Consultant	Cluster Development Agency (Facilitator Agency)
2.	APITCO Ltd.	N.Jagdish Reddy Network Expert	Cluster Development Agency (Facilitator Agency)
3.	Vasant Chemical Pvt. Ltd.	P. M. Rao Executive Director-Operations	Intermediates, performance & specialty chemicals
4.	Vasant Chemical Pvt. Ltd.	G. Raghavaiah Assistant Manager- HR	Intermediates, performance & specialty chemicals
5.	Sreepathi Labs Pvt. Ltd.	Anup Agarwal Managing Director	Bulk drug manufacturer
6.	Archimedis Laboratories Pvt. Ltd.	M.Venkateswara Reddy Managing Director	Bulk drug manufacturer
7.	Yegna Manojavam	R. Poorna	Bulk drug manufacturer
8.	Indus Equipments	A. Mathews	Equipment suppliers
9.	Nalgonda Drug Manufacturers Association	J. Sanjeeva Reddy President	Industrial Association
10	Bulk Drug Manufacturers Association	K V Ranga Rao President	Industrial Association

17.2.3. List of people met in the Food Processing Cluster visit (Pune)

Sl. No.	Organization	Name of person met	Nature of Operations
1.	Apex Cluster Development Services	Minal Rajkarne Cluster Development Manager	Cluster Development Agency (Facilitator Agency)
2.	Desai Brothers Ltd.-Food Division (Mother's Recipe)	Treman S.Ahluwalia Chief Operating Officer	Pickles, chutneys and other food products
3.	Parampara Food Products	Amit Chillal Partner	Spices and mixes
4.	Weikfield Foods Pvt. Ltd.	Gurunath Swami GM- HRD and Admin	Food products
5.	Weikfield Foods Pvt. Ltd.	Sunil Gupta Vice President- Operations	Food products
6.	Trimurti Kings Agro Foods Pvt. Ltd.	Santosh G.Shinde Chairman & Managing Director	Food products

Sl. No.	Organization	Name of person met	Nature of Operations
7.	PKM Foods Pvt. Ltd.	Rahul Jadhav Managing Director	Food products
8.	Gomukh Frozen Foods	Suneel V.Waman	Frozen foods
9.	National Agricultural and Food Analysis and Research Institute	Vinay Oswal Director	Govt. R&D agency and Laboratory
10.	National Agricultural and Food Analysis and Research Institute	Kaustubh Pradhan Business Development Officer	Govt. R&D agency and Laboratory
11.	National Agricultural and Food Analysis and Research Institute	Anant Raj Baldota Consultant	Govt. R&D agency and Laboratory
12.	Ashtavinayak	Dr. Shirur Owner	Food processing
13.	SIDBI	Ashoo Tewari DGM	MSME financing & development

17.2.4. List of people met in the Foundry Cluster visit (Rajkot)

Sl. No.	Organization	Name of person met	Nature of Operations
1.	TERI	Bharat Davda Cluster Development Manager	Cluster Development Agency (Facilitator Agency)
2.	Sardar Castings	Girish Patel	Castings
3.	Real Cast	Jignesh Patel	Castings
4.	Badani Foundry	Shashibhai Badani	Castings
5.	Rajkot Engineering Association	Bhavesh Patel President	Industrial Association
6.	Shining Engineers & Founders Pvt. Ltd.	Vijay Patel Director M.H.Patel Managing Director	Castings
7.	Prabhukrupa Industries	Brijesh Dudhagara Managing Partner	Castings
8.	Indian Institute of Foundrymen (Rajkot chapter)		Industrial Association
9.	GIDC (Lodhika) Industrial Association	Alpesh Patel Manager	Industrial Association
10.	R.M. Engineering	Hasmukh Patel	Castings
11.	SIDBI	Dolphy S D'mello DGM	MSME financing & development

17.2.5. List of people met in the Ceramics Cluster visit (Morbi)

Sl. No.	Organization	Name of person met	Nature of Operations
1.	Color Tiles Pvt. Ltd.	Vipul Patel Managing Director	Tiles
2.	Shreeji Ceramic Industries	Haribhai Patel Director Jignesh Patel	Vitrified Tiles
3.	Omson Ceramics	Bharatbhai Patel	Tiles
4.	Eagle Ceramics	Pankaj Patel	Sanitary ware
5.	Face Ceramics	Raju Patel	Wall Tiles
6.	Boss Ceramics	Velji Patel	Wall & Floor Tiles
7.	Soriso Ceramics	Manoj Patel	Wall & Floor Tiles
8.	Sandro Ceramics	Vipin Patel	Wall & Floor Tiles
9.	Morbi-Dhuva Glaze Tile Association	Ramji Detroja	Industrial Association
10.	Apollo Sanitaryware	Amu Patel	Sanitary ware
11.	Bell Sanitaryware	Ajay Patel	Sanitary ware
12.	Delphi Ceramics	Dinesh Patel	Sanitary ware
13.	SIDBI	Dolphy S D'mello DGM	MSME financing & development

17.2.6. List of people met in the Ceramics Cluster visit (Morbi)

Sl. No.	Organization	Name of person met	Nature of Operations
1.	Entrepreneurship Development Institute of India	Riken Shah Cluster Development Manager	Cluster Development Agency (Facilitator Agency)
2.	Entrepreneurship Development Institute of India	Bipin Shah Senior Faculty	Cluster Development Agency (Facilitator Agency)
3.	MSME Tool Room	Ketan Panchal Manager	Govt. Agency
4.	Neoplast Engineering Pvt. Ltd.	Tushar Parikh Director	Plastic products
5.	Dutron Polymers Ltd.	Alpesh Patel Director	Plastic products
6.	Raj Plastic Industries	R.D.Patel	Plastic irrigation products
7.	Twist Engineering Works	M.Zahid Ansari & M.Shahid Ansari	Manufacturers & suppliers of thermoplastic extrusion plants, ancillary equipment & mixers
8.	Multi-Pack Plast Pvt. Ltd.	Prakash	Manufacturers of multi-layer flexible films, laminated films, stretch films, multi-colour laminated pouches
9.	Mahan Polymers	Mahaveer Khatang & Abhishek Khatang	Manufacturer of engineering plastic raw material
10.	Vatva Industries Association	Archich K.Shah President	Industrial Association
11.	Perfect Pack	Archich K.Shah	Plastic packaging
12.	Navkala Plastic Industries	Sandip Kalathia	Plastic caps
13.	Shree Radhekrishna Extrusions Pvt. Ltd.	Tejas Patel Director	Plastic production machinery
14.	Central Institute of Plastics Engineering & Technology	Dr. Subhas Chandra Shit Deputy Director	Govt. R&D agency
15.	Kamakshi Flexiprints Pvt. Ltd	C.A.Narendra Dhupar Director	Flexiprints
16.	Prasad Group of Companies	Sanjiv Parikh Sr. Manager- Sales & Marketing	Equipment and machinery
17.	SIDBI	Aniruddha Bagchi AGM	MSME financing & development

17.2.7. List of people met in the Paper Cluster visit (Vapi)

Sl. No.	Organization	Name of person met	Nature of Operations
1.	Craft Corner Paper Mills	Vijay Madnaik Director	Paper products
	Gujarat Paper Mills Association	Vijay Madnaik President	Industrial Association
2.	Ruby Macons Ltd.	Ashraf Nathani Director	Paper products
3.	Ruby Macons Ltd.	Santosh Biswas Works Manager	Paper products
4.	Vaibhav Paper Boards Pvt. Ltd.	Nimish J.Shah	M.G.Kraft Paper
5.	Shree Ajit Pulp and Paper Ltd	Gautam D. Shah Managing Director	Paper products
6.	Shree Ajit Pulp and Paper Ltd	Mahesh Mandowara Finance Manager	Paper products
7.	Shah Paper Mills Ltd	AK Shah Owner	Paper products
8.	Ramji Paper	Lalit Garg Owner	Paper products
9.	SIDBI	S Ganesh Manager	MSME financing & development

17.2.8. List of people met in the Engineering Cluster visit (Chandigarh – Panchkula - Mohali)

Sl. No.	Organization	Name of person met	Nature of Operations
1.	TERI	C.R. Panesar Cluster Development Manager	Cluster Development Agency (Facilitator Agency)
2.	Mohali Industries Association	K.S.Mahal President	Industry association
3.	Gifval Industries	K.S.Mahal C.E.O	Machining
4.	Tynor Orthotics	A.J.Singh Executive Director	Medical, surgical and orthopedic equipment
5.	P.K.Industries	Anurag Aggarwal Partner	Machining, Fabrication
	Mohali Industries Association	Anurag Aggarwal Sr. Vice President	Industrial Association
6.	Jupiter Aqua Lines Ltd.	B.S.Anand Director	Sanitary fittings
7.	Techman India	A.L. Agarwal	Industrial fasteners
	Chandigarh Industrial Fasteners Association	A.L. Agarwal President	Industrial Association
	The Haryana Chamber of Commerce & Industry	A.L. Agarwal Sr. Vice Chairman	Industrial Association
8.	Adonis Medical Systems Pvt. Ltd.	Arun Kaul Director	Medical equipment- X-rays
9.	Enn Emm Industries	Naveen Manglani Owner	Machining
	Chamber of Chandigarh Industries	Naveen Manglani President	Industrial Association
10.	H.M.Engineering	Lalit Chopra	Machining
11.	United Gears	Rajive Jain	Automotive & tractor gears
12	Indian Harness Industries	Pulkesh Bassi	Machining

17.2.9. List of people met in the Electronics Cluster visit (Chandigarh – Panchkula - Mohali)

Sl. No.	Organization	Name of person met	Nature of Operations
1.	TERI	C.R. Panesar Cluster Development Manager	Cluster Development Agency (Facilitator Agency)
2.	Gilard Electronics Pvt. Ltd.	K.S.Sethi Executive Director	Electronic switches and components
3.	Micromation Pvt. Ltd.	Serbjit Kukreja Partner	Electronic devices
4.	Continental Device India Ltd.	Amitabh Mohan Unit Head	Semiconductors
5.	Garg Electronics	Rajneesh Kumar Managing Director	Printed circuit boards (PCBs)

17.2.10. List of people met in the Leather Cluster visit (Kolkata & Chennai)

Sl. No.	Organization	Name of person met	Nature of Operations
1.	Entrepreneurship Development Institute of India (EDI)	Sanjay Pal Associate Senior Faculty	Cluster Development Agency (Facilitator Agency)
2.	Council of Leather Exports Rajda Industries & Exports Pvt. Ltd.	Paresh Rajda Paresh Rajda	Industrial Association Leather products
3.	Janbazar Leather Artisans Industrial Cooperative Society Ltd.	Muni Lal Prasad Chairman	Leather shoes
4.	Janbazar Leather Artisans Industrial Cooperative Society Ltd.	Ashok Das Vice- Chairman	Leather shoes
5.	Janbazar Leather Artisans Industrial Cooperative Society Ltd.	Various members in workshop	Leather shoes
6.	Sagittarians International Ltd.	Vikram Kumar Managing Director	Equipment supplier
7.	Central Leather Research Institute- Chennai	D. Chandramouli Scientist & Head- IDLS-PIU-Tannery Modernization Scheme	Govt. R&D institute
8.	Central Leather Research Institute- Chennai	Dr. Shubhendu Chakrabarti Scientist & Head- Business Process Division	Govt. R&D institute
9.	Central Leather Research Institute- Chennai	R. E. Jayakumar Technical Consultant - IDLS-PIU-Tannery Modernization Scheme	Govt. R&D institute
10.	Indian Leather Technologists' Association	Arnab Jha President	Industrial association
		Arnab Jha	Tannery
11.	Harman Group	Adesh Singh	Equipment supplier
12.	FREYA -IIDF	Antara Kumar	Common Facility Centre
13.	Central Leather Research Institute- Kolkata	Mr. Mondal	Govt. R&D institute

17.3 Appendix 3: List of key Government officials / policy makers met

Sl. No.	Name of person met	Designation/ Role	Organization
1.	Arun Kumar Jha, IES	Director	Ministry of Micro, Small and Medium Enterprises
		Director General	National Institute for Entrepreneurship and Small Business Development
2.	Dr. Anita Gupta	Joint Director/ Scientist- "E"	Department of Science & Technology
3	Dr. Sudeep Kumar	Head- Planning & Performance Division	CSIR
		Head- New Millennium Indian Technology Leadership Initiative Planning and Performance Division	CSIR
4.	Sanjay Chawre	Scientist-"E"	Technology Development Board
5.	Arunabha Pradhan	Chief- Business Development	NRDC
6.	Dr. Debabrata Majumdar	Scientist- "D"	TIFAC
7.	Sujit Gulati, IAS	Joint Secretary	Ministry of Textiles
8.	B.K.Singh	Director	Department of Pharmaceuticals, Ministry of Chemicals & Fertilizers
9.	Monika Verma	Director	Department of Pharmaceuticals, Ministry of Chemicals & Fertilizers
10.	Kashi Nath	Under Secretary	Ministry of Food Processing Industries
11.	Dr. T. K. Chakravarthy	Consultant	Department of Chemicals & Petrochemicals
12.	Nand Lal	Sr. Technical Officer	Department of Industrial Policy & Promotion
13.	RR Abhyankar	Adviser / Scientist "G"	Department of Scientific & Industrial Research
14.	N Srinivasan	In Charge, Innovation Management	APCTT

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