Cluster Diagnostic Report and Action Plan

Glass Cluster, Firozabad

Technology Cluster Manager

Technology Centre Systems Program (TCSP)

Office of DC MSME, Ministry of MSME

31st October, 2019

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List of Abbreviations

AZS	Alumina, Zirconia, Silica
BDS	Business Development Services
CAGR	Compound Annual Growth Rate
CDGI	Center for the Development of Glass Industry
CFC	Common Facility Center
CPSE	Central Public Sector Enterprises
CSIR	Council of Scientific and Industrial Research
DIC	District Industries Center
ED	Entrepreneurship Development
FY	Financial Year
GST	Goods and Services Tax
IIT	Indian Institute of Technology
INR	Indian National Rupees
ISO	International Standards Organization
MFI	Micro Finance Institute
MS	Mild Steel
MSME	Micro, Small and Medium Enterprises
MSME DI	MSME Development Institute
NABL	National Accreditation Board for Testing and Calibration Laboratories
NBFC	Non-Banking Financial Companies
NIT	National Institute of Technology
NSIC	National Small Industries Corporation Limited
NSSH	National SC ST Hub
PMKVY	Pradhan Mantri Kaushal Vikas Yojana
SMAS	Special Market Assistance Scheme
SME	Small and Medium Enterprises
SPV	Special Purpose Vehicle
TC	Technology Center
TCM	Technology Cluster Manager
TCSP	Technology Center System Programme
TPD	Tones per Day
TTZ	Taj Trapezium Zone
TÜV	Technischer Überwachungsverein
UAM	Udyog Aadhaar Memorandum
UIDAI	Unique Identification Authority of India
UNIDO	United National Industrial Development Organization
USD	United States Dollar

Table of Contents

List of Figures

List of Tables

1. Executive Summary

Under TCM project, a detailed study of CDGI, Firozabad and Firozabad Glass Cluster was conducted to know and understand the infrastructure available with CDGI for testing, training, consulting and other industrial services which could be useful for reducing cluster related problems. To study cluster in a better way, the cluster has been divided into three product specified prioritized cluster i.e. Bangle Cluster, Tableware Cluster, and Container Cluster. This extensive exercise led to better understanding of cluster and their challenges and how can TC bring solutions against those challenges, which can finally increase revenue of the TC subsequently by reducing challenges of the cluster.

An analysis of services offered reflects that during the last three years, there has been an increase in laboratory services, pollution control, combustive energy and consultation services. On the other hand, there has been a decline in pollution control (stack) and training offered (people trained). It has been observed that the pot development at the facility has not been done for last two years. On the technology front, it has been observed that while some machinery are not working, some machinery such as glass - cutting and polishing are not been used because of the shortage of consumables.

The key services offerings which may be the focus area for CDGI are as below:

- Analytical services with consulting and recommendation for corrective actions wherever applicable.
- Furnace design and engineering
- Thermography and endoscopy
- Computer simulation for the design of glass products
- Microscopic analysis with facility for colour photography and building up of a database and library of defects.
- Database of technical literature for support to industries as and when required for effective knowledge sharing
- Manufacturing processes development for commercial applications and training

On the training front, CDGI Firozabad has a lot of potential to fill skill gap in industry in terms of technology and process improvements. For a self-sustainable model CDGI must increase its revenue from manufacturing, testing of raw materials, training and consulting services. Augmentation of infrastructure must be supported by hiring skilled manpower for capacity building of TC officials. There is imminent need of more TC officials skilled in areas of glass manufacturing, maintenance of equipment and a marketing professional for promotion service offerings of CDGI. Qualified engineers with knowledge of design, process, and AutoCAD need to be recruited and trained. This does not exist today and with the skeleton staff available. Once a capability to design with requisite infrastructure is developed the next step could be to offer the same as a training facility to fresh engineers which would then fulfill the need for trained designers.

The industry is in dire need of know-how related to energy optimization, furnace life, and glass quality. A structured approach with qualified and experienced engineers and technocrats can effectively fill this need and bring about a change in the working philosophies of the industries. Recently, CDGI has been able to provide burner nozzle designs to improve energy consumption. However, the target should be to offer complete furnace design services to the industry.

2. Introduction

Glass is one of the most useful materials in our daily life. Today, glass is so commonly used that its presence often goes unnoticed. The Indian glass industry consists of seven segments namely, sheet and flat glass, glass fiber and glass wool, hollow glassware, laboratory glassware, table and kitchen glassware, glass bangles and other glassware. India is among the top 15 markets for glass packaging globally and is 3rd fastest growing market after Turkey and Brazil. The global market for Indian glassware is fragmented and spread across several countries. Most of the glass demand in the country comes from container glass which accounts for 50% of the country 's glass consumption by value. Apart from few big manufacturers, it is estimated that there are more than 450 manufacturers in MSME segment. There is no specific glass sector-related policy in the country.

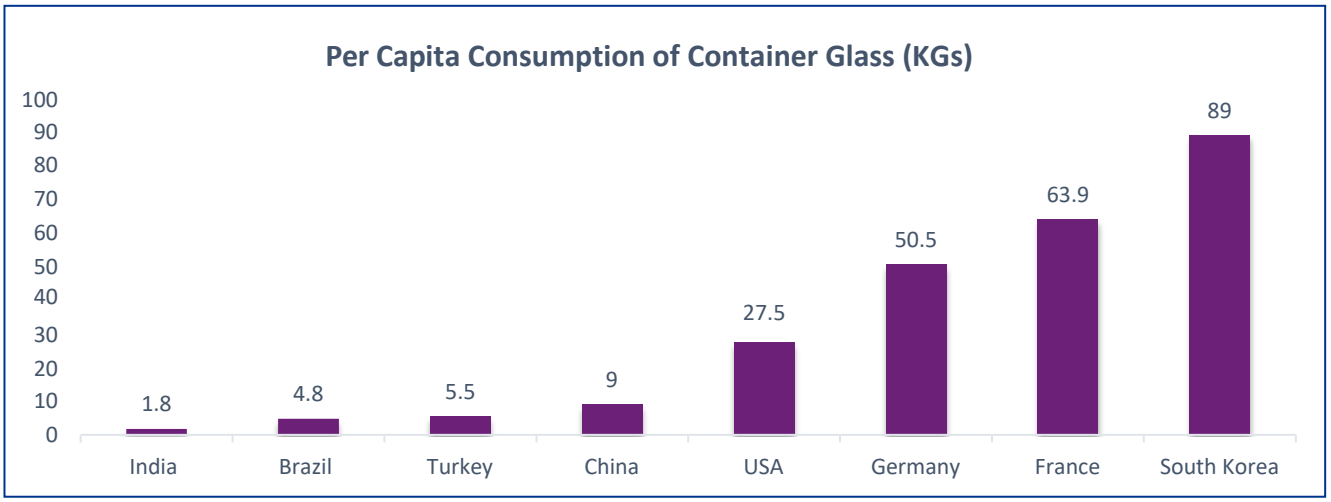

Figure 2.1: Per capita consumption of container glass (Kgs.)

The glass industry in India is ancient but well established and has made steady progress since independence. The first glass plant was set up in August 1908 by Lokmanaya Balgangadhar Tilak in Talegaon, Maharashtra. This industry has largely remained a cottage industry for a long time but in recent years has transformed and developed from rudimentary mouth-blown and manual processes-based industry to a modern process-oriented industry. The industry these days is characterized by the increasing use of processed and high-performance glass in the automotive and architectural sectors because the Indian customer has become more aware of the importance of glass in addressing the concerns of safety and energy efficiency.

India's glass market has been growing across all segments. This growth has been primarily driven by India's booming automotive and construction sector. The industry is highly energy-intensive and energy consumption is a major cost driver. As per ASSOCHAM report, glass industry was estimated at around USD 4.9 bn in 2015 with the share of organized market standing at 55%. In FY18, India was a net importer of glass with total glass imports exceeding glass exports, standing at USD 639 Mn, by USD 606 Mn[1]. The per capita consumption of container glass in India is at 1.8 kg, much lower compared to other nations. This highlights the good upside potential in the overall industry. Above chart shows per capita consumption of container glass (Kgs.)[2]

Production of glass in India is predominantly found in the states of Uttar Pradesh, followed by Maharashtra, Gujarat, Andhra Pradesh, Tamil Nadu, and Karnataka. About 75% of the total glass industries are concentrated in Uttar Pradesh, Maharashtra, Gujarat, Karnataka and Andhra Pradesh

[1] CARE Ratings 2018

[2] Hindustan National Glass & Industries Ltd. investor PPT data

with Uttar Pradesh having highest share at 36.9%, followed by Gujarat at 15%, Andhra Pradesh and Tamil Nadu at 5.6% and Karnataka at 4%.

3. Firozabad Glass Industry

Firozabad, a city in Uttar Pradesh, has been famous since Mughal era for its exquisite glasswork and production. It is popularly known as the Glass City or "Suhag Nagri" and is located about 240 km from Delhi, the capital of India, and about 40 km from Agra. The city has a history of glass manufacturing and is also involved in making utility and decorative glass items. It is also estimated that glass industry caters to over 50 % of Firozabad's population directly or indirectly.

Firozabad is the central hub for many glass manufacturing industries and is one of the leading manufacturers and exporters of glass products. 70% of the total glass production in the unorganized sector in India is contributed by Firozabad glass industry. Over the years Firozabad has turned into a premier center of glassware manufacturing in India. Some of the glass products manufactured are glass toys, candle stands, Christmas hangings, flower vase glass, chandeliers, bangles, automobile glassware, street ware, scientific lab products, etc. Nearly 35% of the total glass products produced in Firozabad are exported to other countries.

Figure 3.1: Firozabad District Map

It is estimated that Firozabad has close to 4000-5000 manufacturing and household units that generate employment for more than 5, 00,000 people[3]. The glass industry in Firozabad is spread across the city and has a total production capacity of close to 5000-6000 TPD. As per the report from AIGMF, Firozabad glass cluster generating an annual business of more than INR 2000 crore[4]. The glass industry in Firozabad caters not just the domestic demand but is also an important contributor to total glass exports from the state of Uttar Pradesh. As per data obtained by DIC Firozabad, in 2017-18, glass products of over INR 278 Cr, have been exported from Firozabad.

The glass industrial units in the region are spread across different areas and can be broadly divided into 3 major categories:

1. **Household units**: The household units are mostly run by the family members of the owners who use basic machines and tools to decorate glass products (primarily bangles). Each unit has an employee strength ranging from 3-10 employees with most of the employees being contractual workers hired on the basis of orders received and requirements. These units are estimated to be over 4000 and are spread across the city.

2. **Pot furnace-based units**: There are about 130-140 pot furnace-based units in Firozabad. Bangle is the main product that is manufactured by these units along with some decorative glass items (through mouth blowing process). On average, pot furnace-based units have an employee strength ranging from 70-100 workers out of which close to 95% are hired on daily contractual basis. A large informal bangle decoration and finishing industry thrive on the raw bangles produced by these units. These units cater to local market and produce raw bangles which are subjected to decoration and finishing at a later stage.

[3] AIGMF Report
[4] AIGMF Report, 2011

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3. **Tank Furnace based units:** Tank Furnace based units are relatively large units and are involved in the manufacturing of tableware, containers and scientific glass-related items. There are close to 40-45 Tank furnace-based units and with each unit having a workforce ranging from 150 – 200 workers. Similar to Pot furnace-based units, these workers are also hired on contractual basis but are hired for a longer duration. Apart from meeting the local demand, these units also cater demands of the domestic and international market.

3.1 Glass Manufacturing Process

Tank furnace-based and Pot furnace-based manufacturing process are the two major types of manufacturing process that are being used for the production of different types of products. Following are the procedures adopted by the units for glass manufacturing in tank and pot furnace.

1. Tank furnace units

Different process steps followed in a tank furnace vases unit are:

(a) Batch preparation

Batch preparation is the first step under glass production. The batch of raw materials makes up the single largest cost component in any glass industry. The main process comprises of handling the raw materials, weighing them in the right proportions, mixing the same to form a homogenous batch mixture and transferring the same to the furnace after blending with glass cullet of the similar type. Raw materials such as silica sand, soda ash, calcium carbonate and cullet (recycled glass) are blended together in different proportions depending upon the product to be manufactured. The batch and cullet mixture are fed into the furnace through a batch charger.

Figure 3.2: Tank Furnace

(b) Melting

After completion of blending exercise, the resultant homogenous batch is sent for the melting process. Melting is the most energy-intensive step in the entire process of production of glass. Since melting of glass requires dealing with very high temperatures, different units use different types of furnaces depending on their tonnage demand and quality standards. Table 3.1 shows, different kind of furnace used for manufacturing different types of glass.

#	Type of Glass Product	Glass Pull TPD	Type of Furnace	Fuel Used	Special Features
1	Bangles - multicolor	6-8	Pot Furnace	Natural Gas, Furnace Oil, Petcoke, Coal Gas	
2	Bangles - single color	6-8	Pot Furnace	Natural Gas, Furnace Oil, Petcoke, Coal Gas	
3	Pressed and blown glassware	6-8	Tank Furnace	Natural Gas, Furnace Oil, Petcoke, Coal Gas	
4	Automatic Container Glass	100 – 650	End Fired Furnace	Natural Gas, Furnace Oil, Petcoke, Coal Gas	Oxygen Bubblers, Electric Boost
5	Glass Tubing	10-30	End fired Furnace	Natural Gas, Furnace Oil, Petcoke, Coal Gas	Oxygen Bubblers, Electric Boost
6	Rolled Glass	70 – 300	End fired Furnace	Natural Gas, Furnace Oil, Petcoke, Coal Gas	Oxygen Bubblers, Electric Boost
7	Float Glass	500-1000	Cross Fired Furnace	Natural Gas / Furnace Oil	Air-gas, Oxygen Bubblers, Electric Boost

8	Special Glasses	100-400	End / Cross Fired	Natural Gas / Furnace Oil	Oxy-gas, Oxygen Bubblers, Electric Boost

Table 3-1: Different type of units for glass melting

Since melted Glass is corrosive in nature, the life of furnaces becomes a critical issue for which special AZS (Alumina, Zirconia, and Silica) refractory blocks are used.

Selection of the most appropriate refractory bricks or blocks in a furnace depends on the different requirement they are catering. Since a glass furnace has different temperature zones, refractory blocks and bricks are used as per the zone.

- Glass Contact Refractories – Fused Cast AZS Refractory blocks
- Melter Crown – Super duty Silica arch bricks
- Superstructure (above glass level) – Sillimanite, mullite, AZS, Zircon.
- Regenerator for heat saving – Magnesite, Fireclay, Sillimanite
- Areas subjected to thermal shock – Mullite, Sillimanite

Zirconium based electro-cast refractory blocks are used in areas having direct contact with glass melt. Sillimanite blocks are used in other high-temperature zones.

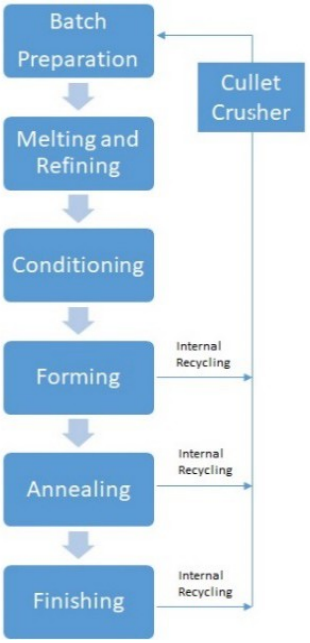


Figure 3.3: Tank Furnace based unit value chain

The temperature of the glass melt is maintained at about 1450 - 1550°C. The molten glass is flown through the “refiner zone" to get rid of air bubbles. The melt is tapped from the feeder chamber for shaping and forming.

(c) Shaping and forming

The glass melt is used to produce various glass products either through automatic presses or blowing machines. In some of the units, mouth blowing is also practiced for specialized glass products.

(d) Annealing

Annealing is a heat-treatment process. It is essential to remove strains from glass products so that they are not brittle. The annealing process removes this stress through gradual heating, soaking and cooling of the products.

(e) Finishing

The glass products after annealing are sent for finishing operations like cleaning, grinding, polishing, cutting, painting and grading as per requirements. The final products are packed after inspection for defects.

2. Pot furnace units

The pot furnace units are deployed primarily by bangle making units. Following are the procedures adopted by the units for glass manufacturing in pot furnace.

(a) Batch preparation

The batch charge consists of raw materials such as silica sand and soda ash. The raw material is sieved, weighed and mixed in required proportions. The composition required for pots changes depending on the requirement of color and quality of the glass.

Figure 3.4: Pot Furnace

(b) Melting

In an open pot furnace, the charge is melted into glass in open pots placed within the furnace. The number of pots in a furnace varies between 10 and 12. Preheated pots are placed within the furnace along its circumference. The pots filled with raw material are heated to the required temperature of 1250-1280°C. The total time required for melting is about 16-18 hours. During routine melting operation, each pot is charged consecutively three times after completion of melting of the previous charge material so as ensure that it holds glass to its maximum holding capacity.

After first filling, as the batch melts, its volume decreases which is again filled after about 8 hours. As the volume decreases upon further melting, the pot is again filled after about 5 hours from the previous filling. The third filling is done after about 3 hours from the second filling.

The quality and color of melt glass in a pot is dependent on raw material composition and coloring additives in a charge batch.

Figure 3.5: Process Flow: Bangle Making

(c) Drawing

The quality of melt glass is inspected visually to confirm whether it is ready for bangle making or not. This is done by dipping MS rod inside the pot through the charging door. When the molten glass gets ready, it is taken out using MS rods. These rods are of 10-18 mm in diameter and about 2.5 meters in length. These rods have a small notch at the end, which facilitates lifting of molten glass.

(d) Shaping

The operator (loom maker) provides the required shape (cuboidal) to glass ball using a mason's patter. The rod is taken to coloring workplace where molten color is applied on the shaped glass ball. Normally, the color is applied to the three sides. After application of color, the rod is taken back to pot furnace and dipped in the pot containing same colored glass. This composite glass ball is called loom. The glass ball is taken to loom maker and again shaped.

(e) Reheating

The temperature of the glass, after final shaping of glass loom, drops resulting in inadequate plasticity. It is therefore heated in a reheating furnace to increase the temperature to make it soft and compatible

for next operation of making bangle spiral in bangle making furnace. The ready loom is brought manually to the operator of bangle making furnace.

(f) Bangle making

Bangle making furnace (*belan bhatti*) has a rotating shaft with lead screw, which is driven in a manner to have both linear forward movement and rotary motion along the same axis simultaneously. The shaft is rotated with motor in most of the units. As the belan rotates, the lead screw slowly comes out. The reheated glass loom is made to touch the rotating shaft, which starts spiralling around the shaft.

(g) Cutting and bundling

The spiral glass is cut in one plane with a diamond tip cutter to get round shaped bangles. After this cutting process, bangles are counted and are packed by a string to a bunch of 320 pieces, which is also called one “toda”. This is the final product of bangle making pot furnace unit, which is sent for finishing operations.

4. Key Stakeholders and Institutional Framework

Being a mature glass manufacturing market, Firozabad has a strong stakeholder and institutional framework. There is a strong interplay between the different stakeholders that have helped in development of a strong glass manufacturing community in the region.

The glass industry in Firozabad has largely been a self-sustaining one having a strong presence of several supply and demand-side players. The supply and demand-side players are ably supported by several external service providers which have acted as strong pillars for supporting the Industry.

Government Institutions: MSME DI, Agra, District Industries Centre, UPSIDA and Uttar Pradesh Pollution Control Board are the main government institutions that are responsible for promoting the development of glass industries in Firozabad and ensuring that the industry is following pollution control norms that are set for it. Those bodies are responsible for execution and implementation of different central and state schemes.

Raw Material Suppliers: Glass manufacturing units at Firozabad procure raw materials such as silica sand, soda ash, calcium carbonate and other chemicals and pigments from local dealers and wholesalers. Soda ash is primarily sourced from Gujrat and Silica sand from Rajasthan. Chemicals and pigments are most of the time imported from the overseas market. Few large containers and tableware units also procure raw material directly from the primary supplier.

Industry Associations: Successful operations of manufacturing units in the Industry require close coordination between the industry, government bodies, and other key stakeholders. In order to minimize the gap between these important stakeholders, the units in the cluster have come together and form 2 active Industry Associations. These associations are playing a good role in becoming the voice of MSME units.

- The Glass Industrial Syndicate, Firozabad
- UP Glass Manufacturers Syndicate, Firozabad

CDGI - a R&D Institution: Apart from these, the cluster actors are also supported by an R&D institute, Centre for Development of Glass Industries, (CDGI) that was set up in 1992 under a joint venture project of Government of India, United Nations Development Program (UNDP), United Nations Industrial Development Organization (UNIDO) and Government of Uttar Pradesh. CDGI was set up with a focus on improving the performance of Firozabad Glass Industry and to assist the Government in design, development, and adoption of new technologies & products for the glass industry. The Technology Centre in Firozabad has a good infrastructure to cater to local glass industries to offer services such as analytical services for raw materials, refractories, glass chemistry, and glass defects.

Academia: To cater the human resource needs of the cluster, Firozabad has Government Polytechnic College and Seth Ganga Sagar Jatia Polytechnic College, Khurja. Those institutions are conducting long term courses in Glass & Ceramics and in other branches i.e. mechanical, electrical primarily to provide technical hands to the industries.

Banks/FI's: The majority of cluster financing needs are met by the nationalized banks in the clusters. Almost all the major nationalized banks have their branch offices in Firozabad and offer financing services to the cluster units

BDS Providers: A number of business development providers are also present in Firozabad that cater to the designing and furnace making needs of these clusters. Apart from these pot and furnace manufacturers, there are also a number of labor contractors available that help the glass units get contracted labor on need basis.

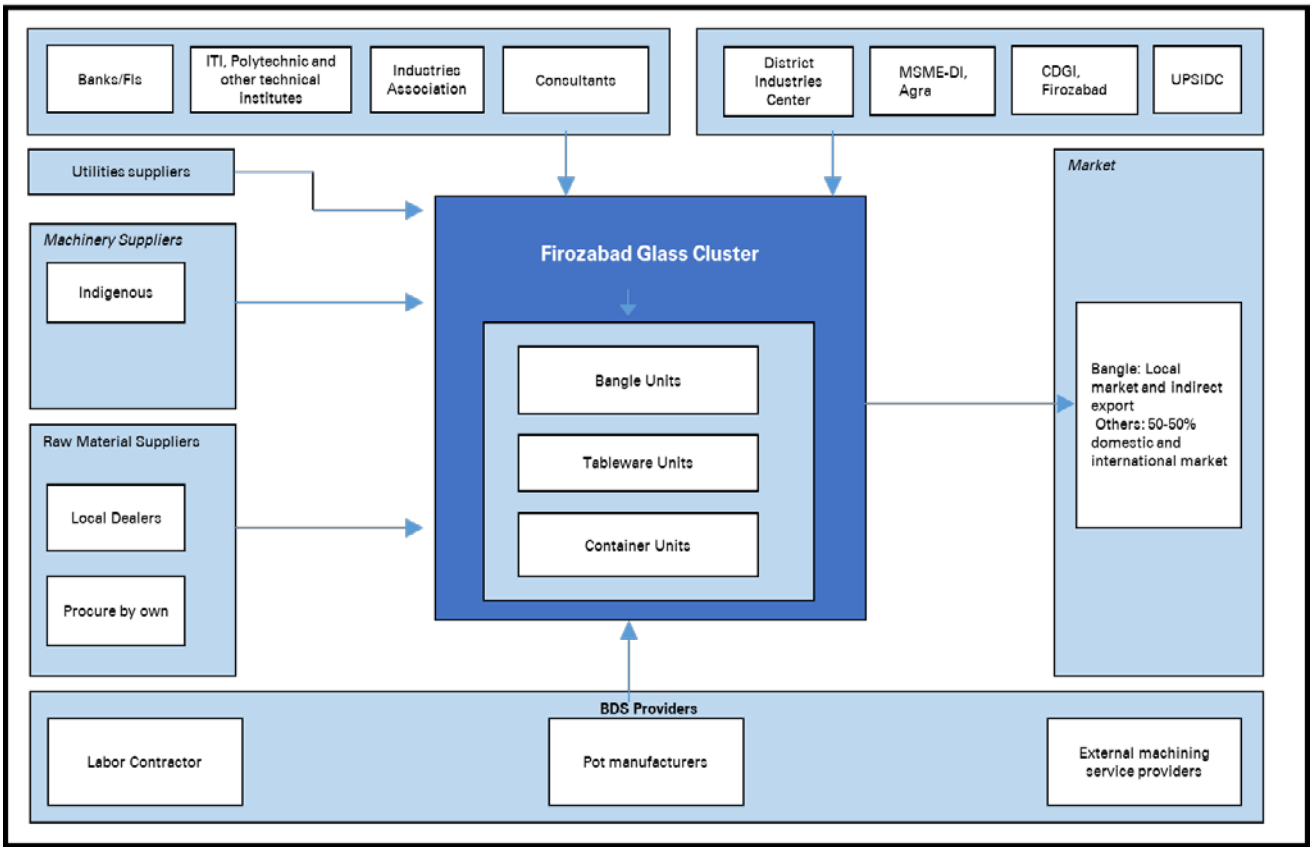


Figure 4.1: Cluster Map - Firozabad

5. Approach and Methodology

For ensuring that a comprehensive diagnostic study was carried out, a multi-step approach was followed that required revisiting the findings multiple times. As a part of this process, TCM team in Firozabad, Support Consultant, Mr. Vishal Srivastava, Specialized Glass Manufacturing expert Mr. CV Raju and Glass Design and Decoration Expert Mr. Nitin Hari Rane, conducted desk review and undertook in-person consultations with the representatives from the Technology Center, cluster-based industrial units, financial institutions, industry associations and other stakeholders. The idea behind adopting this approach was to get a detailed understanding of the Technology Center, technology and training service portfolio, and map them with the requirements of the cluster.

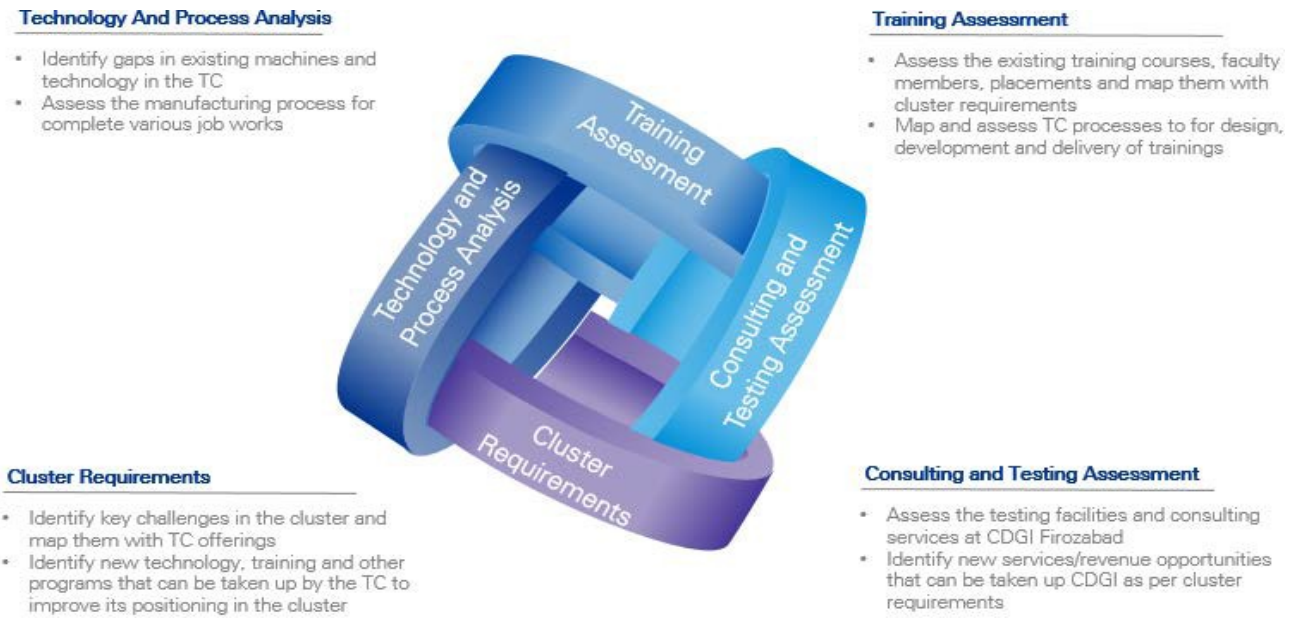


Figure 5.1: Integrated approach for mapping TC services with cluster requirements

Tier 1 – Gap Analysis of the Technology Center

Step 1: Review of the Technology Center annual reports, training brochure, and market insight reports.

A detailed review of the available literature was conducted by sector experts. As a part of desk research, secondary research was carried out to understand the market need and trends. Apart from the secondary research, the expert also conducted detailed discussions with the head of different departments and faculty members of CDGI to receive their key inputs.

Step 2: Production Floor and Training Floor Visits

The Team visited all the departments of TC to understand the availability of physical infrastructure for the present services. These visits assisted the experts in identifying TC's standing in the technology and manufacturing process with respect to global best practices and upcoming technologies. Apart from technology and manufacturing processes, the focus was on conducting qualitative and quantitative assessment of all the parameters critical to understand the requirements of the TC. Some of the key qualitative parameters included- curriculum development process, methods of training delivery, examination process, status of equipment and infrastructure, placement and post-placement tracking mechanism, skill set and qualifications of the trainers, etc.

Tier 2 – Analysis of the clusters

Step 1: Desk Review of the Firozabad Glass Cluster

A detailed desk review of the glass industry was conducted by the cluster team under the guidance of the cluster development expert. As a part of this exercise, secondary research was conducted to understand the glass industry ecosystem in Firozabad to identify key trends in the local market in terms of overall market growth rate and other parameters. The team also conducted one to one discussion with different stakeholders such as District Industries Center, Banks, and Academia to identify the cluster development activities that can be taken up by the technology center.

Step 2: Stakeholder Identification and Industry consultations

For mapping cluster requirements, the team identified major cluster actors and conducted consultations with close to 40+ stakeholders. As a part of these consultations, the team interacted with all the major

stakeholders having a good mix of MSMEs, TC, associations, academia and financial institutions. The main objective of the stakeholder consultation was to understand the business requirements, issues, and challenges of the complete cluster ecosystem and map them with the TC's services and offerings. As a part of these consultations, inputs were sought in terms of marketing, financing, manufacturing and training requirements across the value chain. The focus of the industry consultation was on identifying the key challenges faced by the units in clusters and accordingly suggest key interventions through which the Technology Centre (TC) can play an important role in overall development of the clusters.

Tier 3: Analysis and Recommendations
Inputs and feedback received during the TC technology, training, and manufacturing gap analysis were mapped with the requirements received from the cluster stakeholders. Their findings were analyzed and discussed with TC officials to identify specific interventions that can be driven by the technology center.

6. Technology Centre – CDGI Overview

In May 1992, Centre for the Development of glass industry (CDGI) was set up as a joint venture project of Government of India, United Nations Development Program (UNDP), United Nations Industrial Development Organization (UNIDO) and Government of Uttar Pradesh. CDGI was set up with a focus on improving the performance of Firozabad Glass Industry and to assist MSMEs in design, development, and adoption of new technologies & products for the glass industry. CDGI has a good infrastructure to cater to local glass industries to offer services such as analytical services for raw materials, refractories, glass chemistry, and glass defects.

CDGI is committed towards creation of new jobs and improvement of skills of workers in small scale industries. CDGI is also focused on adopting best practices and contributing to improving the working condition of employees in the glass industries.

CDGI has various division/units to offer services to the MSMEs. Each of the division tracks the volume of services offered and revenue generated from each of their division. The broad activities undertaken by various divisions of CDGI are as follows

Division	Activities Offered
Laboratory	**Physical Laboratory:** Measurement of softening point, annealing point, strain point, liquids temperature, coefficient of thermal expansion, strain in glass and specific gravity of glass and identification of glass defects by petrographic analysis. **Chemical Laboratory**: Analysis of glass, analysis of refractory & refractory raw materials, purity test of chemicals and grading of glass
Pollution Control	Stack Monitoring and Ambient Air Quality Measurement in the catchment area of CDGI.
Combustion Engineering	Flue gas analysis and monitoring of furnace temperature and design & construction of various types of fuel-efficient furnaces.
Production & Technology Development	Demonstration of best practices on batching, melting, forming and finishing operation of glass units.
Consultancy	Plant layout, furnace design, equipment selection, product development, batch formation, energy conservation, pollution control, analysis of glass defects & recommendation on prevention of defects.

Division	Activities Offered
Design and Decoration Unit	Glass casting, fusion & slumping, lampworking, glass cutting & polishing, engraving, hand painting & screen printing, frosting and sandblasting
Training Unit	Short term training programs (2-12 weeks) as well as tailor-made training programs based on the industry requirements

Table 6-1: Divisions and Services offered by TC

Currently, the main services provided by CDGI include chemical analysis of raw materials, refractories, glass chemistry, and glass defects. The other services include consulting services such as burner nozzle and tip designs for improved energy consumption, stack monitoring for Pollution Control Boards. The services offered by CDGI have been categorized are as below:

Production	▪ Pot development ▪ Demonstration of best practices on batching, melting, forming and finishing operation of glass units
Training	▪ Short Term Training courses ▪ Long term training courses ▪ Outreach programs
Design and Consulting	▪ Laboratory Services ▪ Pollution Control - Stack monitoring ▪ Pollution Control - Ambient air quality monitoring ▪ Combustion Engineering ▪ Consulting and troubleshooting services

Table 6-2: TC Service Portfolios

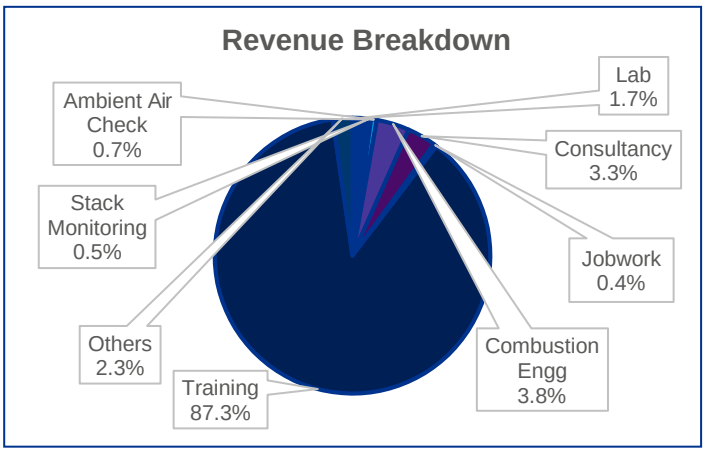


Figure 6.1: Revenue Breakdown TC: Year 2018-19

6.1 Technical Support and Consulting Services

CDGI has an inbuilt facility for providing the essential services generally required at base level for providing technical support and consulting services to the glass industries in and around Firozabad. Around 30 industrial units are taking various services from CDGI on a regular basis. Although CDGI claims 100% correctness of test results, it requires a NABL accreditation for further increasing its reach.
Current services offered by CDGI has been categorized into the following areas:

Services Offered	Limitations
Chemical and Instrumental Analysis	• Availability of platinum dishes (2 are available) so at a time only two samples can be accepted for analysis and given the time frame of 3 to 5 days for one sample, the productivity is limited to around 2 samples in 5 days. If any company wants 3 samples to be tested (minimum for reliability and repeatability of sampling) the time frame will become 7 days or more which is generally not acceptable to the clients. • Availability of trained manpower: Currently there are only two persons in this department, and both are responsible for all functions such analysis, maintenance proper cleaning of glassware and reporting.

Services Offered	Limitations
Physical Tests for refractory and glass properties	• Refractory properties such as porosity, cold crushing strength, coefficient of linear expansion, etc. can be estimated by overhauling of available equipment. • Glass properties analysis such as density, light transmission, annealing, and softening point, etc. can be made operational by overhauling and maintenance of available infrastructure. • The petrographic microscope is non-functional, hence microscopic analysis services cannot be offered.
Glass Processing	• CDGI has a well-equipped facility for glass processing such as heating furnaces bending and finishing. Facilities for glass staining, decorations, and heating ovens, and furnaces are also available. • Many of the machines are used for training purposes in areas such as glass cutting, edge grinding, and finishing. • The preheating furnaces are used to heat up the glass slabs and blocks above the softening point whereby they can be reshaped, straightened or flattened and returned to the client
Raw Material and Cullet Processing	• CDGI has equipment available for processing of raw materials and cullet. Equipment such as cullet crusher, batch mixer, sand screener, magnetic separators are available but have not been in use for quite some time now as they non-operational on account of no maintenance.

Table 6-3: Technical Support and Consulting Services

6.2 Training Service

CDGI provides short term and mid-term training courses (which are mix core glass and allied sector i.e. computer courses, fire safety courses, training on GST, etc) for skill development and human resources development. The steps undertaken by CDGI for imparting training is as follows:

(a) Course Design and Content Development: As per course structure and duration of the training program, TC officials design the course and content of the training program. CDGI provides proper study materials as per design of program to the trainees.

(b) Training Delivery: As per training needs, classroom training is provided by TC officials. These training are also carried out by different training partners. Practical or in job training is provided by industry which is in collaboration with TC. In fresh training program, candidates are trained in a given job role. For RPL Training (Recognition of Prior Learning), the candidates are meant to have prior knowledge of job role and are trained on additional requirements.

(c) Certification: Certification is the final process of skill development. After completion of successful training, trainees are awarded certificates of completion. The certification process includes grading of trainees with respect to marks/grades earned in evaluation process.

(d) Placement: After certification, all trainees are encouraged to register on the MSME Sampark portal which gives a platform to trainees to get placed in the respective industry. CDGI is also campaigning in local industry to register MSMEs as an employer in this portal and display their manpower requirement for skilled, technical candidates. CDGI collaborates with local industry for their skilled manpower requirement and training officer coordinates all placement activities. Around 20% trainees were placed in industry after the training during the last three years. The remaining candidates are mostly teenagers (16 - 19year old), 70% of them opt for higher studies and 10% students work as entrepreneurs.

S. No	Activities Performed	Equipment Name	Condition of Equipment	Maintenance Type
1	Grinding and Polishing	Hand grinder	1 working and 1 non-working	Outsourced

S. No	Activities Performed	Equipment Name	Condition of Equipment	Maintenance Type
2	Stained Glass	Edge Grinding and Tools	In working condition	In house maintenance
3	Edge Grinding	Belt grinder		In house maintenance
4	Engraving in glass	Engraving machine		No load
5	Sandblasting of glass	Sandblasting machine		In house maintenance
6	Grinding and Polishing	Flat grinder		Outsourced
7	Glass bending and fusing	Electric Kiln		In house maintenance
8	Shape beveling and polishing	Shape beveling machine		Outsourced
9	Ceramic painted glass	Heating oven		Outsourced
10	Screen printing on glass	Manual Semi-Automatic		Outsourced
11	Bending and melting	Flame torch		In house maintenance
12	Grinding and Polishing	Glass Cutting and polishing m/c	in working condition, shortage of consumables	In house maintenance,
13	Drilling in glass	Glass drilling machine (semi-automatic)		Outsourced
14	Sand blasting of glass	Plotter Machine	Not working (repairable)	Outsourced
15	Glass re-melting and reannealing after straightening and shaping	Heat Treatment oven	Working and in active use	

Table 6-4: Training Infrastructure

Total number of beneficiaries trained during the financial year 2018-19 was 5283 and total revenue earned through the training courses with the use of these equipment was Rs. 429.94 lakh. It has been observed that none of the equipment may be used for manufacturing purpose. It was also observed that more than 50% of the equipment which is being used have maintenance requirements. It is suggested that in-house capability may be built for carrying out maintenance of the equipment. This would also enable trainees to understand the maintenance requirement of each of the equipment. Subsequently, a module may be developed by the in-house team to train the trainees on the maintenance of the equipment.

6.3 Specialized service Offerings

At present no specialized services are being offered by CDGI. However, it has been observed that in the area of rural development, there is potential for skill development in glass decoration, and glass hand & screen painting which can provide gainful employment and improve the standard of living in the adjoining rural areas of Firozabad.

6.4 SWOT analysis of the TC

Strengths	Opportunities
Fundamental knowledge of Glass manufacturing processes NSQF certified courses offered to industry units Infrastructure to provide Glass testing services Dedicated pollution monitoring division Only premium institute available in Firozabad for providing practical training in Glass manufacturing ISO 9001 and ISO 14001 certified organization	Consultancy & job work services with to serve Firozabad Glass Industry. Digital/online training courses. Potential to become a NABL certified body to ensure complete safety & quality in process and product. Potential to product development hub for Glass Industry in Firozabad Government's push on the limited use of plastic products Production of fusion products
Weaknesses	**Threats**
Industry units are located far away from the institution Lack of exposure to the latest technology in glass manufacturing Non-Functional and outdated lab equipment and manufacturing equipment Lack of skilled manpower for maintaining the machines in Non-availability of skilled man-power for the marketing of TC. Non-availability of accredited testing labs Modern teaching aids are missing at the center	Fast rate of obsolescence of technology Competition from mass manufacturing units impacting their production facilities The emergence of alternate Glass Manufacturing and training centers and testing facilities

Table 6-5: SWOT Analysis- TC

7. Overview of the Firozabad Glass Cluster

Firozabad has a total area of approx. 2362 km^2 and is located in the northern state of Uttar Pradesh. Firozabad has a promising industrial support system & infrastructure that has helped in the development of a mature glass market in the region. The wide presence of the glass manufacturers in Firozabad can be attributed the fact that there are close to 198 registered glass products manufacturing firms in the region. As mentioned earlier these units produce different products like bangles, containers, scientific

glasswork and other glass decoration items. Apart from these registered manufacturing units, there are close to 4000-5000 household units that are engaged in activities like decoration of glasswork.

The finalization of clusters in Firozabad was done based on different types of products that are produced in the clusters. This approach was primarily adopted due to the presence of different types of products and difference in their manufacturing approach. The following 3 clusters were prioritized for the study after detailed discussion with CDGI, Firozabad. Some of the other factors that contributed in the selection were presence of active industry associations, geographical importance of the cluster, number of units in the cluster, past cluster development programs, and viability of the cluster, social & environmental considerations: -

1. Bangle Cluster
2. Tableware Cluster
3. Container Cluster

Bangle Cluster

Bangle cluster is based on pot furnace and as the name depicts, have bangle as the major product. This cluster contains 115-120 units. Conventional process of manufacturing is deployed in these units with almost no modernization apart from using gas-fired pot furnaces and semi-automatic bangle spiral machines. 70-100 workers are employed in each unit which is dominated by male workers. The production capacity of each unit is estimated as 5-7 TPD. Apart from these manufacturing units there is a strong informal market of around 4000 – 5000 household units that are involved in decoration of bangles which receive orders on job work basis. During interactions with different stakeholders, it was observed that these household units operate in a highly informal manner and are also not registered with UAM.

Tableware Cluster

Tableware cluster has 20-25 units with most of the units being semi-mechanized units that are engaged in production for both domestic and international clients. The units of these clusters deploy both pots based and tank-based furnaces for production of glassware. On average, there are close to 100-150 contractual workers employed in each firm apart from some key technical persons which produce 40-60 tons of material per day.

Container Cluster

There are about 15-20 units producing glass containers in Firozabad that are involved primarily in the production of liquor and beverage bottles. The units in these clusters typically deploy a tank furnace and use semi-automatic processes for the production of final Glass. Employment range is 150-200 workers including both technical and non-technical manpower. Average production capacity of these units varies from 100-200 TPD. These units cater to both domestic and overseas market and exports 40-50% of their overall produce primarily to US, Europe, and Southeast Asian countries.

Component	Bangle Manufacturing Units	Tableware Manufacturing Units	Container Manufacturing Units
No. of Units	115-120	20-25	15-20
Range of workers	70-100	80-120	150-200
Type of Furnace used	Pot/ Tank Furnace	Pot/ Tank Furnace	Tank Furnace
Production capacity/Day	5-7 TPD	40-60 TPD	100-200 TPD
Price Range	INR 60-80 per Kg	INR 40-80 per Kg	INR 20–50 per Kg
Raw Material Used	Silica sand, soda ash, calcium carbonate and cullet (recycled glass), colouring pigments etc	Silica sand, soda ash, calcium carbonate and cullet (recycled glass), dolomite, colouring pigments etc.	Silica sand, soda ash, calcium carbonate and cullet (recycled glass), colouring pigments etc.
Products Manufactured	Bangles	Tableware, scientific glassware and decorative glass Items etc	Containers, bottles
Market	Local wholesale Markets in Firozabad	Local, Domestic and International Market	Local, Domestic and International Market

Table 7-1: Prioritized clusters

7.1 Understanding of the Cluster – SWOT Analysis of Cluster

Strengths	Opportunities
Raw Material • Ease of availability of raw material **Infrastructure** • Good rail and road connectivity with different major markets like Kanpur, Delhi, and Agra. Good transportation ecosystem and connectivity with National Highways **Technology** • Availability of National level R&D institute in the form of CDGI, Firozabad **Access to Market** • Positioning of Firozabad as “the Glass City of India in domestic and international markets”	• Government schemes and initiatives to promote the local industry **Technology** • Availability of modern age furnaces and insulation techniques for improving productivity and reducing operational cost **Access to Market** • Increased market outreach through increasing penetration of online market places/platforms
Weaknesses	**Threats**

▪ A high percentage of unregistered bangle decoration units **Workforce** ▪ Limited uptake of the profession by entering the workforce ▪ Limited availability of workforce with formal skilling certifications **Access to Market** ▪ Weak marketing linkages – absence of organized marketing channels **Technology** ▪ Absence of NABL certified testing labs in the region ▪ Limited awareness about advanced manufacturing technologies ▪ Bad condition of EHS compliances and norms	**Access to Market** ▪ Risk of being out of fashion ▪ Economic slowdown/ recession in the global market ▪ Finding new markets is a tougher job now **Regulatory** ▪ Restriction of expansion and setting up new units in Firozabad due to TTZA Regulations

Figure 7.1: SWOT - Firozabad Glass Industry

7.2 Cluster need assessment – Key Issues and Challenges

The focus of the cluster diagnostic report is on identifying the key challenges faced by the different units in the clusters. For this purpose, the team conducted one to one discussions and interactions with different stakeholders including MSMEs, associations, financial institutions, and business development services providers.

Based on the interactions with Industry units across clusters it was observed that challenges faced by different types of units are different. It can be observed from the fact that issues in Tableware and Container cluster were quite similar due to presence of a similar type of units and were different from those faced by units in Bangle Cluster that depend on pot furnace and are involved in decoration and other activities. The challenges identified in these clusters were mapped with TC offerings and accordingly potential areas of improvements in the TC were identified to increase collaboration between the TC and cluster

Challenge	Description of the Challenge	TC Offerings that can mitigate cluster challenges	TC Service Offerings – Cluster Applicability
Access to Technology	Limited access to the latest manufacturing technologies	**Yes**	• Though TC conducts a number of Knowledge sharing workshops and is working towards improved pot life and bangle joining machine, cluster firms are not able to take the required advantage because of absence of production-related equipment at CDGI, Firozabad. • Due to the non-functional furnaces in PTDU, CDGI is losing an opportunity of revenue generation, also few old and non-functional equipments to be replaced with the new one.
	Erratic pot life		
	Limited innovation in bangle industry		
UAM Registration	Units involved in bangle decoration are not registered with UAM	**Yes (Services to be offered potentially)**	• ED cell can be formed in CDGI to address regulatory and other issues

Challenge	Description of the Challenge	TC Offerings that can mitigate cluster challenges	TC Service Offerings – Cluster Applicability
Training needs and skill level	Shortage of skilled manpower 2nd generation entrepreneur is not interested in continuing the business	**Yes**	• Training programmes are being offered from CDGI but very few courses focused on the glass sector • Limited courses offered on bangle manufacturing, furnace design, new and upcoming technologies, refractory blocks usage, etc. • A large number of vacant faculty positions
Poor EHS Conditions	Limited use of safety measures and personal protective equipment Hazardous working environment	**Yes (Services to be offered potentially)**	• TC to prepare an EHS plan for the cluster and conduct workshops on EHS adoption • Focus on EHS on different training modules offered by TC
Regulatory Challenges	Due to TTZ regulation, expansion or setting up the new unit is restricted	**No (Not aligned with TC Activities)**	NA
Improper Quality Control	No NABL lab testing facilities in Firozabad Rejection rate due to improper batch	**Yes**	• CDGI offers comprehensive test service right from raw material to finished glass with various chemical and physical analysis. Though CDGI lab is ISO certified, but needs to be upgraded with NABL accreditation to enhance its further capabilities. • Though SOPs are defined for undertaking all the test in the lab, however, the SOPs needs to be revised as the present SOPs are not updated since long • Turnaround time in testing services is 50-60% more than an average private lab. • A large number of vacant positions related to lab technicians and machine operators to be filled
Poor Access to Information	Limited awareness about government schemes	**Yes**	• CDGI undertakes activities to inform cluster members about different central and state schemes • ED cell at CDGI can be formed to discuss various regulatory issues Awareness workshops on schemes and initiatives can be conducted by CDGI

Table 7-2: Cluster specific challenges

8. Recommendations

8.1 Technology Specific Interventions to strengthen job works services

A careful assessment of the key technology gaps at the TC and cluster requirements was done by the part-time key experts to identify the new technologies that can be taken up. Based on this analysis, it was identified that there is a considerable gap in technology offerings of the TC service and requirements

of the cluster. TCM recommends adding following machines for improving the job work services portfolio of the TC

Machines	Price of Machine	Description of Technology	Applicability
New Machines required in TC that are currently not available			
Thermal Imaging Camera	INR 7 Lakh	The portable thermal imaging camera will provide an immediate picture of thermal radiation which can be used to identify weak areas in the refractory and steel due to corrosion or burn-out.	It has very limited usage in the Cluster, TC can use this camera as a service which will enable the glass manufacturing units to take preventive and proactive action whereby major breakdown, collapse, and accidents can be pre-empted.
Endoscope	INR 24 Lakh	The portable endoscopic camera is a useful tool to inspect the inside of the furnace, distributor, regenerators etc. without disrupting the process.	It has very limited usage in the Cluster, TC can use this endoscope on an “as a service model” which can help in identifying weak areas, gaps and holes in the refractory and steel and take corrective action in a planned manner leading to minimization of unforeseen and unplanned downtime and also reduction of potential accidents
Glass melting pot by slip casting	INR 20 lakh	The traditional way of making glass melting pots in Firozabad is by hand moulding and hand pounding with clay and refractory and grog digested in water. The whole process takes 3 months. In contrast the slip casting method is a more consistent process of shorter duration. The refractory mix is made into a "slip" which is slurry with adequate water agitated and mixed to the desired consistency which is then poured into plaster of Paris moulds and then dried in air and later fired to sintering temperature. This gives longer life and better yields	Successful completion of this project would give relief from erratic life of pot to glass manufacturers
RUL & Creep Measurement apparatus in refractories	INR 150 Lakh	This is a new requirement based on the perceived requirement from the glass industries. This helps in selecting and approval of quality of refractories before acceptance and commencement of furnace construction. This will be part of the package for complete analysis and testing of refractories by the client company. In course of time the package should be augmented to include cold crushing strength, Apparent porosity, Permanent linear change, Pyrometric cone equivalent in addition to complete chemical analysis	TC can offer consulting services which would help them in the selection of better refractories leading to energy saving and pollution control
Advanced Mini melter to replace pots	INR 300 Lakh	Idea is to replace pot by mini Melter (small day tank furnace), which will be electrically driven and replace the pot and its problems	This facility can be on demonstration basis and can support cluster firms to change move from Pot based

			furnaces to small day tank furnace
Glass Mold design & workshop	INR 500 Lakh	Glass manufacture requires very precise mold components with specific metallurgical properties such as thermal conductivity, expansion characteristics, and low deformation at high temperatures. CDGI can set up a mold manufacturing facility for small volume, high precision components along with measurement reports.	The same facility can also be used as a training center for fresh ITI and Diploma candidates looking for a future in mold design and manufacture
Glass Tempering Facility	INR 1000 Lakh	This objective is to set up a high-quality glass tempering facility for solar glass applications. This will be a commercial cum training facility whereby the trainees can obtain actual hands-on exposure to the theoretical and practical issues related to tempering.	The capacity of the tempering line may be small, but it will cater to the exacting demands of size, surface preparation, edge cutting and beveling, washing and drying and finally tempering to the highest globally accepted standards

Table 8-1: Cluster Interventions

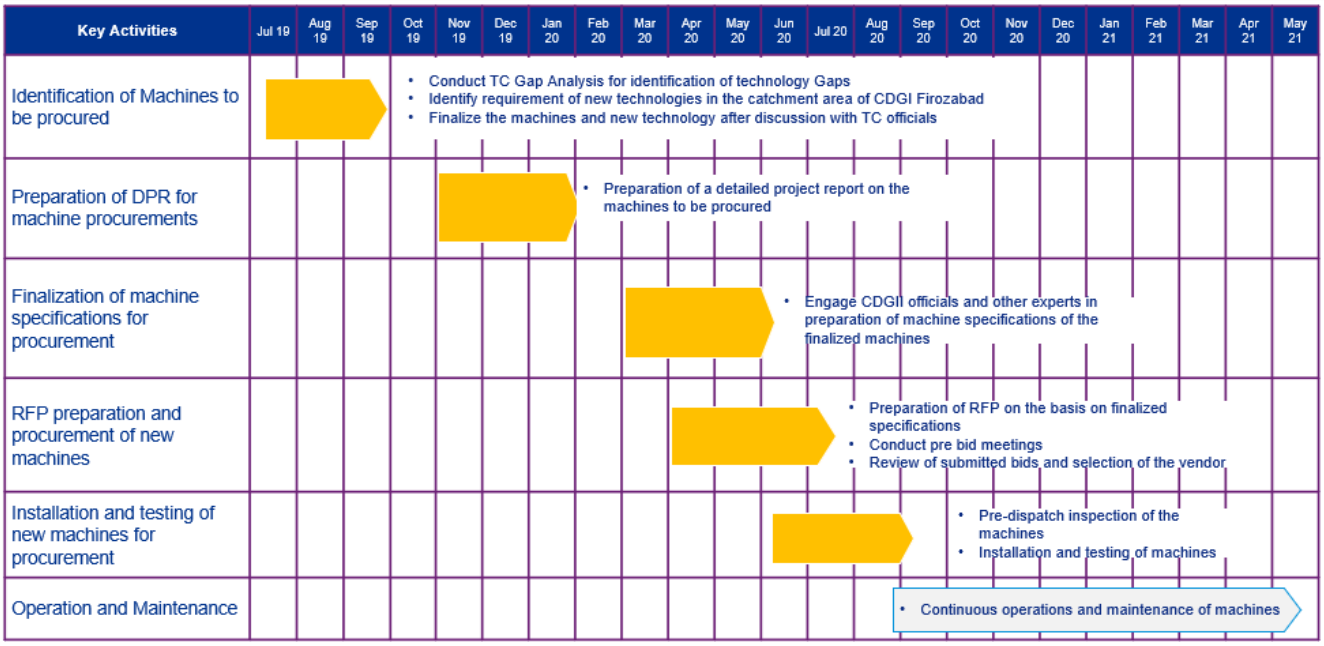
Technology Adoption Road Map

		2019-20				2020-21				2021-22	
Technology Description	**Type**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**
Short Term (Phase 1)											
Glass Melting Pot - Slip casting											
Thermography, Endoscopy											
Petrographic Microscopy											
Chemical and Physical Laboratory Augmentation											
Glass Art Studio - Mobile workshop Bus											
Medium Term (Phase 2)											
Glass Melting Pot - total furnace design & upgrade											
Mold design and Workshop - Operation and Training											
Glass Tempering Facility - Job work and training											

Upgradation of existing plant, equipment, machinery

Set-up of a new plant, equipment, machinery

Opportunity sponsor	DC-MSME, Ministry of MSME and Principal Director, CDGI Firozabad



8.2 Introduction of new training programs by CDGI as per cluster requirements

On the basis of interaction during the diagnostic study, it was observed that workforce in Firozabad had basic skills required for glass manufacturing that they had learned over job, however there is a need to polish their skills for improving the quality of the final product. Keeping this in mind, CDGI Firozabad can plan to initiate new training programs that would be customized as per the cluster needs

Bangle Cluster, Tableware Cluster, and Container Clusters

In order to improve productivity in all the three clusters, there is a need to upskill the workforce with respect to new techniques for designing and operations of the furnaces and pots. For this purpose, there is a need for CDGI to come up with innovative courses that focus on following aspects

- Design and dimensions of pots and furnaces
- Develop low-cost systems for pot furnaces to recover and reuse heat from flue gases.
- Identify and demonstrate BOP (best operating practices) in areas such as combustion control, reducing cullet
- Material management for improved usage of refractory blocks and insulation
- New technologies for the preparation of charge

The course content should be developed for managerial and workers staff of

- Furnace manufacturers
- Pot manufacturers
- Furnace operators
- Glass unit managers

CDGI can also use its existing facilities to set up new labs that can be used to demonstrate new technologies and operate and run laboratories focusing on best-operating practices. The TC can partner

with industry to prepare training curriculum for training programs. The recommended courses are illustrated in the table below

#	Recommended Training	Duration	Intervention required
1	**Training program on Glass handling and Safety** • Training on glass handling • Precaution to be taken in a continuous glass processing plant. • Cullet Management • Industry visit - to a nearby glass processing plant	One week (One-day classroom and six-day industrial training)	• Module to be developed by an external expert in consultation with TCM expert • Training of trainer (CDGI) by an external expert • Industry tie-up for field visits
2	**Training Program on Quality of Processed Glass** • Training on quality assurance-raw material. • Quality check-in process parameters • Physical testing and lab testing training for the finished product such as tempered glass, laminated glass, Double glaze glass, etc. • Industry visit & training in nearby glass plant	4 weeks (one-week classroom and three week Industrial Training)	• Module to be developed by an external expert • Training of trainer (CDGI) by an external expert • Industry tie-up for field visits
3	**Training program on Glass Mould Design and Development** • Initial design brief and product requirement to create first sketch for discussion purpose. In a concept parameter such as finish type, container height, shape, labelling etc. will be established. • Create all technical information n after the initial drawing. This technical information will take care of container physical requirement such as forming machine type SG, DG, TG, QG, forming process, internal pressure, impact, vertical load, etc. • Produce manufacturing drawing of mould for any machine type and process. To make design for existing equipment or new set up. • Make a mould from establishing design and check trail report of mould. • Simulate and access the forming process on current or new developed drawing. • Industry visit & training in nearby glass plant	6 Months (one-month classroom training and 5 months of industrial training	• Module to be developed by an external expert • Training of trainer (CDGI) by an external expert • Industry tie-up for field visits
4	**Glass Furnace Design and Development**	3 weeks of Classroom programs	• Module to be developed by an external expert

#	Recommended Training	Duration	Intervention required
	• Training of design and development of Pot and Tank furnace • Importance of retreatment of flue gases in the existing systems • Usage of simulation software for better understanding of benefits from new-age furnace designs, refractory blocks and heat usage systems		• Training of trainer (CDGI) by an external expert • Identification of best in class training software

Table 8-2: New training programs by CDGI

Apart from this, it should also be noted that many entrepreneurs have started their business without taking any formal training related to business management. They have adopted traditional style of business, but in growing competitive environment they need formal management training. Various areas for soft training could be:

- Modern HR practices (Balanced Scorecard, Attrition rate, Behavioral Competency, Exit interview, Teambuilding, Conflict Management, Decision Making, etc.)
- Compliance certifications.
- Digital marketing & social media promotions.
- Sustainability of family business.
- Total quality management
- IT management
- Lean manufacturing

Short term training programs of 1-3 days can be arranged on above-mentioned areas

Investments required for training purposes

S. No.	Training description	Timelines	Estimated cost (in Rs. lakh)
Short Term			
1	Thermography, Endoscopy and Petrographic Microscopy for CDGI officials	6 months	• Vendor based
Long Term			
2	Training for CDGI officials (under ToT)	12 months to 36 months	25
3	Course development and initiation of new training programs (3 short term and 1 medium term Nos.)	12 months	25
	Total		**50**

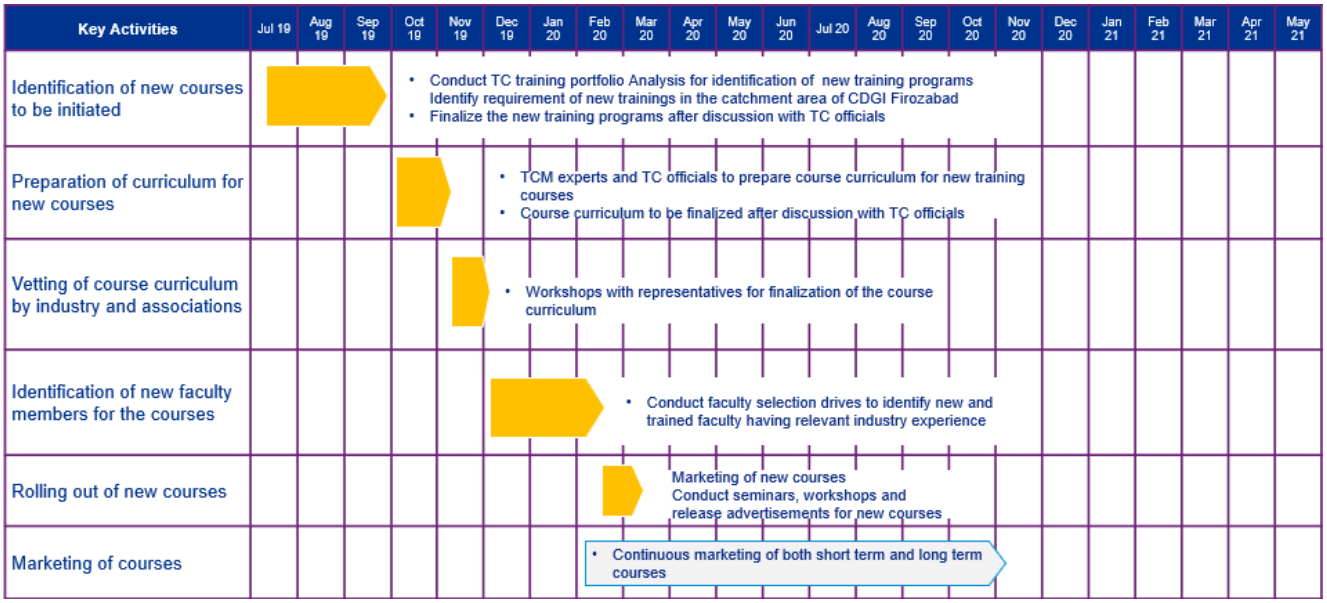
For training program other than machinery, investment is required for design of training program with the help of an industry expert, development of study materials, Industry expert lecture fees and faculty charges. The rate has been assumed at the rate of Rs. 5 lakh for each new short term course proposed to be implemented. For medium-term course development an estimated expenditure of Rs. 10 lakh would be required.

Collaboration with leading Training Institute

To impart world-class training program, it is important that CDGI develop collaborations with leading glass institute like CSIR-Central Glass and Ceramic Research Institute (Kolkata, Ahmedabad, Khurja), Glass Academy, IITs and NITs and Engineering colleges which offer ceramic engineering courses. Linkages and networking with national and international institutes will greatly help meet the actual need for consulting services by the industries. It is proposed to create a database of all raw material vendors,

refractory suppliers, national and international consultancy services associated with the Glass industry can be developed with quick referencing methods it will greatly benefit the Industry.

Focus Clusters	Implementing Agencies	Challenges Mitigated	Planned Activities
• Bangle Cluster • Tableware Cluster • Container Cluster	• CDGI with the help of private consultants	Enhanced skill set by focusing on new technologies, finishing of products, total quality management, productivity enhancement among others.	• Assessment of training requirements • Shortlisting of training agency/institute • Finalization of course content and duration of training • Shortlisting of units for training • Creation of standard training content for ready reference



Opportunity sponsor	Principal Director, CDGI Firozabad

8.3 NABL Accreditation for CDGI, Firozabad

Setting up of NABL Labs

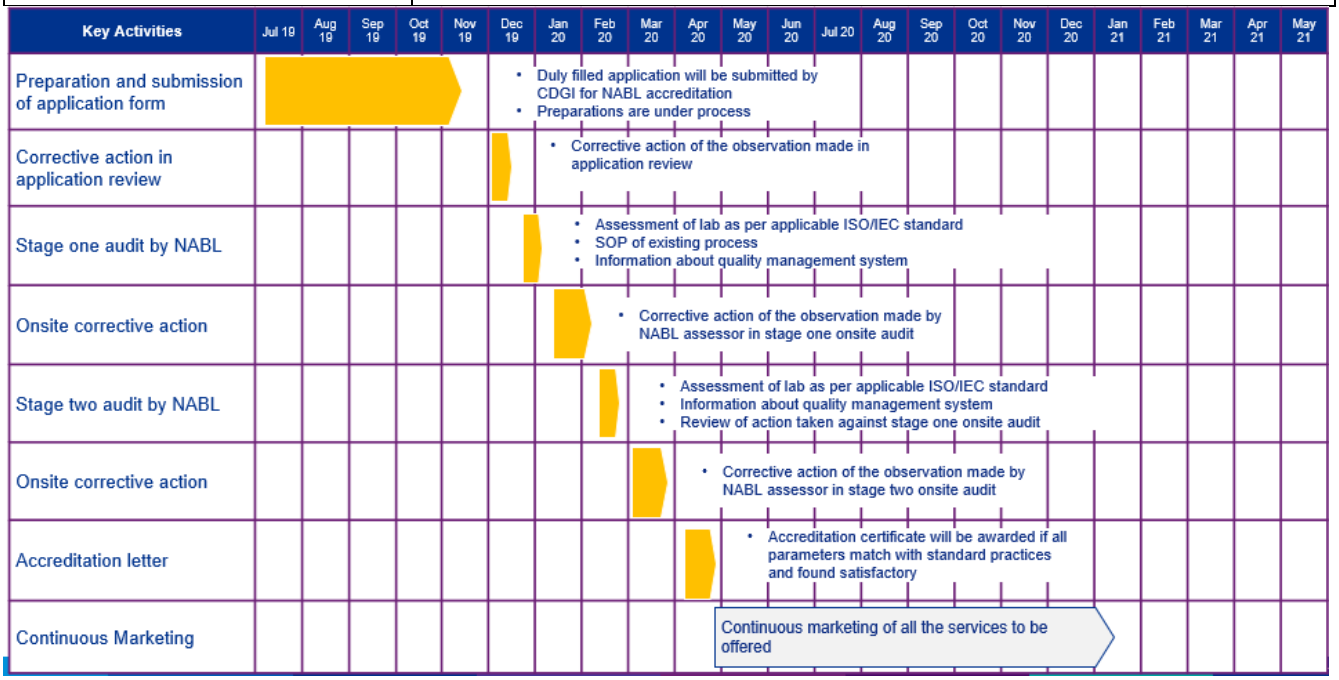
CDGI currently offers lab services for glass industries in the region and in 2018-19 lab services accounted for INR 8.27 lakh revenue. As CDGI is already offering these services it should move towards getting NABL accreditation as there this is no NABL accredited facility in Firozabad to cater the material testing and final product certification needs. Since CDGI is one of the reputed government institutes present in the region, it can undertake a technical feasibility study for chalking out a plan for taking up this accreditation. This can act as a great source of revenue for CDGI as it would be the only player in the entire region that is offering these services. Some of the testing facilities that can be offered by this NABL are

- Generation of Glass Annealing Curve including Co-efficient of linear thermal expansion, Dilatometric Softening Point, Strain Point, and Annealing Point
- Co-efficient of linear thermal expansion of Glass and supply of data with Curve including Dilatometric Softening Point
- Determination of Density of Glass
- Softening Point Test
- Residual Stress test

- Thermal Shock Resistance
- Sieve Analysis as per IS: 1528 (Part – XIV) (a) Dry (b) Wet
- Size tolerance
- Water Absorption /Apparent Porosity/ Bulk density/ Apparent Specific gravity
- True porosity / Closed Porosity
- Dry & Fired Shrinkage

Focus Clusters	Implementing Agencies	Challenges Mitigated	Planned Activities
• Bangle Cluster • Tableware Cluster • Container Cluster	• CDGI	• Availability of NABL certified testing facility in the region • Improved reputation of CDGI as a testing facility	• Expert to help CDGI in identifying the potential testing facilities that can be offered • Identification and purchase of labs/equipment that is required for setting up the lab

Opportunity sponsor	DC-MSME, Ministry of MSME and Principal Director, CDGI Firozabad



8.4 New service lines in the consulting division

Currently, there are no facilities offering business development or process improvement services in the cluster. Keeping this in mind CDGI should focus upon offering specialized consulting services in the cluster.

8.4.1 Energy Audit and Optimization Solutions

In order to assist the manufacturing units in improving their energy efficiency, CDGI should offer services under which it would conduct periodic energy audits. In order to ensure that there is a good uptake of these services, the training offered by CDGI should educate the entrepreneur and different trainees about the benefits of energy audits and how keeping a track of energy consumption can help in reducing their overall costs. For offering these services, CDGI should hire certified energy auditors or train their own faculty members to become certified energy auditors to offer services that are in line with those which are offered by those that are best in the Industry.

Focus Clusters	Implementing Agencies	Challenges Mitigated	Planned Activities
• Bangle Cluster • Tableware Cluster • Container Cluster	• CDGI	• Poor energy utilization	• Prepare guidelines for conducting periodic energy audits • Hire certified energy auditors or train the existing trainers to take this up • Workshops and Seminars to create awareness about energy audits

8.4.2 Furnace Design and Development solutions

This consulting service should be in line and continuation to the training service that would be offered for improving Furnace Design and Development. As a part of this offering, CDGI can help the owners in designing state of art glass furnaces. Apart from this, CDGI can also audit and prepare reports on the performance of the furnaces for individual units as currently there are very limited certified service providers for the same. Moreover, since most of the units are using old furnaces with limited knowledge about the best operating services, this can be a possible new revenue option for CDGI, Firozabad

Focus Clusters	Implementing Agencies	Challenges Mitigated	Planned Activities
• Bangle Cluster • Tableware Cluster • Container Cluster	• CDGI	• Unawareness about low efficiency from using old furnaces	• Seminars to create awareness about benefits of proper furnace designs

8.4.3 Restarting the business operation of Design Studio at CDGI, Firozabad

CDGI should plan to reinitiate the operations of the design studio. Under this design studio, CDGI can offer paid services to help local designers promote new designs and can also help them in making prototypes. The new design studio would have all the necessary equipment like an electric furnace, annealing oven, glory hole, latest 2D, 3D CAD among others. As a part of the design studio, CDGI can also offer usage of simulation software for industry to test and create reports for different furnace designs. These services can be offered on pay per use model

Focus Clusters	Implementing Agencies	Challenges Mitigated	Planned Activities
• Bangle Cluster • Tableware Cluster • Container Cluster	• CDGI Firozabad	• Limited technology for development of new designs and achieving product differentiation	• Identify the designing requirement of the Industry and accordingly keep different equipment and software for promoting in the studio • Workshops to promote it in the cluster. • Tie up with International and national designers is required to get the latest design inputs.

As a part of different activities planned under the design studio, CDGI can tie up with Start-up India and Invest India to come up with an innovation challenge for finding innovative solutions to existing challenges. This can help in identifying solutions for issues related to erratic pot life, bangle joining machines, etc. These innovation challenges can be conducted on a periodic basis by CDGI with the

help of MSME-DI and DIC where different startups and MSMEs can participate. These events should focus around

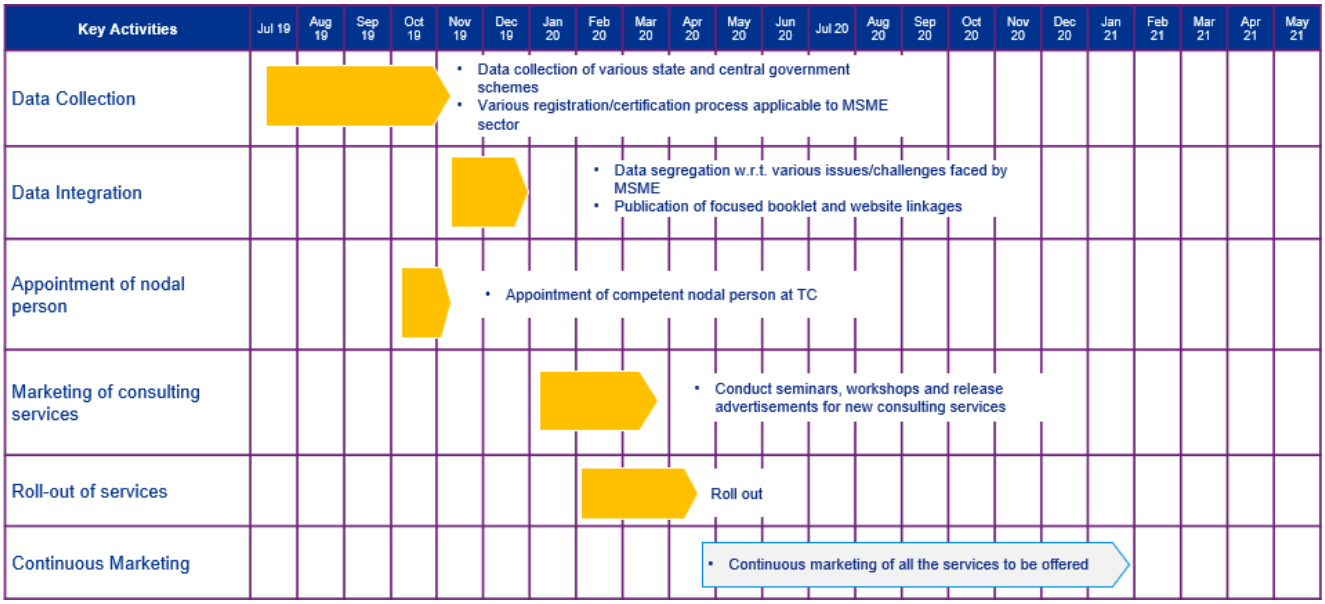
- Provide opportunities to mold their product innovations to better serve the industry.
- Provide opportunities for representatives to explore the potential benefits of tech adoption
- Build relationships with innovators, industry contacts, and government organizations in the Glass Sector

Focus Clusters	Implementing Agencies	Challenges Mitigated	Planned Activities
• Bangle Cluster • Tableware Cluster • Container Cluster	• CDGI Firozabad	• Innovative solutions to improve technology in the clusters	• CDGI is planning to make pots by slip casting method under close observation and inspection

8.4.4 Creation of Entrepreneurship Facilitation Cell in CDGI

To promote government schemes and to guide and educate SMEs about basic documentation of UAN, GST, Import /Export Registration, loan processing, digital learning, E-marketing, etc. ED cell should be created in CDGI. ED cell will educate MSMEs and promote government schemes through booklets and newsletters. It will act as a one stop nodal point for all the information related to any government scheme. It will also facilitate basic registration of UAN, GST along with providing basic guidelines and documents required for loan approval. This cell can be operated by CDGI with support from DIC and MSME DI, Agra. This would not only help in creating awareness about different government offerings but will also help in creating awareness about different service offerings of CDGI.

Opportunity sponsor	Principal Director, CDGI Firozabad (along with DIC and MSME DI Agra)



9. Annexure 1: Detailed listing of Cluster Challenges

9.1 Limited access to new and Improved Technology

During multiple visits to the clusters, it was observed that access to new technologies is one of the major challenges faced by the units in the cluster. Usage of conventional technologies in different clusters has impacted the overall efficiency and productivity of the units. Some of the challenges that were observed in the cluster were related to

- Usage of conventional methods for production - All three clusters
- Reduced productivity of pot-based furnaces due to erratic pot life – Bangle and Table Ware Cluster
- Extensive use of labor in Bangle Jointing due to limited innovation in Bangle Jointing techniques

Bangle Cluster:

The bangle manufacturing process in the current state is very labor intensive and requires technology interventions at multiple steps to improve the final output. During cluster visits, it was observed that the bangle cluster units start facing challenges from preparation of batches which continue up till decoration and finishing of the bangles. In this section the focus is primarily on two major areas, i.e. charge melting and bangle joining, which require quick interventions for improving the overall efficiency

The style of production adopted by bangle manufacturing units has not modified much in the past 30-40 years. Though these clusters have switched to using gas-fired furnaces, it was observed that they use furnaces that have not been replaced over the years and have poor insulation. It was further observed that there is limited usage of good quality refractory blocks that often leads to breakdown of the furnaces and increases the overall consumption of fuel that further increases the overall cost of production.

Two types of pots are used. Open Pots and Closed Pots. Open pots are widely used despite high inefficiency because of their lower cost

It was further observed that there has been limited innovation in terms of the design of the furnaces over the years. The furnaces are manufactured by “Mistry” who have derived their knowledge from traditional methods of manufacturing and have limited awareness about new designing techniques and material. This leads to usage of poor-quality material in construction of pots and furnaces that reduces the overall life and leads to large quantity of heat loss.

Figure 9.1: Open Pot

Figure 9.2: Close Pot

Another major challenge in the pot-based furnaces is the erratic life of pots that are used in these furnaces. During visits it was informed that pots had an average life of around 20 days before they cracked or failed which meant wastage of fuel and hundreds of Kgs of charge. It primarily happens because of lack of awareness regarding latest pot manufacturing techniques and good quality material among the potters and the pot furnace owners.

The efficiency in these units is further reduced because of limited usage of regenerators in the furnace which led to wastage of flue gases leading to increased consumption of fuel for reaching the melting temperature of the glass.

Apart from charge melting, bangle joining also requires an immediate solution. Currently, bangle joining is done manually using a flame that increases the overall cost and cycle time of bangle production. There has been limited innovation in this space in terms of automating the entire process and reducing the overall time and manpower.

CDGI is in process of developing Bangle Joining Machine in collaboration with Central Tool Room Ludhiana. This project has been approved by O/o DC MSME

Tableware and Container Cluster:

Unlike units in the bangle cluster, the tableware and container cluster units use tank furnaces instead of traditional pot-based furnaces. This helps them in achieving superior efficiency as compared to their bangle unit counterparts. Apart from this, it was also observed that there is an improved focus on better

insulation and regeneration techniques in these clusters. The units in the container cluster are more advanced in terms of the systems that have been deployed in all three clusters. The units in these clusters have adopted an assembly line kind of approach where they have installed conveyor belts for automatic production of containers and bottles. Despite this, these units require a number of interventions in material handling, cullet management and use of new technologies for extracting maximum efficiency from flue gases and using improved insulation.

Challenge	Bangle Cluster	Tableware Cluster	Container Cluster
Conventional Techniques of Production	High	Medium	Low
Erratic Pot Life	High	Medium	NA
Limited Innovation in Bangle Jointing	High	NA	NA

9.2 Improper Waste Management (Cullet)

Improper management of broken/waste glass, known as Cullet, is another major issue that was noticed across all three prioritized clusters.

Figure 9.3: Cullet

Even though glass is 100% recyclable, it was observed that only limited firms leverage the waste for reducing the overall cost of raw material and use them in production. This is primarily due to limited awareness about their production, environmental and cost benefits.

Apart from this, segregation of cullet is also a major hindrance in wide acceptance of their usage. As cullet require proper washing to ensure complete segregation from other waste products, it is important for firms to have proper washing facilities which is not the case in most of the units in these clusters.

Improper treatment of cullet not only increases the overall waste in the clusters but also makes manufacturing units a hazardous place to work in. As workers are mostly working without any safety equipment, they often receive bruise and cuts due to improper cullet treatment and handling.

Challenge	Bangle Cluster	Tableware Cluster	Container Cluster
• Improper Waste Management • Cullet Handling and Recycling	High	Medium	Medium

9.3 Manpower

The glass industry in Firozabad is witnessing a cultural change with respect to reduced uptake of profession in the glass industry. Due to hazardous working conditions, a number of new people entering the ecosystem is reducing year on year basis which is leading to shortage of young skilled workforce and entrepreneurs in the clusters.

Bangle Cluster:

Out of the three prioritized clusters, units in the bangle cluster are facing the maximum brunt with respect to the shortage of manpower. Due to limited innovation in improving the processes in bangle making and designing, the process is still manual in nature and requires working in difficult working conditions. This coupled with low salaries has restricted people from taking up this profession. During interactions with Bangle unit operators, it was informed that due to limited product differentiation the units were operating at low operating and profit margins. They further informed that the financial pressure is further increasing due to reduction in market demand of bangles.

Similar to bangle manufacturing market, the downstream bangle decoration market is also facing challenges related to manpower. The units in bangle decoration are largely household units and receive their orders from wholesalers on a daily job work basis. Due to high uncertainty with respect to getting new orders and low pay scale as compared to the required effort, the entering workforce is preferring to take up different professions.

Tableware and Container Cluster:
The tableware and container cluster market are facing increased pressure from the plastic manufacturers that is reducing the overall demand. It was informed that the Indian market is being flooded with plastic products of different densities that are slowly replacing their glass counterparts. This has increased a lot of financial pressure on the manufacturing units in tableware and container clusters that are already operating at low-profit margins. This increased financial pressure has made a direct impact on the earnings of the workers. This is forcing people to take up jobs in better-paying professions and hence is reducing the availability of skilled manpower

Challenge	Bangle Cluster	Tableware Cluster	Container Cluster
Limited uptake of the profession by new workforce	High	Medium	Medium

9.4 Training Needs and Skill Level

The training and skilling need of the glass industry workforce in Firozabad can be divided into soft interventions and hard interventions.

Bangle Cluster
Majority of the workforce in the cluster has not received any formal skilling and have earned their skills from their experience while working in the units. The challenge is not just limited to the operators of the pot furnaces or "*bhattis*" but is also applicable to "*mistrys*" who have designed and built the pots or furnaces.

It was further observed that there is limited awareness about process improvement techniques and technologies that that leads to production losses due to wastage of raw materials and overuse of gas fuel.

There is a requirement for upskilling the existing workforce in terms of new manufacturing techniques, material management, and heat utilization by focusing on following areas

- Design and material quality for construction of furnaces and pots
- low-cost systems for pot furnaces to recover and reuse heat from flue gases
- Technical know-how about insulation for better heat utilizations
- Best operating practices to ensure maximum heat utilization

Tableware and Container Cluster

Unlike units in the bangle cluster, the tableware and container clusters units have moved ahead in the maturity curve in the terms of process improvement. This can be understood from the fact that these units use semi-automatic systems such as conveyor belts and have employed automatic manufacturing process production of final products.

Though this has helped in improving efficiency there are certain areas such as cullet management, end product handling among others that still require quick intervention for further improving the overall productivity. Apart from this, the focus is also required on training the operators, managers, and entrepreneurs about redesigning of furnaces, refractory blocks, and flue gas regenerators for further improving the efficiency

The units in these clusters are more sensitive towards quality-related issues because of the strict standards that they are required to meet to cater the demands of their clients. Training on Total Quality Management (TQM) for managerial level staff and owners also emerged as major needs while interacting with these units.

Apart from the above training, focus is also required on softer aspects in all three clusters

- Cullet Management
- Environmental Health and Safety
- Product Handling
- Export-Import Facilitation
- Packaging
- IT Management with respect to basic computer operations

Challenge	Bangle Cluster	Tableware Cluster	Container Cluster
Upskilling of workforce	High	High	Medium

9.5 Poor EHS Condition

Bangle, Tableware and Container Cluster:

During visits to units in all the three clusters, it was observed that the working conditions do not meet the required health and safety norms. Though the conditions are slightly better for large container and tableware units, ample improvements are still required in terms of improving overall EHS conditions. Some of the challenges that were observed during the visits were related to

Figure 9.4: Poor Occupational Health Safety

- Limited availability of first-aid kits in bangle units and tableware units
- Limited usage of safety equipment during job work
- Non-compliance towards ISO Standards and environmental compliances
- Direct exposure to high temperatures, flue gasses, and fumes during the manufacturing process
- No availability of EHS manuals is most of the units
- The manufacturing of Glass is affecting the environment the health of people working in the industry as well. Workers who are employed as glass-workers face the threat of Silicosis.
- The manufacturing process releases highly polluting oxides of Sulphur and Nitrogen into the air causing serious environmental degradation. It causes severe damage to the local air and water ecosystem.

Challenge	Bangle Cluster	Tableware Cluster	Container Cluster

Poor focus on Environmental Health and Safety	High	High	High

9.6 Quality Control

9.6.1 Batch preparation

Bangle Cluster and Tableware Cluster

Most of the bangle and tableware units operate through the preparation of charge in batches. During visits it was observed that there was limited use of sophisticated scientific scales with high dependence on manual process and approximations for batch preparation that created a problem of non-uniform batches.

Since batch decides quality of final products, the units are facing issues in preparation of homogenous products from different batches. The challenges are more relevant in Bangle clusters as bangles are required to be manufactured in different shades and colors. The improper batch composition creates problems like high rejection rate and impacts the operational life of pots.

Container Clusters

Units in container cluster primarily deal in transparent glass so preparation of batches of different composition is not a major challenge. Moreover, since these units deal mostly in exports and are required to maintain standard quality of their products, they have employed modern batch preparation techniques that help them in preparation of products of required density and thickness

Challenge	Bangle Cluster	Tableware Cluster	Container Cluster
Non-uniformity in Batch Preparation	High	Medium	Low

9.6.2 Insufficient Testing Facilities

One common requirement that was highlighted by units in all the three clusters was related to the availability of raw material and end product testing facilities. The units highlighted that due to absence of NABL accredited testing facilities, majority of the units were forced to send their raw material and other production equipment to other places such as Agra, Delhi, and Kanpur etc. for getting the required results.

Apart from this, it was also mentioned that there were limited accredited facilities available for performing energy audits and furnace efficiency tests

There is an urgent requirement of setting up a NABL accredited lab in the region. Though CDGI, Firozabad offers some testing facilities, unit operators are apprehensive towards its test results because of no accreditation. Since CDGI is not NABL aggregated, the testing certificate does not hold good for export-oriented units

Challenge	Bangle Cluster	Tableware Cluster	Container Cluster
Limited Testing Facilities	High	High	High

9.7 Low Registration of MSMEs

This challenge is limited to only downstream firms in the Bangle cluster that are involved in the decoration of bangles. It was observed that there are close to 4000-5000 household units that are involved in bangle decorations but are not registered with Udyog Aadhar Memorandum. This is primarily because of limited awareness about the benefits of registration with Udyog Aadhar Memorandum. Though a number of efforts have been taken by government authorities, DIC and MSME DI, the overall

registration level remains low. The main reasons for the low registration of enterprises are primarily because of the following reasons

- No knowledge of the registration process
- No perceived benefits of registration

Challenge	Bangle Cluster	Tableware Cluster	Container Cluster
Low Registration of MSME Units	High (Among Local Decoration Units)	Low	Low

9.8 Regulatory Issues

A huge area of Firozabad falls under the Taj Trapezium Zone (TTZ). It is defined as an area of 10,400 sq. km. around the Taj Mahal to protect the monument from pollution[5]. As per the directive order of Supreme Court of India, glass units under the TTZ are banned from using coal/coke in their units and are mandated to switch over to natural gas. An ad-hoc moratorium on the expansion and setting up of new industry (except white category) is under effect to control air pollution by Taj Trapezium Zone Authority (TTZA).

Challenge	Bangle Cluster	Tableware Cluster	Container Cluster
Regulatory Challenge Impacting expansion	High	High	High

9.9 Poor Access to Information

The government has taken several initiatives for the benefit of the enterprises including various schemes such as Stand-up India, NSSH, etc. Most of the enterprises in the clusters have very limited or no knowledge of government schemes and initiatives. The primary source of information about such schemes and initiatives are either industry associations or implementing agencies such as NSIC, DI-MSME, etc. The information provided is very sporadic in nature and is not comprehensive. This uncoordinated effort amongst different agencies leads to either duplication /asymmetry of information. Even though many workshops have been organized in the past, but due to low turnout, it became difficult for the agencies to make units aware of schemes.

Challenge	Bangle Cluster	Tableware Cluster	Container Cluster
Poor Access to Information	High	High	High

10. Annexures 2

10.1 Number of Stakeholders Contacted

#	Stakeholder	No. of Stakeholders
1	SMEs	34
2	Industrial Associations (IAs)	2
3	Technical Institutions	3
4	Financial Institutions	2

[5] http://www.ttzagra.com/

5	Other Stakeholders (BDS, Government Institutions)	1

10.2 List of Stakeholders Contacted

#	Stakeholder	Stakeholder Name	Designation	Unit Name	Glass Cluster
1	MSME	Anurag Gupta	Owner	M/s Advance Glass	Tableware
2	MSME	Rajendra Kumar Agarwal	Owner	M/s Amrit Glass Work	Bangles
3	MSME	Laltesh Agarwal	Owner	M/s Bapu Industries	Bangles
4	MSME	Hemant Agarwal	Owner	M/s Choice Glass Industries	Bangles
5	MSME	Harish Chandra Agarwal	Owner	M/s Delux Glass Industries	Bangles
6	MSME	Chandra Kumar Jain	Owner	M/s Durga Glass Works	Bangles
7	MSME	Laltesh Agarwal	Owner	M/s Durgesh Glass Industries	Tableware
8	MSME	Mohd Islam	Owner	M/s Express Glass	Bangles
9	MSME	Rajendra Gupta	Owner	M/s G K Glass Industries	Tableware
10	MSME	Manish Bansal	Owner	M/s G M Glassworks	Container
11	MSME	S Chaudhary	Owner	M/s Geeta Glass	Container
12	MSME	Reetesh Bansal	Owner	M/s Hari Om Glass	Bangles
13	MSME	Nitin Agarwal	Owner	M/s Hind Glass Industries	Container
14	MSME	S Chaudhary	Manager	M/s I B Glass	Tableware
15	MSME	Anil Kumar Gupta	Owner	M/s India Optical & Scientific Glass Work	Bangles
16	MSME	Sanjay Jain	Owner	M/s Jain Enterprises	Bangles
17	MSME	Rahul Jain	Owner	M/s Jain Industries	Bangles
18	MSME	S Chaudhary	Manager	M/s Mateshwari Glass	Bangles
19	MSME	R K Mittal	Owner	M/s Mittal Ceramics	Container
20	MSME	Aizaj Azim	Owner	M/s Nadar & Co	Bangles
21	MSME	Manish Bansal	Owner	M/s O K Glass	Tableware
22	MSME	Anurag Gupta	Owner	M/s Om Glass Works	Container
23	MSME	Sanjay Agarwal	Owner	M/s Oriental Glass	Tableware
24	MSME	Mukesh Agarwal	Owner	M/s P L S Sales Pvt Ltd	Bangles
25	MSME	Harish Chandra Agarwal	Owner	M/s Padmavati Glass	Bangles
26	MSME	Devicharan Agarwal	Owner	M/s Pooja Glass Works	Container
27	MSME	Rakesh Agarwal	Owner	M/s Prem Glass Works	Bangles
28	MSME	P K Jindal	Owner	M/s R S Glass	Bangles
29	MSME	Mukesh Agarwal	Owner	M/s Rajeev	Bangles
30	MSME	Hanuman Prasad Garg	Owner	M/s Sarvodaya Industries	Bangles

#	Stakeholder	Stakeholder Name	Designation	Unit Name	Glass Cluster
31	MSME	Rohit Gupta	Owner	M/s Sri Vardhman Project	Bangles
32	MSME	Sachin Gupta	Owner	M/s Suhag Kanch Udyog	Tableware
33	MSME	Dharmendra Mohan Gupta	Owner	M/s Tigersons	Tableware
34	MSME	Sharad Mittal	Owner	M/s Yadav Glass Works	Bangles
35	Industrial Association	Hanuman Prasad Garg	Director	The Glass Industries Syndicate	
36	Industrial Association	Raj Kumar Mittal	President	U P Glass Manufacturing Syndicate	
37	Academia	Dr. L K Sharma	Scientist-in-Charge	CGCRI, Khurja	
38	Academia	Sanjeev Chinmalli	Principal Director	CDGI, Firozabad	
39	Govt Body	Sandeep Kumar	Asst Manager	DIC, Firozabad	
40	Academia	Karan Pal	HoD, Ceramics	Govt Polytechnic, Firozabad	
41	Bank/FI	Rajeev Singh Gautam	Chief Manager	State Bank of India	
42	Academia	J P Mishra	Principal	Industrial Training Institute, Shikohabad	
43	Industrial Association	Shanker Gupta	Secretary	Firozabad Glass Decorators Association	

10.3 Glass Manufacturing Value Chain

Value Chain in Container (5 Glass Bottles)

Particulars	Value Added	Percentage	Total Value (INR)
Raw Material	8	45.7	8
Energy	4	22.9	12
Consumables	1	5.7	13
Maintenance	1	5.7	14
Labor	2	11.4	16
Packaging	1	5.7	17
Misc.	0.5	2.9	17.5
Total Production Cost	**17.5**		
Profit Margin	**20%**		
Selling price	**20.5**		

Table 0-1: Value Chain Analysis of Glass Bottle

The value chain analysis has been prepared based on the stakeholder consultation. It can be observed that the raw materials amount over 45% of the total cost of production including hardware and other components. The industry is energy-intensive, with energy costs accounting for approximately 23% of total production cost of a bottle. The competitiveness of the cluster units can be increased by targeting

the major cost area of machinery (particularly pots) and providing common facilities to the units in order to undertake process at a lower cost.

The value chain of Bangle Manufacturing for 1 toda (set of 320 bangles)

Particulars	Value Added	Percentage	Total Value (INR)
Raw Material	28	22.4	28
Energy (fuel)	30	24	58
Bangle Joining	28	22.4	86
Overheads (tax, power, maintenance, etc.)	12	9.6	98
Labor	20	16	118
Packaging	2	1.6	120
Misc.	5	4	125
Total Production Cost	**125**		
Profit Margin	**10%**		
Selling price	**137.5**		

Table 0-2: Value Chain Analysis of Glass Bangle

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