Business Continuity Plans for New-normal MSMEs conforming to Environmental Norms
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1. Introduction

A. Overview

I. Live Studio

MSMEs play a vital role in the global economy and national economy of every country. They generate employment, create wealth, produce various products and services, and satisfy consumer requirements; and in the process contribute to Gross Domestic Product (GDP)- an indicator for development matrix, exports, and investments. The labour intensity of the MSME sector is much higher than that of large enterprises. They further help to achieve fair and equitable distribution of wealth by regional dispersion of economic activities. The MSMEs contribute significantly to employment generation and development of rural areas. The MSME sector is one of the key drivers for India’s transition from an agrarian economy to an industrialized economy. Around 50 percent of MSMEs in India are owned by underprivileged groups, which show how MSMEs contribute to improving the entrepreneurial skills and economic empowerment. Through their continuous performance in the field of employment generation and gross output, the MSMEs held a leading position in economic activities and social issues. The significance of MSMEs' influence many other activities of the Indian economy and help the country to bring changes in the economy. There is the triple impact of MSMEs i.e. economic, environmental and social. All three are interrelated.

In India, it is projected that MSMEs contribute roughly 70 percent to the industrial pollution. It has been estimated that MSMEs potential environmental impact can be proportionate with large companies in similar sectors. They create considerable pressure on the environment through resource consumption and pollution and emission. Collective negative impact from pollution and emission thus generated by MSMEs are a huge challenge towards India’s commitment for the Paris Agreement. This particular issue during the challenged pandemic time was selected for the Live Studio with an intention to understand the ground reality associated with MSMEs and providing solutions with a special focus on environmental impact.

B. Objectives

The Live Studio was designed to understand ongoing challenges faced by selected MSMEs for business continuity during COVID-19 pandemic in 2020 and to plan intervention to improve the same. The objectives are as follows:

- To identify issues and develop process mapping of selected MSMEs
- To identify threats and develop Business Continuity plan for MSMEs especially with regards to COVID-19 pandemic
- To develop comprehensive sustainable solution (Socio-economic, environmental) for the MSMEs
- To come up with innovative business solutions and get them validated with stakeholders
C. About project (COVID-19, Industry- MSME, SDGs, Livelihood)

The project was focused on MSMEs, industries, SDGs, livelihood and COVID-19 situation. The essential requirements focused by the mentors to guide the students to find a sustainable solution:

- Project formulation, management, and evaluation.
- Awareness about environmental issue caused by industries
- National & international examples that are optimal and sustainable
- Best Management Practices
- Socio-economic and political impacts
- Environmental impact assessment
- Sustainable development goals
- Process mapping
- Practical and site information
- Methodologies and ideas to prepare a sustainable and profitable business plan
- Business continuity planning
- Multi-sectoral Handholding
- Financial assessment and break even scenarios
- Project pitching and industry lingo
- Customer validation

D. Project Process

The Students formed groups among themselves. Based on their approachability, they selected the MSME for review. This ensured opportunity for physical survey and primary data. During the project, primary data was collected through site visits and telephonic interviews with the owner and employees and secondary data was collected through government websites, reports, case studies, journal articles, etc. It leads in drafting the process of the industry and helped in developing process map, identification of problems associated with the production stages and business continuity during the lockdown period and later for the pandemic. The aim was to develop ideas for improve the sustainable growth of the MSME. The Best Management Practices (BMPs), government policies and guidelines were studied to develop Business Continuity Plans (BCP) for MSMEs considering present COVID-19 scenario and any future threat. This was an iterative process which was evaluated and mentored by experts in this field. The solutions proposed included technical intervention, spatial and neighbourhood planning, and financial and collaborative models. Interaction with the stakeholders brought incentive/value addition for the proposed ideas and later validation was completed by conveying and putting proposal in front of MSME owner and workers, wherever it was possible. Thereafter, comprehensive suggestions were made by the group of students for their respective MSMEs and are compiled in this report. The Ideation Process is presented in Table 1 and the flow of discussion among different stakeholders are given in Figure 1.
Table 1-1: Ideation Process

<table>
<thead>
<tr>
<th>#</th>
<th>Sequence</th>
<th>Exploration</th>
<th>Inspiration</th>
<th>Reasoning</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PROBLEM IDENTIFICATION</td>
<td>- Area of intervention</td>
<td>Source</td>
<td>- Customer + Beneficiaries + Users Segments</td>
<td>- Clarity in problem</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Data/ Information</td>
<td></td>
<td>- Process mapping clarity</td>
<td>- Best management practices</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Establish problem</td>
<td></td>
<td></td>
<td>- Global positions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Stakeholders</td>
<td></td>
<td></td>
<td>- SDGs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Visuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>KEY INNOVATION IDEAS / SUITABLE SOLUTIONS</td>
<td>- Uniqueness/ USP</td>
<td>Case studies</td>
<td>- Value proposition</td>
<td>- Logical thinking</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Innovation</td>
<td>Brain Storming</td>
<td>- Customer relation</td>
<td>- Alternative options</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Target Users</td>
<td></td>
<td>- Key twigged activities</td>
<td>- Identification of the entire process</td>
</tr>
<tr>
<td>3</td>
<td>BUSINESS PROPOSITIONS</td>
<td>- Prototype</td>
<td>Mentors</td>
<td>- Partners</td>
<td>Product: close loop, Profitivity stream</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Development Cost</td>
<td></td>
<td>- Resources</td>
<td>tracking/ monitoring/ progress</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Maintenance</td>
<td></td>
<td>- Cost structure: social/ economic &amp;</td>
<td>documentation/ reporting/ updating profile</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Business potential</td>
<td></td>
<td>environmental</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Revenue and Recovery Model</td>
<td></td>
<td>- Revenue streams</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- HR</td>
<td></td>
<td>- Benefits: social/ economic &amp; environmental</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Investment/ Finance</td>
<td></td>
<td>- Investment vs Revenue generation graph</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>- Investment vs Revenue generation graph</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>PHASED DEVELOPMENT/ IMPLEMENTATION</td>
<td>- Ideation</td>
<td>Mentors</td>
<td>- Cash flow</td>
<td>Market validation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Pilot project</td>
<td></td>
<td>- Improved Process</td>
<td></td>
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<td></td>
<td></td>
<td>- Feedback</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>- Market Product/ expansion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>ACCEPTANCE</td>
<td>- Scalability</td>
<td>Customer</td>
<td></td>
<td>Competitive pricing vs quality product</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Adaptability</td>
<td>Evaluators</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Sustainability</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Profitability/ Flexibility/ Future potential</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 1-1: Flow Diagram for discussion
### E. Weekly Theme/Programme:
The Table 2.0 records the Activity Plan during the course of journey.

**Table 1-2: Activity Plan**

<table>
<thead>
<tr>
<th>Date for Deliverables</th>
<th>Things to be delivered</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  August 31, 2020</td>
<td>1- Team Members &amp; leader (please note leaders can be changed based on work done by the member), 2- MSME that the group wants to work with and why, 3- Region where the group is going to work (at least one student must be residing in that area), 4- Who is going to do the primary survey and how the surveyor is going to include the other team members in that survey, 5- Sources of primary &amp; secondary data.</td>
<td>2 PM- 3 PM: Few examples of MSME will be presented and discussion will happen for the same. 3 PM onwards: Each group will present the data that was discussed in the previous class (deliverables are written below).</td>
</tr>
<tr>
<td>2  September 7, 2020</td>
<td>1- List of content of Report with your mentor (before class) 2- Survey questionnaire to be prepared and discussed before going on site (before class) 3- First draft of report submission on Sept 7, 2020 4- Comprehensive PPT to be given to guest mentors <strong>Things to keep in mind for presentation</strong> a- Environmental norms and issues to be discussed in more details b- Process mapping to be included in the presentation c- Government policies needs to be discussed d- Presenter must be anyone except the leader</td>
<td>As per the discussion and presentation held on August 31, 2020 in Live Studio class; I have jotted down few points to keep in mind for next class. If I am missing anything please feel free to add. Primary &amp; Secondary Survey to be done meticulously before class on Monday and details to be presented.</td>
</tr>
<tr>
<td>3  September 9, 2020</td>
<td>Report and Presentation submission of all groups</td>
<td>Next class will be a site survey and working on assignment class, if you need any help contact your respective TA for suggestions and set up time with</td>
</tr>
</tbody>
</table>

ARN 415: Live Studio (B. Arch 4th Year) 5 | Page
<table>
<thead>
<tr>
<th>Date</th>
<th>Points to be kept in mind for next class:</th>
<th>Parameters for final presentation: Summary of:</th>
<th>Notes</th>
</tr>
</thead>
</table>
| September 14, 2020 | Points to be kept in mind for next class:  
1- Industry Brief  
2- Data collection  
3- Process Mapping  
- Universe  
- Specific  
4- Impact: Social, Economic & Environmental (SDG)  
5- Problem Identification: Materials, waste (liquid & solid), pollution, emission, technology  
6- Code & policy, regulations  
7- Best Management practice BMP | Parameters for final presentation: Summary of:  
1- Industry Brief & Problem Identification: Materials, waste (liquid & solid), pollution, emission, technology  
2- Data collection  
3- Process Mapping  
4- Impact: Social, Economic & Environmental (SDG)  
5- Code & policy, regulations  
6- Best Management practice BMP  
7- COVID-19 related Impacts & immediate actions (attempts to attenuate or arrest the business decline)  
8- Neighbourhood spatial level plan (highlighting the infrastructure services and circulation of goods and services)  
9- Proposed policy guidelines along with implementable action plan  
10- Degree of stakeholder involvement  
11- Sustainability of product & venture  
12- Business Continuity Plan/ Contingency Plan/ On site Plan | Discussion with respective ADA mentors  
- Two assignments are to be proposed by each group (as a group submission) for next assignment submission on Oct. 3, 2020  
- Discussion of Presentations with respective ADA mentor on Oct 3, 2020  
- Plan has to be implementable and not dogmatic  
- Every entrepreneur thinks their idea is the best idea- strategy on how to sell your idea to investors, strategy to diversify risks, contingency plan, socio-economic sustainability (this question can be asked by guest mentors, so be prepared)  
- Be aware of terms like: Blue ocean strategy, supply chain, spatial planning, BCP, BMP, Revenue Model, |
| 6  | October 26, 2020 | - Presentations as per discussion with ADAM group on Oct. 12, 2020  
- All points must be incorporation that are suggested by guest mentors. | For discussion, please contact your respective Mentor. |
| 7  | November 2, 2020 | 1. **Introduction**  
a. Profile  
b. Data Collection & Methodology  
2. **Status:** BMP, Current status, standards, Competitiveness  
3. **Pitching**  
a- Process Mapping  
    - Current  
    - Proposed  
b- Spatial Mapping (min. 4 maps are required)  
    - Enterprise level (Current & Proposed)  
    - Neighbourhood level (Current & proposed)  
c- Business Corner  
    - BCP as per COVID 19 like Situation  
    - Idea Pitch as per Regular Problem  
4. **Stakeholders**  
   - Government  
   - Investors  
5. **Customer Validation**  
   - Company  
   - Customer | Deliverables will be modified, so keep on checking the Deliverables sheet.  
For further details contact your respective ADA Mentor |
2. Students’ Group Presentation and Report

The students formed 6 groups and each group identified MSMEs which they can visit and/or interact with the people associated with the Industry. The Tabular details are given in Table 3. Each of the group report is presented sequentially.

Table 2-1: Industry Types

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Group</th>
<th>Industry Type</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Group I</td>
<td>Chemical Industry</td>
<td>Kanpur</td>
</tr>
<tr>
<td>B</td>
<td>Group II</td>
<td>Lead acid battery recycling Industry</td>
<td>Ghaziabad</td>
</tr>
<tr>
<td>C</td>
<td>Group III</td>
<td>Bio polish and Dyeing Industry</td>
<td>Indore</td>
</tr>
<tr>
<td>D</td>
<td>Group IV</td>
<td>Refractories Industry</td>
<td>Kolkata</td>
</tr>
<tr>
<td>E</td>
<td>Group V</td>
<td>Ceramic Glazing Industry</td>
<td>Hyderabad</td>
</tr>
<tr>
<td>F</td>
<td>Group VI</td>
<td>Electroplating Industry</td>
<td>Faridabad</td>
</tr>
</tbody>
</table>
A. CHEMICAL INDUSTRY

I. INTRODUCTION
We interviewed and documented a chemical factory located near the outskirts of Kanpur that manufactures Chromium Sulphate, a chemical mainly used in the tanning of leather in the leather industries nearby. In this report, we present our research process as well as findings.

**Type of industry:** Chemical based (Manufacturing of basic Chromium Sulphate)  
**Location:** Outskirts of Kanpur, UP  
**Year of Establishment:** 1990  
**Annual turnover:** 3 crores  
**Investment expenses:** 89% of Annual turnover  
**Stakeholders:** Leather based industry

1. II. DATA COLLECTION

(a) Primary Research
There were two stages at which we conducted our primary research – site interview and telephonic interview:

**Telephonic interview:** We discussed and touched upon the common topics that we would like to discuss in more detail through a site interview.

**Site interview:** After the telephonic interview we went on for a site interview where we did a site visit and noted our observations and also interviewed them personally on the basis of a questionnaire.

Below we describe the important information that we came up with from the site interview:

- **Company’s Impact on the natural environment:**
  - Use of natural resources Increased  
  - Air pollution Increased  
  - Soil Pollution Declined  
  - CO2 emissions Increased

- **Annual environmental protection-related expenses:** Rs. 1-2 Lakh

- **Changes in environmental protection expenses over the last five years:**
  - Emission charges Increased  
  - Financial penalties Increased  
  - Environmental investment expenses Increased
○ Market scope of the company: Local and National

● Role played by stakeholders in the process of company’s adjustment to environmental regulations:
  ○ Local Authorities: Very Important
  ○ Regional authorities: Important
  ○ Central government authorities: Unimportant
  ○ Banks and other financial institutions: Unimportant
  ○ Industry and trade associations: Unimportant
  ○ Environmental NGOs: Unimportant

● Number of controls in last three years: 2 major Controls (Planned)

● Company’s financial performance during the last five years: Revenue was high enough to cover expenses.

(b) Secondary Research

Secondary research involved looking over the existing literature regarding the environmental impacts of Chromium and norms that the government has introduced that are needed to be followed by the chemical industries.

i. Environmental Impact: There are numerous impacts that unregulated disposal of Chromium related products into water can have on the environment. A few of them are:
   ● Chromium is generally introduced in the form of Cr(III) which has less negative impact, but it could be changed to Cr(VI) during disposal in water, which is carcinogenic.
   ● It creates a lack of dissolved oxygen in water bodies
   ● It greatly disturbs the ecosystem
   ● Increases the total dissolved solid and lowers the pH

ii. Government Policies and Environmental Norms: There are multiple legislation for chemical management in India that falls under the purview of different Ministries:
   ● Ministry of Environment, Forests and Climate Change (Environment Protection Act, 1986)
   ● Ministry of Labour (Factories Act, 1948)
   ● Ministry of Road Transport and Highways (Motor Vehicles Act, 1988),
   ● Ministry of Commerce and Industry (Explosives Act, 1884),
   ● Ministry of Home Affairs (Disaster Management Act, 2005),
Table 2-1A: Existing environmental legislation addressing the chemical management in India

<table>
<thead>
<tr>
<th>S.No</th>
<th>Indian Legislation</th>
<th>Objective of the Legislation</th>
<th>Responsible Government Agencies in India</th>
<th>Articles/Provisions on Chemical Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>The Air (Prevention and Control of Pollution) Act, 1981</td>
<td>Prevention, control and abatement of air pollution</td>
<td>Central Pollution Control Board (CPCB), State Pollution Control Boards (SPCB) and Pollution Control Committees (PCC) in Union Territories (UT)</td>
<td>Section 2, 21, 22, 24, 25, 26, 37 - 43</td>
</tr>
<tr>
<td>02</td>
<td>The Water (Prevention and Control of Pollution) Act, 1974</td>
<td>Prevention and control of water pollution and also maintaining or restoring the wholesomeness of water bodies</td>
<td>CPCB, SPCB and PCC for UT</td>
<td>Section 2, 20, 21, 23, 24, 25, 26, 27, 41-49</td>
</tr>
<tr>
<td>03</td>
<td>The Water (Prevention and Control of Pollution) Rules, 1975</td>
<td></td>
<td></td>
<td>Rule 2, 30 &amp; 32</td>
</tr>
<tr>
<td>04,05</td>
<td>The Environment (Protection) Act and Rule, 1986</td>
<td>Protection and improvement of the environment</td>
<td>Ministry of Environment, Forest and Climate Change (MoEF), CPCB, SPCB and PCC for UT</td>
<td>Section 2, 7, 8, 10, 11, 15 - 19 Rule 2, 3, 5,13,14</td>
</tr>
<tr>
<td>06</td>
<td>EIA Notification, 2006</td>
<td>Requirement of environmental clearance before establishment/expansion of certain type of industries</td>
<td>MoEF, SPCB,PCC</td>
<td>Rule 3</td>
</tr>
<tr>
<td>07,08</td>
<td>Hazardous Waste (Management, Handling and Transboundary) Rules, 2008</td>
<td>Management and handling of hazardous wastes in line with the Basel Convention</td>
<td>MoEF, CPCB, SPCB, Directorate General of Foreign Trade (DGFT), Port Authority and Customs Authority.</td>
<td>Rule 2, 3, 4, 4A, 4B, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 19, 20</td>
</tr>
</tbody>
</table>
III. PROCESS MAPPING

The diagram given above describes the entire functioning process of the MSME. There are four different processes which have been visually described above. These processes work in conjunction with each other to allow proper function of the MSME. Here we will briefly describe the four processes depicted above:

- **Production**
  The MSME gets its raw materials from pharma companies which produce chromium containing ionic salts as their byproduct. This MSME buys this from them as its raw material for production. The production process is mainly composed of different production steps that converts Chromium ions into Chromium Sulphate. Chromium water is the major byproduct in this process and is generally recycled back through a condenser.

- **Finance**
  This MSME generally sells its produce to buyers from nearby leather industries which is used in the tanning of leather. Other times, they sell it to middlemen from Kolkata who then sell it to Bangladesh since it also has a booming leather industry. Generally, the MSME sells its produce at credit and has suffered losses a number of times when their buyer fails to pay back. Their profit is around 11% of their total revenue (3 crores). This allows them to function without any hefty financial aid (loans) from banks Though they are eligible for instant unconditional loans of amount up to 5 lakhs from banks which they have used a number of times and have quickly paid back.

- **Waste Management**
  Due to strict laws for the operation of chemical industries in Uttar Pradesh, they have a good waste management system. Though it rarely happens, but if it ever happens they generally dispose of their byproduct – Chromium water into the environment after a thorough treatment. Otherwise, it is most of the time recycled back into the condenser as depicted in the diagram. Sometimes however, in rainy season they face problems when due to excessive rains, ground runoff water mixes with Chromium water. This leads to soil pollution.
● Safety
Workers are given gloves and helmet during work. Safety checks are also carried out before every annual inspection by an external government officer. Everything here is operated and checked manually by the employees. For this reason, this MSME has observed a few fatal accidents (boiler blast) in the past due to human error.

Figure 2-1A: Process Mapping
IV. PROBLEM IDENTIFICATION

Here are a general problems that the MSME has been facing since its inception:

- Environmental laws are far too strict in Uttar Pradesh for setting up a chemical industry. This has discouraged and perished several developing chemical industries within the area. Only the old ones that established themselves in the 90’s or early 2000 have been the ones to survive in today’s time.

- The cost to apply for certification and its processing requires a lot of investment from the side of owner, while the support (monetary or otherwise) from government at any level (district, state, central) is almost non-existent. This encourages corruption and discourages owners from taking up any serious environmental measures in many cases. Although this MSME has a number of certifications, but it had to pay hefty prices for it as described in the point below.

- Non-compliance to any environmental norm results in the closure of the entire production line. This has severely affected the relationship of the owner with its clients several times in the MSMEs lifetime. They have often been forced because of this to apply for certifications and invest in upgrades and fixes.

Due to COVID-19, our MSME went through a financial crunch and is still going through one:

- The raw materials for its production come from pharmaceutical companies. These companies were left open to operate during the COVID pandemic producing chromium salts as their byproduct.

- Our MSME uses their waste as their raw material but had to stay closed during the lockdown. This led to an accumulation of Chromium related waste in the Pharmaceutical companies since they cannot freely dispose it off into the environment.

- Because of this, the government was forced to issue a notice that instructed this MSME’s begin to their production. Our MSME had to forcefully purchase raw materials from the pharma companies that led to over accumulation of raw materials into their inventory.

- Though now our MSME has nearly tripled its production but it is being forced to sell its produce at a very low price to its buyers due to slowdown that the Indian economy is currently under.

V. BEST MANAGEMENT PRACTICES

The production process of this MSME is optimized, reasonable, simple and easy, makes the most of natural resources and natural conditions, has the advantages of low production cost, small investment and high yield and enables the problem of waste chromium pollution to be effectively overcome and the waste chromium material to be processed into inorganic chemical products, thereby producing remarkable environmental and economic benefits.
VI. SCOPE FOR INTERVENTION

(a) Problems and Opportunities:

As described before there exist a number of problems with this MSME that pose a risk to its existence. Hence to better understand the existential risk posed by the different problems we mapped out a risk map to identify the set of problems that can be solved to have a maximum impact. One can observe that there are a number of severe safety risks that the MSME is under. Safety risks include events like - Boiler leakage, Boiler explosion, Electrical fire, Operational accidents, Machinery failure, Closure of production line. To better understand the spatial nature of these safety risk, the diagram below depicts the spatial layout of some of these safety risk in the factory. Since there are multiple safety risks of different severity and that too with a high collective probability, we propose that these safety risks need an immediate attention. The solution needs to be such, that can either solve or partially reduce the probability of the occurrence of these risks. In the upcoming sections we will present our solution and analyse its impact on the MSME. However, the problems don’t end here. Apart from safety risks there’s also a need for the MSME to have a BCP that can help them tackle a situation like COVID-19 in future. Such a continuity plan will be presented in the upcoming section on BCP.

(b) Idea Pitching

i. Process: Let us first understand the necessary steps that are needed to be taken up in order to successfully reduce the various existing safety risks. Once we understand this, we will be describing the needed implementation of these steps as our solution. We depict these needed steps this with the help of a diagram that maps out these steps (see numbers) in the different processes of the MSME. To summarise, we mainly looked over the following needed steps in the above diagram:

1. Conducting regular health and safety checks of workers.
2. Regular Machinery checks present in the MSME.
3. Safe disposal and transport of hazardous materials within the premises of the factory.
4. Establishment of a system of investigation to take up necessary steps for the mitigation of future accidents and emergencies.

We now ask the question of how can these steps be implemented in our MSME? What kind of solution can successfully help us in the implementation of the needed steps mentioned above? We propose our implementation in the form of an architectural space and product, which we will be describing in the sections below.
<table>
<thead>
<tr>
<th>Probability</th>
<th>Certain</th>
<th>Likely</th>
<th>Occasional</th>
<th>Unlikely</th>
<th>V. Unlikely</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Boiler leakage</td>
<td>Machinery failure</td>
<td>Closure of production line</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Boiler explosion</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Loan from banks</td>
<td>Shipment delay</td>
<td>Quality check failure</td>
</tr>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Waste management issue / Shipment delay</td>
<td>Changing government policies</td>
<td>Defaulting safety equipment</td>
</tr>
</tbody>
</table>

Figure 2-2A: Risk Mapping
Figure 2-3A: Spatial Layout of Safety Risks
Figure 2-4A: Updated Process Mapping
ii.  **Spatial Mapping:** There are two different levels at which an architectural intervention can help in the implementation of the necessary steps as described above. The two levels are at the level of the enterprise i.e. the factory and the other one is at the level of its neighbourhood i.e. the locality in which the factory is present.

- **Enterprise Level:** Given below is the enterprise level layout of the factory. The hazy colourful areas marked in the diagram below mark the different regions of activity, while the arrows mark the flow of chemicals from one area to another. The current spatial layout is such that all the processes take place under one single roof and there exists no partitions or walls to separate out one area from another (hence the use of hazy areas in the diagram above). This is dangerous when it comes to safe transportation of materials within the premises of the factory as well as for having safe disposal area of hazardous wastes. There also exists insufficient daylight within the premises of the production factory to facilitate safe working conditions of its employees. For this reason, we propose following architectural interventions to improve the efficiency and safety in all production lines and increase the indoor environment quality of the interior space:
  
  1. Introduce partitions between the different areas of the factory and keep all the different production lines together.
  2. Open up back up walls to bring in natural light and ventilate the factory.

- **Neighbourhood Level:** The diagram below depicts the neighbourhood level planning of the space. It is evident from the map that there are hardly any nearby facilities available since it lies in the middle of the highway connecting Kanpur and Unnao. Being in such a remote location, workers too come from their faraway villages. This to some extent poses a health and safety risk of its employees since their travel is restricted to highways where road accidents often take place. A suitable solution to this can be that a separate small workers housing be developed in the vicinity of the factory where workers can temporarily stay during the weekdays and come back to their villages during the weekends.
iii. Business Continuity Plan: Here we describe the business continuity plan for the MSME that can enable it to tackle future situations that are similar to COVID-19 in their impact:

1. **Approaching multiple markets:** Currently the MSME only caters to the leather industry. The product Chromium is also used for Textile and Water treatment.

2. **Safety measures for equipment and facilities:** Proper safety measures must be incorporated at an earlier stage to protect the fixed capital from any damage from accidents.

3. **Preserving stocks of raw materials and products:** Extra funds must be kept aside to be used at the times of crisis. Emergency funds should be preserved.

4. **Diversification of material procurement:** Raw material should be procured from multiple ways so that if there is some issue from one side, other resources can be relied upon.

5. **Flood Management Plans:** Proper safety measures must be taken based on National and State level flood resilience guidelines at the building level.

6. **Emergency Stocks:** Extra stocks and raw materials must be preserved to be used at the times of crisis.

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**Figure 2-5A: Neighbourhood Plan and Proposed Plan**
(c) **Product Proposal**

Now that we have discussed implementable architectural interventions to safeguard the health and safety of the MSME employees, we now propose a product in the form of software to further aid in the mitigation of health and safety risks. Currently, the MSME operates completely manually which means that there is no form of automation at any level of the process apart from the usage of user operated machines which too need close human monitoring during its functioning period. This increase the chances of operational accidents due to management issues, lack of operational knowledge, awareness of danger on the operator side, etc. For this reason, we propose the development of a **Health, Safety and Environmental Management Software**. This software is an automated suite of software utilities designed and developed to aid in environmental protection, occupational Health and Safety of worker at work by automating and several manual health and safety protocols of a production process. These software suites in fact came into picture after a few serious incidences were occurred in chemical industry like Bhopal disaster (India, 1984) and Seveso disaster (Italy, 1976) due to failure in Management System. EHS Management System ensure company's continuing suitability, adequacy, and effectiveness of the company. It makes it easy to manage, track and report the safety data using the special features. The structure of the HSE Management System is based on the “Plan – Operate – Monitor – Improve” structure. This is equivalent to the management approach known as Plan-Do-Check-Act or PDCA cycle. A HSE Management System has a number software utilities included with it. Each software utility aims to automate a separate aspect of the environment, health and safety:

- **Document Control**: Let’s you store different versions of all of your documents in a secure online repository and allow you to access them from anywhere and on any device.
- **Safety Incidents**: Let’s you record, track and report incidents, accidents, injuries and near misses. It also automatically logs daily data regarding the functioning of different machines and shifts of different workers.
- **Risk Assessment**: Identify, analyze, monitor and mitigate existing and potential risks and hazards by extracting useful information from the data of daily logs. It suggests potential threats and their possible solutions which are in accordance with the local guidelines of that particular region.
- **Training Management**: Let’s you track the knowledge and awareness level of your different employees and assess their suitability to a particular task/operation.

1. **Value Proposition**: Following are the points that aim to describe the impact and value created by adopting a HSE Management System:

   - Improved health and safety performance by your business. This reduces the costs associated with accidents and incidents.
If employees see that you are actively looking after their health and safety, relations and morale will improve.

The public see that you are taking a responsible attitude towards your employees. This improves your image and helps generate positive PR for your business.

Improving the efficiency of your business reduces your costs.

You can demonstrate to your insurers that you are controlling risk effectively. This may help lower your insurance premiums.

Banks and investors will be more willing to finance your business if you can show that it is well managed.

Business partners have more confidence in your business. Larger companies and government agencies may only buy from businesses that can show effective management systems.

VII. FUNDING SUPPORT AND STAKEHOLDERS

(a) Funding support

- **Technology and Quality Upgradation Support to MSMEs:** This scheme advocates the use of energy efficient technologies (EETs) in manufacturing units so as to reduce the cost of production and adopt clean development mechanism.

- **Chemical promotion and development scheme:** Promotion and Development of chemical and petrochemical sector by extending financial support for conduct of seminars, conferences, exhibitions, conducting studies/consultancies, for facilitating growth, as well as analyzing critical issues affecting the same.

- **Financial Support to MSMEs in ZED Certification:** Promote adaptation of Quality tools/systems and Energy Efficient manufacturing. The subsidy provided by the Government of India for Micro, Small & Medium Enterprises will be 80%, 60% and 50% respectively. Who can apply? All manufacturing Micro, Small and Medium enterprises (MSME) having Udyog Aadhar Memorandum can apply.

- **Assistance for Technology adoption:** UP also provides technology upgradation reimbursement under Technology Upgradation Scheme of Central Government. It provides assistance for money spent on purchase/import of technology enhancing quality and production by reimbursing 15% subject to a maximum of Rs.10 lacs.

- **CSR Initiative:** MyEasyISO announces CSR Initiative to help MSME companies in India become more productive and profitable with free HSE Software (March 2018). MyEasyISO is a global software company in the domain of business process management & augmentation helping organizations in more than 100 countries implement a robust Quality – Health & Safety & Environment Management System, provides a paperless & automatic software solution that can be used for ISO 9001 implementation, ISO 14001 implementation, ISO 45001 implementation, ZED assessment, ISO 22000 certification or any management system certification etc.
Figure 2-6A: Stakeholders Involved

- **INVESTORS:**
  - Indian Companies under CSR Initiatives:
    - Tata Chemicals, BPCL, etc
    - MyEasyISO

- **CUSTOMERS:**
  - Leather based Industry, intermediate moderators, Khaki Fabric industry, chrome-based dye industry

- **GOVERNMENT:**
  - Regulatory bodies: U.P Pollution Control Board, taxes

- **STAKEHOLDER INVOLVEMENT**

  - Owner
  - Employee
  - Investors
  - Customers
  - Suppliers
  - Government

- **Government schemes:**
  - Technology and Quality Upgradation Support to MSMEs
  - Chemical promotion and development scheme
  - Financial Support to MSMEs in ZED Certification
(b) Stakeholders

Society
● Minimizes the adverse impact on the environment

Internal Stakeholder
● Helps them maintain a documented HSE management system which reflects best industry practice and is consistent with legal and regulatory requirements.
● Defines the accountability and responsibilities for HSE within the organization.
● Enhances the image within the company for employees, the communist, clients and customers, and other stakeholders.
● Better employee relations within the company. Everyone is on the same page with regard to safety.

Government and other regulatory bodies
● Improved relations with Regulating bodies (such as Government, OSHA, etc) and other associated agencies that come for annual inspection.

VIII. CUSTOMER VALIDATION

Due to the limited time available we were only able to conduct a small pilot study of the impacts of our solution by taking in the account of the opinions as were expressed by the owners of the MSME. A few of the important comments that came to surface were:

● “The planning is very much implementable & it has a long-term benefit with regards to safety of our operations”
● “Yes, we can plan to implement HSE management systems in our MSME, as it promises economic, health and environmental benefits”

We felt that the overall response to our proposed solution was positive as expressed by the owners of the MSME.

IX. CONCLUSION

In this report we presented the documentation of an MSME. We analyzed its existential risks and proposed solutions accordingly. Through our risk analysis we concluded that the majority of the existential risks faced by the MSME are related to health and safety since most of the safety procedures followed by it are manual that leaves the chances for human errors. From here, we proposed an architectural intervention and a software product for mitigating the health and safety risks posed by the organization. The solutions proposed by us were unique in the sense that they not only aim to the improve safety and mitigate the accidental risks posed by the MSME, but it also helps in the establishment of a level of trust between the employer and employees, government, investors and regulators because of the humanitarian nature of the solution.
B. **LEAD ACID BATTERY RECYCLING INDUSTRY**

I. **INTRODUCTION OF THE MSMES**

With the introduction of such a holistic problem statement by Dr. Mahua Mukherjee, Dharna madam, Atul sir and Aditya sir, we as a team were in search of an industry or MSME that is important to India and at the same time possess some serious environmental issues. We also aimed at analysing the impact of COVID-19 pandemic on the industry and further aim to propose solutions in form of business plan, spatial planning or business opportunities. We found Battery Lead Recovery Industry fulfilling all the given criteria. Furthermore, we found a possible link in the Make in India possibility and need for better labour laws and licensing provisions. We will be following the EAST approach (Empathise, Analyse, Solve and Test) for this problem that will help us in thinking more critically to and around the problems faced by the industry. For better understanding of problems of industry, we have taken an MSME in Ghaziabad as a part of on ground research or primary research. Questionnaires prepared and filled with data from different stakeholders as a schedule under Empathise phase. Further supplemented with secondary research and a thorough study of environmental laws, bye laws and regulations. We finally reached the Analysis phase where we will end up with Problem Identification and preparation of a problem statement for the MSME.

II. **DATA COLLECTION**

(c) **Primary Research**

In order to know what are the real problems faced by the industry and have a fact check to the data found on reference sources, we prepared for field visit as a part of Primary research. We aimed to find the general course of the factory which will help in knowing about the industry. We also aimed at knowing production levels before the pandemic, during the pandemic and after resuming the industry activities.

i. **Outcomes of Primary Research**

- The workers work under very dangerous circumstances without minimum safety equipment. They are affected and suffer from health problems other than just burns while working. They work despite these problems in order to feed themselves and their family.
● The materials are improperly handled and proper storage areas are not allotted.
● Coal plays a major role in this industry too as a huge amount of coal is used to fire up the kilns.
● The pandemic has affected the battery scrap industry as well as the labour have migrated back to their hometowns. The overall efficiency of the factory has gone down, which will lead to problems in other industries.
● Lead recycling plays an important role in various industries. But, people are indifferent towards the effect of improper handling and disposal of these materials on the environment.

(d) Secondary Research

i. Lead

Lead is still widely used for car batteries, pigments, ammunition, cable sheathing, weights for lifting, weight belts for diving, lead crystal glass, radiation protection and in some solders. It is often used to store corrosive liquids. It is also sometimes used in architecture, for roofing and in stained glass windows. Its widespread use has resulted in extensive environmental contamination, human exposure and significant public health problems in many parts of the world. Lead isotopes are the end products of each of the three series of naturally occurring radioactive elements.

Environmental effects of lead

Lead released into the environment makes its way into the air, soils, and water. Important sources of environmental contamination include mining, smelting, manufacturing and recycling activities, and, in some countries, the continued use of leaded paint, leaded gasoline, and leaded aviation fuel. More than three quarters of global lead consumption is for the manufacture of lead-acid batteries for motor vehicles. Lead can remain in the environment as dust indefinitely. Lead can end up in water and soils via corrosion of leaded pipelines in water transporting procedure and through corrosion of leaded paints. It cannot be broken down; it can only be converted to other forms. Lead is absorbed by plants through roots where most of the lead is also accumulated. Intoxication of animals by lead occurs particularly after grazing on pasture contaminated with lead. Lead enters the organisms with food and air. Once lead accumulates in the bodies of water organisms and soil organisms, these will experience health effects from lead poisoning. Health effects on shellfish can take place even when only very small concentrations of lead are present. Body functions of phytoplankton can be disturbed when lead interferes. Phytoplankton is an important source of oxygen production in seas and many larger sea-animals consume it. In humans, lead can
cause several unwanted effects such as a rise in blood pressure, kidney damage, Brain damage, Decline fertility of men through sperm damage, diminishing learning ability of children, Behavioral disruption of children, etc.

**Economic Benefits of Lead Recycling**

Recycling lead creates 40 times more jobs than sending the same amount of metal waste to the incinerator, and six times more than sending the metal to a landfill.

**Lead Battery Recycling**

Lead Acid battery usage is colossal in railways, transportation, telecommunication, automobiles and many other sectors and is further increasing with solar and wind schemes launched by the government. More than 50% of world’s lead demand is met by secondary lead production. In a developing country like India instead of having sufficient amounts of lead available for recycling we are forced to import it from other countries like Australia, USA and Korea. According to the data available only a fraction of batteries is collected for recycling while proper regulation is there for used battery collection. Retailers collect the batteries by consumer authorized smelters and get the spent batteries through open auction by Metal and Scrap trading Corporation(MSTC). MSTC is providing limited auction of batteries because the price quoted by these smelters is quite low which is not profitable to MSTC. Thus because of low battery collection these smelters are working below their full capacity. Even industries prefer to buy lead from the unlicensed unit (backyard smelters), because the cost of secondary lead coming from unauthorized smelters is low. As no pollution control equipment is used there which leads to the problem of emission of lead dust, fumes and SO2. This pollutes the ecosystem severely and is responsible for health disorders. Waste water from Indian lead plants contains 615 times more lead than is permissible under Indian regulation. Thus the present system not only entails lead import but also leads to environmental disbalance. So the regulation is not enough if not implemented properly.
III. PROCESS MAPPING

Operational Risk
- Exploitation of small scale garbage collectors.

Financial Risk
- Lead is a commodity in stock market hence has a variable price that leads to change in availability and price of scrap.

Process Flowchart

1. Scrap Collection

The chief source of used up batteries are the Industry suppliers, i.e. the electric generators and EV automobile industries among many others providing car batteries scrap, inverter batteries, solar batteries, etc. A significant household portion of batteries is procured from the local kabadiwalas.

Management Risks
- Lack of organised collection model results in loss of most batteries to regular garbage.

ARN 415: Live Studio (B. Arch 4th Year)
**Operational Risk**

- Lack of safety equipments. Regular injuries to workers.
- Exposure to dangerous acid.
- Workers come in direct contact with lead.
- Acid fumes fill the workplace.

**Financial Risk**

- Labour needs to be engaged during harvesting times from outside that is nearly 30% higher costs

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**Management Risks**

- Much less efficient in terms of no. of batteries processed each day.
- Mechanised process is cheaper in long run.
- In manual separation, Waste is more. Potentially recyclable Lead is thrown away.
Operational Risk

- Coal smog causes respiratory problems in workers.
- High risk of burns.
- SO2 fumes are inhaled.
- Workers come in direct contact with lead.

Financial Risk

- Number of smelts need to be more if the scrap is of low quality or adulterated and increases operational costs.

Management Risks

- The desulphurization process reduces slag to just 10%.
- Mechanised process is more efficient and cheaper in long run.
- By making alloy at this stage, the need for customers to again melt the metal is eliminated.

Environmental Risk

- Large amounts of particulate matter, toxic effluents, and other various solid wastes.
Operational Risk

- Workers come in direct contact with lead.
- Risk of burns.

Management Risks

- Efficiency is reduced in manual process.

Financial Risk

- Need of casting again at the time of alloy takes up considerable costs.
**Operational Risk**
- Land Pollution

**Financial Risk**
- Plastic if not purchased by any industry needs to be dumped which increases cost of the recovery industry.

**Management Risks**
- Plastic Recycling infrastructure is not available. Example: segregation, thermal recomposition, and pellets distribution.
**Operational Risk**
- Land Contamination
- Risk of skin infections in workers
- Corrosion of Sewage Pipelines

**Financial Risk**
- Acid filled batteries, are almost 60-70% heavier in weight making higher transportation cost
- Severe burns with acid can lead to higher burden on owner for medical claims

**Management Risks**
- Economic Opportunity of sodium sulfate lost.

**Environmental Risks**
- The dumping of acid causes deterioration of soil and water quality.
- Loss of Aquatic Life
- Eutrophication

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**Acid Disposal**

**Actual**
The acid is not neutralised as it should have been, instead it is dumped to the sewage untreated.
This results in severe environmental hazards.

**Ideal**
Most reclaimed acid is chemically treated forming sodium sulfate.
After the acid is neutralized the sodium sulfate crystals are separated from the liquid through a distillation process and dried through a multi-stage process.
The purified sodium sulfate is sold for use of common household goods such as powdered laundry detergents or by the glass industry in their refining process.
The remainder acid is neutralized meeting regulatory standards that can be safely discharged or reused in the battery manufacturing process.
IV. PROBLEMS IDENTIFICATION

Materials
- Recyclable Lead is being wasted.
- The factory receives batteries with the acid already removed. There is a huge possibility that the acid is disposed of into local water bodies and drains.
- PE separators in the battery are usually thrown away and used as dump fills.

Technology
- Breaking machines are not usually available to dismantle the battery
- Machine setup is imported and costly while Indian setup is not at par

Waste/Pollution
- Though the plastic is separated from the lead plates before melting, a small amount of plastic remains stuck. This gets burnt in the kiln which is then released into the atmosphere through smoke.
- Though filters are used to screen this smoke, it is still hazardous as the filters are of very low quality and not changed regularly.

Management
- Battery scrap handling and storage is not done properly causing acid leak, spills, pollution of land and water sources nearby.
- The space is not planned. Raw material in different stages of processing lie on the ground without any proper space allotted to it.
- Workers do not have basic safety equipment
- The guidelines specified by the government to ensure workers’ health are ignored.
V. BEST MANAGEMENT PRACTICES

(a) Battery Breaking and Component Segregation

1. Isolated and Covered Storage
2. Transport by vehicles not involved in hazardous waste handling
3. Segregation area
   1. Close to TCM
   2. Paved floor with slope to ETP
   3. Components washings (flow through) with treated water from ETP
4. Battery Cases not to be involved in any in-house use or taken by workers

(b) Smelting and Casting Operation

1. Material for furnace to be kept ready near the furnace for loading
2. Air Pollution Control System to be in brought in operation before charging
3. Negative pressure at the loading door/molten metal tapping point
4. Suction hoods for fugitive emission control in the casting area
5. Air blower to be kept off while the charging door/lid is open

(c) Air Pollution Control System (APCS)

1. Cooling/Settling Chambers
2. Cyclone Separator
3. Bag Filter (Pulse Jet/Vibrating)
4. Alkaline Scrubber
   a. Close loop
   b. Three sumps in series
   c. Overflow of one going to the next

(d) Storage and Disposal of Wastes

1. ETP Sludge
   a. Storage under covered shade
   b. Gypsum to be given to cement plants
   c. Sent to TSDF
2. Furnace Slag:
   a. Storage under covered shade
   b. Sent to TSDF
d. Recirculation from the third

5. Stack Separation
   a. Minimum 30 meters
   b. Port hole for sampling
   c. Monitoring platform and access ladder

c. Ash from APCS
d. Storage under covered shade
e. Sent to TSDF

(e) Effluent Treatment Plant

1. Preferably Modular
2. Preferably above ground level & under a shed
3. Physicochemical Treatment
4. Tertiary treatment by activated Charcoal
5. Built in Sludge Drying Beds
6. Overhead storage of the treated water from ETP
7. Use of treated water for scrubber water make up, washing of plastics etc

VI. SCOPE FOR INTERVENTIONS

Problems and opportunity

- Batteries are drained of acid before arriving at the facility. Preventing this may help expand the business in the acid recycling field.
- Breaking machines are not usually available to dismantle the battery. This poses danger to workers too. Automation will reduce cost while ensuring worker safety.
- Low quality filters in the chimney contributes to air pollution.
Battery scrap handling and storage is not done properly causing acid leak, spills, pollution of land and water sources nearby.

The space is not planned. Raw material in different stages of processing lie on the ground without any proper space allotted to it.

The guidelines specified by the government to ensure workers’ health are ignored.

Labour shortage due to COVID

**Idea pitching (COVID situation and Sustainable approach)**

**Process:** The proposed policies are

- A new battery can be issued on submitting old batteries. Each battery should be given a unique ID which can be registered on an online app where the concerned authority can keep the track of the battery.

- Acid should not be removed before reaching the recycling facility. If the recycler is made aware of the economic value of recycling acid, unchecked draining of acid can be reduced.

- Baghouses and chimney installation are only included in setup guidelines and enforced but there is a need to issue guidelines that help in regulating the maintenance and proper functioning with proper standards.

- Importance of acid contactless working procedure needs to be developed which are cost friendly and easily implementable. Rather than guidelines this should become a mandated law.

- If any battery swapping found without ID registration online, strict action is to be taken against the personal involved.

- Electrolysis refining: Aqua Refining utilizes a room temperature, closed-loop, water-based process combined with non-toxic, biodegradable organic elements to produce 99.99% pure lead. This is equal to or better than mining, with no need for secondary processing; effectively meeting increasing demand for lead through an environmentally and economically sustainable operation.

- Introduce worker safety measures, along with best hygiene & sanitation practices, at work

- Evaluate supply chain agility, and make it more resilient
• Digitisation is no longer optional; it has become a critical need in a scenario where physical interactions will continue to be extremely limited and remote access to everything will be the order of the day
• Need for alliances and partnerships
• Reduce unnecessary spending and focus on conserving money to keep operating

Approach:

CIRCULAR ECONOMY (Cradle to Cradle)
Concept of circular economy is still not completely implemented in lead acid battery recycling at MSME level. Every component of the battery can be recycled and reused in one way or another. Current practice of recycling releases waste which would had some economic value if processed and stored properly. Acid to be processed and the sodium sulphate crystals recycled from fluid can be sold to textile industry. Plastic to be shredded and tried to be processed for making containers by same industry Lead extracted from the battery grid can be used to create new grid, parts and lead oxide.

Spatial mapping

Figure 2-1B: Existing Site mapping and area distribution

Figure 2-2B: Proposed Site mapping and area distribution
BCP (As per COVID-19 Situation)

Table 2-1B: Problems and Probable Solutions

<table>
<thead>
<tr>
<th>PROBLEMS</th>
<th>SOLUTIONS</th>
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<tbody>
<tr>
<td>Raw material shortage</td>
<td>1. Recycling other metals like copper or steel</td>
</tr>
<tr>
<td>1. lead batteries</td>
<td>2. Replace furnaces with aqua smelting</td>
</tr>
<tr>
<td>2. coal</td>
<td>3. Revisit their sourcing strategies, and line up alternate suppliers</td>
</tr>
<tr>
<td>Labour Shortage</td>
<td>Increasing amount of mechanisation aiming towards semi-automatic processing.</td>
</tr>
<tr>
<td>Reduced demand from consumers</td>
<td>Recycling other metals increases the amount of consumers in various industries</td>
</tr>
<tr>
<td>Pandemic impacts</td>
<td>1. Digitisation to increase outreach and reduce human contact</td>
</tr>
<tr>
<td></td>
<td>2. Reducing the human intervention in the process by mechanising stages reduces dependence on labours.</td>
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</tbody>
</table>

Value propositions of idea
In general, the break-even point for the industry is reached at about 2 years.

Acid processing cost:
Average acid quantity per battery=8L (6L for E-Rickshaw, 12L for long tubular)
Weight of acid= 1.3x8=10.4kg which has about 30% cp sulphuric acid= 3.12kg
By reaction $2\text{NaOH} + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$, 1kg of sulphuric acid yields about 1.4kg of sodium sulphate sold at 25 per kg. Which gives, roughly 110 Rupees per battery which after labour and sodium cost yields roughly 25-30 Rupees per battery.

**Plastic cost recovery:**
Recycled PP price= 55 Rupees/ kg
Plastic per battery roughly= 2kg yielding total 110 Rupees per bigger battery

**Plastic shredder**
Machine cost roughly 2,00,000 Rupees which can help with present quantity of production and helps in saving about 3 Rupees/ kg + and total savings of about 25000 Rupees roughly per month after costs incurred and in 8-9 months break-even point is achieved.. This also helps in lower carbon footprint of transportation as of lower volume transported.

**Current status and competitiveness of the idea**
Currently the industry lacked very much in spatial planning and layout of industry setup. Also, funds and their sources are unrelent and not managed properly. Lack of machinery and better processes hold their overall output. No environmental concerns are addressed in present functioning, only the ones mandated by the government to setup are in place but still not totally applied. Labour laws and protection are not in consideration. Our ideas are approached from an environmental basis but supported by strong economic benefits that make them easily pitchable to MSMEs in the industry. Plastic shredding and acid neutralisation could be easily explained in economic terms to the MSMEs with help of financial models. While plastic shredding helps reduce the chances to cycle disruption by ending up in dump fill, acid drained into sewage lines and water sources reduces pH and leads to ecosystem disturbances. Further mechanisation with funds sourced from related field industries could create better collaborations and trusted business opportunities with bigger industries gaining an already set management and these recyclers funds for expansion.

### VII. STAKEHOLDERS AND FUNDING SUPPORT
**Government**
- Rs 3 lakh crores Collateral free Automatic Loans for Business, incl MSME.
- Global tenders to be disallowed up to Rs 200 crores.
● New definition of MSMEs, increasing the Investment limit promoting the growth in MSMEs.
● Rs 20,000 crores Subordinate Debt for stressed MSMEs including the business suffering from COVID.

Investors
● Big battery manufactures like Exide, Luminous, Amaron have their own recycling units but also rely on small factories for extracted lead alloy and could be urged to invest or collaborate to make these MSME’s follow environmental friendly approaches
● Also, imports of scrap could be facilitated with help from such companies which are major exporters also.

VIII. CUSTOMER VALIDATION

Costumer
● “I would like to see lead recyclers and lead suppliers to merge, as it will drastically reduce the cost of lead.”
● “Yes we can provide funds to the MSMEs for their upgradation in infrastructure, which are involved in the supply chain of lead to us.”
● “The quality of lead supplied to us is of low quality, we purify it to EC: 231-177-4 grade. It would be much better if the suppliers supply in those grades.”

Company
● “Aqua-Metal refining by electrolysis is alien to us. We don’t have the skill force to manage it even if we get the funds somehow to buy such expensive machinery.”
● “For safety/environment point of view, We would prefer to buy modern furnaces rather than electrolysis “
● “It would be very difficult for such a policy to work, as only a handful of people involved in the chain of supply of batteries, trust the concept of apps and IOT “………. “they would be very reluctant to lose their existing setup “
● “Yes we plan to incorporate the Desulphurisation process in our MSME, as it promises economic/environmental benefits under our budgets.
● “We need a lot of funds, infrastructure to manage acid and plastic waste. And for that we have not received any governmental aid, banks also don’t provide us loans.. They ask for collateral.”
• “You can’t enforce laws straight away without first establishing an alternate setup. “.. “Without us the batteries will go to waste and prices will also increase. “.... “we also want to improve but we need Loans more than Laws “
• “Yes it’s viable / economical for lead recyclers and alloy producers to combine their industries and supply directly to end customers of lead…. We need good initiatives for that “
• “The planning is very much implementable and appropriate and the machines can be installed in the long run”

IX. CONCLUSIONS: UNIQUE SELLING POINTS (USP)

We found out that newer technologies are available but will require funding and training for workers to adapt making it unviable for short run but could be achieved in the long run.

Our proposal have following striking features or Unique Selling Points (USP):

1. The spatial planning can be easily implemented without disturbing the current operations of MSME and leaves scope for gradual mechanisation of the industry. Also, it provides a generalised planning that could be adopted by other firms in the industry.
2. The app, though a difficult and alien concept for the industry in today’s time if somehow came into action could help in cent percent assured recycled lead from battery and also reduce theft cases.
3. Battery collection vehicles with safe storage need to be enforced with desulphurisation and acid neutralisation as part of production and their benefits could be brought up not only environmentally but also economically.
4. Combining lead extractor and composition correction of alloy could help in reduction of transportation costs, working costs and could help in saving energy also.
5. Seeking funds from bigger companies and managing help in imports of scrap batteries could also be a viable option.
6. Mechanisation or attaining semi-automatic processes could help in pandemic and stress times also.
7. Setup of a plastic shredding machine has a break-even point of less than half of the other industrial setup and hence a very economically beneficial as well as environmentally conscious one.
C. **BIO POLISH & DYEING INDUSTRY**

### I. INTRODUCTION OF THE MSMES

**Name:** Samprocess bio polish Pvt. Ltd. (changed name)

**About:** The firm bio-polishes and dyes clothing pieces like jeans and t-shirts on the order of the manufacturers. It only operates in local areas.

**Product:** Dyed clothing, bio polished clothing

**Area of business(reach):** Indore, only local areas, in a radius of 4-8 km

**Transport used for delivery:** E-rickshaws, autos, etc.

**Stakeholders:** Owners(investors), laborers, manufacturers of jeans, and t-shirts.

**Establish problem:** Setup was more on the expensive side (11 crores approx.).

**Turnover:** 18-20 lakhs per annum

**Investment:** 50 lakhs (excluding land)

**Materials used:** Fabric softener, silicone, lubricant, anti-bag, desizer, bio polish, color dye fix, chemical soap

**Raw material sources:** Imported from Mumbai, manufactured in Bangladesh.

**Machinery used:** Washing machines, hydro extractor, tumble driers

**Role of laborers:** In transportation, coloring, drying clothes

**No. of laborers needed /day:** 10/ 1500 jeans per day (during the season)

**Building Location:** Indore

**Impact of COVID:** Fewer laborers available even now, costing has increased, sanitizers, masks for employees have risen the cost, demand for clothes has decreased.

**Impact on transportation of material:** None

---

**Competitive Status of Indian Textile Industry**

Textile Industry in India

- Indian textile industry employs 105 million (10,50,00,000) directly and indirectly.
- Indian textile industry is extremely varied, right from fiber to fashion.
The Indian textile industry, currently estimated at around US$ 150 billion, is expected to reach US$ 230 billion by this year’s end. The textile industry contributes approximately 2% to India’s GDP (Gross Domestic Production), 10% of manufacturing production, and 14% to the overall Index of Industrial Production (IIP).\(^1\)

Competitiveness in the Indian textile Industry\(^1\)

- The competitiveness of the Indian textile industry is very high. This is by the virtue of:
  - Constant threats of substitutes
  - High bargaining power of the buyers
  - High competitive rivalry
  - High threat of new entrants

Table 2-1C: Impact: Social, Economic, & Environmental (SDGs)

<table>
<thead>
<tr>
<th>Environmental Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional Dyeing process need a lot of water and the waste effluents can stay in the environment for extended period of time.</td>
</tr>
<tr>
<td>Effluents that seep into fields, clog the soil surface and render the land unproductive.</td>
</tr>
<tr>
<td>Chemical dyes after coming in contact with humans can cause allergic reactions and may also be absorbed by the skin after prolonged contact.</td>
</tr>
</tbody>
</table>

Environmental Goals (SDGs):
- **Goal 14: Life Below Water** - Effluents from Dyeing greatly affects live under water as it kills fishes, algae and many other marine life forms.
- **Goal 15: Life on Land** - Effluents also decreases the soil productivity and chemical used in dyes harm us humans too.

<table>
<thead>
<tr>
<th>Social Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Being the second largest industry employment generating sector, after agriculture.</td>
</tr>
<tr>
<td>This large size also makes this industry vulnerable to the issue that include:</td>
</tr>
</tbody>
</table>
  - Child Labour |
  - Mode of Wage Payment |
  - Health and Safety (especially of labour) |

Social Goal (SDG):
- **Goal 4: Quality Education** - This industry prevents the attainment of this goal by recruiting children into their workforce.

<table>
<thead>
<tr>
<th>Economic Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>The job profile includes from mainstream industry (dyeing, fabric processing and manufacturing) to related sectors, such as transport, packaging, etc.</td>
</tr>
<tr>
<td>The textile industry also contributes greatly to the GDP.</td>
</tr>
</tbody>
</table>

Economic Goal (SDG):
- **Goal 1: No Poverty** - The textile dyeing sector provides jobs to various people and this helps in reducing poverty to some extent.
Technology Impacts on Textile Industry

- The textile industry with its increasing demand and huge size not only has an extensive impact on the economy but also on the technological advances of the country.[3]
- Market drivers of clothing industry technology include greater importance on the design, innovative fabrics, quick response, quality, and flexibility.[2]
- Retailing is more concentrated in the global fashion market. Mass merchandisers extend their involvement and relationships with supplier’s right back to fabric, fibers, and yarns.[2]
- The technological changes promote the automation of clothing production. In the sewing machine industry, technology provides a flexible method of adapting to changing styles, fabrics, and sizes.[2]

Disaster Management

Issues
The city of Indore does not suffer from any major natural disaster risks, thus our disaster management plan includes a solution for the disasters that our site is inclined to suffer from; man-made disaster like-

- fire hazards
- COVID 19 like situation, (that is spread of an infectious disease, which may lead to complete of partial lockdown)[3]

Solutions
The drivers of the disaster risk pertaining to fire hazards are local, the new city planning policy, under the smart city development scheme of the Indian government includes solutions to this problem by accessing and addressing the disaster risk factors through macro and micro-level city planning.[3]
The solution for the COVID-19 situation is being included in the BCP (Business Continuity Plan).

Policies of the City
The Indore Management Association has developed a meticulous master plan for disaster management. Under the plan, the administration will identify areas sensitive for calamities to prepare a micro plan for every area. And keep the disaster management team prepared and ready to deal with any situation.[3]
Under public safety, a disaster management center is also to be established. It is proposed to be a complex with fire post, disaster management training center, etc.[3]
II. DATA COLLECTION (PRIMARY SURVEY)

<table>
<thead>
<tr>
<th>No. of laborers needed per day</th>
<th>10/1500 jeans per day (during the season)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water usage per day</td>
<td>2000 liters</td>
</tr>
<tr>
<td>No. of times machines used per day</td>
<td>15 times per day</td>
</tr>
<tr>
<td>Water used per wash</td>
<td>~130 liters</td>
</tr>
<tr>
<td>Clothes dyed per wash</td>
<td>80-100 per wash</td>
</tr>
</tbody>
</table>

Amount of chemicals used per wash:

- Colour Dyefix
- Silicone
- Fabric Softener
- Anti-BAG
- Chemical Soap
- Lubricant
- Desizer
- Direct Dye

- 1 liter (100-500 Rs./liter)
- 1 liter (100 Rs-500 Rs./liter)
- 2 liters (100 Rs-500 Rs./liter)
- 500gm (100 Rs-500 Rs./liter)
- 3 liters (100 Rs-500 Rs./liter)
- 500ml(100 Rs-500 Rs./liter)
- 500ml (100 Rs-500 Rs./liter)
- **10-12 kg (100-1000 Rs./Kg)**
Materials Used in the Industry

Direct dyes
These dye staffs are generally sodium salt of sulfonic acid. They have direct affinity to cellulose fiber.\(^{[1]}\)
Types of dyes and their properties are water soluble and needs salt addition in the dye bath, should be applied at alkaline or neutral condition. This dye staff is poor fastness to wash but cheaper.\(^{[4]}\)

**Environmental impact:** The dying process discharges many chemicals through the polluted water and chemicals, which results in the death of aquatic life, the ruining of soils and poisoning of drinking water.\(^{[5]}\)

Color Dyefix
After the dyeing process, if the fabric has unfixed dyestuff on the surface and it becomes final good. It causes color migration when it is wet or during washing. The fixing agent is to be applied to the dyed fabric to fix the unfixed dyestuff on fabric. It improves wet colorfastness and fabric quality.\(^{[6]}\)

**Dyefix permanently protects reactive dyeing against colour fading** and makes optimal washing, rubbing, precipitation, etc.\(^{[6]}\)

**Environmental impact:** As it reduces the colour run-off during finishing and is free from formaldehyde it reduces the amount of effluents entering the water bodies.\(^{[5]}\)

Silicone
Silicones are used in both the processing and final finishing of fabrics and yarns.

**Applications cover three main areas:**
1. **Fluids and emulsions for thread and fabric lubrication,**
2. **Antifoams as processing aids,**
3. **Emulsions for use as textile modifiers.**

Silicone helps manufacture fabrics that repel water, prevent wrinkles, reduce thread breakage, increase elasticity, and resiliency. The silicone coating used in apparel makes it breathable and comfortable.\(^{[6]}\)

**Environmental impact:** With granular silicone softening technology there is less consumption of all the resources and even combining a few steps, which reduces the consumption of water by approximately 50 liters per pair. Silicon dioxide is basically sand and is harmless to the environment.\(^{[6]}\)

Desizer
Sizing is a process that is used during textile manufacturing to aid the weaving process. Size forms a coating on warp yards to help them to withstand tension during weaving and reduce breakage. Once this process is complete, the textile must go through a desizing process to remove this coating before bleaching or dyeing. By using **starch-degrading enzymes, amylases, starch-based size can be removed without damaging the fibers or negatively impacting the dyeing.**\(^{[6]}\)

**Environmental impact:** As desizing uses Enzymes, and Enzymes are complex organic, soluble bio-catalysts, formed by living organisms, that catalyze the chemical reaction in biological processes. These chemicals end up in the water bodies and contribute to water pollution.\(^{[6]}\)

Chemical soap
Soaps are metallic salts of fatty acids (saturated or unsaturated) containing from 8 to 22 carbon atoms. It’s a natural cleansing agent. There may be various kinds of metallic salt but sodium and potassium salts are used as detergents. Commercially soap is produced by boiling natural fats/oils with an aqueous solution of sodium or potassium hydroxide. This reaction is called Saponification.[6]

**Environmental impact:** It does not harm the environment as they degrade quickly.[6]

**Lubricant**

Textile Lubricant is a Non-Reactive Mixture of Waxes and Stainless Liquid Lubricants for Yarns, threads, and fabrics. Textile lubricant deposits a film of stainless lubricant on the yarn that reduces friction and static, allows the yarn to run smoothly without broken ends or frayed filaments and provides a protective finish to the thread.[7]

**Environmental impact:** As it is a petroleum-derived oil, solvent, or wax it does not harm the environment and thus, sustainability and performance can go hand in hand.[7]

**Fabric softener**

Fabric softener is used to prevent static cling and make the fabric more soft. Softening agents are applied to textiles to improve their hand, drape, cutting, and sewing qualities. They work by coating the surface of the cloth fibers with a thin layer of chemicals; these chemicals have lubricant properties and are electrically conductive, thus making the fibers feel smoother and preventing the buildup of static electricity.[6]

**Environmental impact:** It is available as a liquid or as dryer sheets. The fabric treated with the softener is also found to be exceeding the toxicity limit which is harmful to the fish, algae, and other small invertebrates; thereby harming the ecological balance.[6]

### III. PROCESS MAPPING

**Customer + Beneficiaries + Users**

- Customers & Users - Manufacturers
- Beneficiaries - Owners (No partnership)

**Process mapping (working of their industry)**

- Raw materials (chemicals) imported from Mumbai.
- Manufacturers orders for the softening and dying of clothing (Eg- 2000 jeans or 1000 T-shirts)
- Those clothes are put in washing machines along with chemicals. They are first dipped in water in the washing machine for some time, then chemicals are added and the machine is operated.
- After they get soft and dyed, the clothing gets transferred into hydro extractors using laborers and drums.
- Then they are air-dried on ropes using hangers for 1-2 days.
- Then they are again dried in tumble driers.
- At last, they are packed and sent back to the manufacturers.
Universal Process Mapping

- Biochemical oxygen demand (BOD) from sizes, enzymes, starch, and waxes
- Hydrogen peroxide, sodium silicate, organic stabilizer and alkaline conditions
- Color, metals, urea, formaldehyde & solvents
- Sizing
- De-Sizing
- Scouring
- Bleaching
- Mercerizing
- Dyeing
- Printing
- Finishing
- Sodium hydroxide, surfactants, soaps, fats, pectins, oils, sizes and waxes
- Metals, salts, surfactants, color & alkaline/acidic conditions
- Softeners, solvents, resins & waxes
Workflow:

1. Jeans/Shirts Samples from manufacturers
2. Use of washing machines
3. Clothing transferred to hydro extractors
4. Garments sent back to manufacturers
5. Dyed & packed garments
6. Garments put in tumbler driers
7. Garments air dried on ropes

Process Mapping:

1. Well scouted and bleached sample
2. Dye addition
3. Salt addition
4. Soda ash addition (2 times)
5. Dyeing
6. Hot wash
7. Soaping (at boil)
8. Regular wash
9. Enzyme treatment
10. Cold wash
11. Drying the garments
IV. PROBLEMS IDENTIFICATION

1. Water consumption in textile industry
   The daily water consumption of about 8000 kg of fabric per day is about 1.6 million liters.\(^8\)
   Water consumption for dyeing varies from 30 - 50 liters per kg of cloth depending on the type of dye used.\(^8\)
   Dyeing section contributes to 15% - 20% of the total waste water flow.
   72 toxic chemicals have been identified in water solely from textile dyeing.\(^8\)

2. Water pollution
   Mills discharge millions of gallons of the effluent as hazardous toxic waste, full of color and organic chemicals from dyeing and finishing salts.
   The mill effluent is also often of a high temperature and pH, both of which are extremely damaging.\(^8\)
   Depletion of dissolved Oxygen in water is the most serious effect of textile waste as dissolved oxygen is very essential for marine life.\(^8\)

Table 2-2C: Characteristics of effluent from dyeing and printing unit of a textile mill

<table>
<thead>
<tr>
<th></th>
<th>pH</th>
<th>Alkalinity mg/l</th>
<th>Total Solids mg/l</th>
<th>Total Dissolved Solids mg/l</th>
<th>Suspended Solids mg/l</th>
<th>BOD mg/l</th>
<th>COD mg/l</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dyeing</td>
<td>9.2 - 11</td>
<td>1250 - 3160</td>
<td>3600 - 6540</td>
<td>3230 - 6180</td>
<td>360 - 370</td>
<td>130 - 820</td>
<td>465 - 1400</td>
</tr>
<tr>
<td>Printing</td>
<td>6.7 - 8.2</td>
<td>500 - 1080</td>
<td>2110 - 2750</td>
<td>1870 - 2360</td>
<td>250 - 290</td>
<td>135 - 1380</td>
<td>410 - 4270</td>
</tr>
</tbody>
</table>

V. BEST MANAGEMENT PRACTICES

Case Study: Textile Industry of Tirupur\(^9\)
- Construction of CETP (Common Effluent Treatment Plant) to treat water, with an aim to reduce the BOD and COD of the waste water being discharged. Several industry with similar effluent discharge come together to establish this treatment plant, together benefiting everyone.
- Solid waste generated in the area can be used as an alternative of fuel.
- The energy requirements can also be met through engaging in renewable energy generation methods on site (wind mills, solar photovoltaic panels, etc).

Research Paper: Textile Dyeing Industry: Environmental Hazards\(^10\)
- Adsorption of textile dye effluent **using activated carbon**. Being inexpensive and easily available it can be used effectively in a commercial system.
- **Reducing and Recycling water**: consists of rinsing the product in a series of tanks each using cleaner water and reusing rinse water moving it progressively from last tank towards first.
- Awareness to go green.

**Air Dyeing Technology.**
A solution seems to be in sight with the coming of “Air Dyeing Technology”. Air Dyeing Technology is a dyeing process that uses air instead of water to dye garments, allowing companies to create garments with vivid designs and colors, without polluting the water and environment.

Figure 2-1C: Comparison of Air Dyeing and Traditional Wet Dyeing process for 25,000 medium men’s t-shirts)
## VI. PROBLEMS & OPPORTUNITIES

<table>
<thead>
<tr>
<th>Problems</th>
<th>1</th>
<th>2</th>
<th>Impacts of Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opportunities</td>
<td>Large Water Consumption</td>
<td>Water Pollution</td>
<td></td>
</tr>
<tr>
<td><strong>Solution A</strong></td>
<td>Use of air-dyeing technology</td>
<td>Use of air-dyeing technology</td>
<td>Does not use boilers, screen printing machines, drying ovens, or cleaning and scouring chemicals, thereby eliminating major sources of pollution.</td>
</tr>
<tr>
<td></td>
<td>Switching to different technology</td>
<td>Switching to different technology</td>
<td>Air-Dye uses up to 95% less water, and up to 86% less energy, contributing 84% less to global warming.</td>
</tr>
<tr>
<td><strong>Solution B</strong></td>
<td>Re-using the water (Will require lots of space and energy)</td>
<td>Shifting the industry in industrial area, near existing water treatment plant.</td>
<td>Effluents previously left untreated will now be treated and this will reduce water pollution to great extents.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Easy procuring of raw materials.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Manufacturers near the industry.</td>
</tr>
</tbody>
</table>
Idea pitching (COVID situation and Sustainable approach)

Process:
1. Air Dyeing Technology:
   - Extra steps for Putting clothes into different machines using labourers will be eliminated.
   - Only one machine is to be operated.
   - Less energy cost.

Shifting the Industry:
- Water treatment step will be added.
- Manufacturers nearby, so transportation cost is reduced.
Spatial Mapping

Enterprise level planning

Issues identified:

- Hygiene In Fabric
- Fire Safety Point (Disaster)
- Leaking IN Business
- Wet & Dry Zone
- Future Expansion
Neighbourhood level planning

Business Continuity Planning (BCP)

Industry Centric Continuity planning (Process)

Organizational threats

Due to covid pandemic, there is **decrease in the demand as well as the labor force.** This has led to decrease in profit.

To deal with decrease in demand (tackling Covid issue)

*(Taking covid situation in consideration, the industry can adapt dyeing of products which are most needed, like masks.)*
Primary tasks
Introduction of basic means so as to **decrease the revenue for the working** of the industry. Hence **purchasing of new machinery can be postponed.**

Safeguarding interest of clients
While working with less equipments, the **loyal customers** should be worked out more importantly initiating a sense of **trust.**

Backup planning
If there is some or the other problem while working with this method, secondary working plan of **using government’s support for the uplifting of the industry through loans and going online if needed.**

Collaboration & management
Finally if required, **collaborating with other local garment stores and increasing the opportunities for both the contributors**

---

Figure 2-2C: BCP model
Business Model & Revenue Generation

Basic activity of the firm - Dyeing & Bio-polishing

Initial inputs - Land (₹30 lakh), Machinery(₹20-22 lakh)

Initial production costs - ₹77,00,000/annum
(Bio polish: 7-10 Rs. per piece, Colour: 20-30 Rs. per piece, Transport: 150 Rs per round, Electricity: 50,000/month, Monthly Production: 25,000-30,000 piece)

Current liabilities as labour-salary, property taxes, other taxes, machinery repairing, etc.
Labour salary: 1,60,000/annum X 10 (no. of labours) = ₹16,20,000/annum approx.
Machine repairing: ₹1,80,000/annum approx.
Taxes: ₹2,00,000/annum approx.

Long term liability as interest against bank loans, financial debts, etc.
₹5,00,000 (financial debt - ₹1,00,000/annum to be paid back to the lender)

Shareholders’ contribution - 0.0000 (100% owned by the company)

Total revenue generation - ₹1,08,00,000
Break Even Point & Future Scenario

<table>
<thead>
<tr>
<th>Net Cash inflow per Annum</th>
<th>₹10,80,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Cost(Fixed Cost)</td>
<td>₹50,00,000</td>
</tr>
<tr>
<td>Initial Cost(Variable)</td>
<td>₹24,00,000 (6 Month)</td>
</tr>
<tr>
<td>Break even period/payback period</td>
<td>50,00,000/10,80,000 years (Initial fixed cost/net annual cash inflow) Approx. 5 years (approx.) time will be taken as a payback period.</td>
</tr>
<tr>
<td>Future profit generation and model enhancement</td>
<td>Purchase of new advanced machinery (air dyeing machine) with introduction of more labor, force, hence increasing the profit as well as giving employment opportunities to more people.</td>
</tr>
</tbody>
</table>

Feasibility by costing

Implementing air dyeing technology:
- Air-Dye uses up to 95% less water, and up to 86% less energy.
- ₹76,50,000/annum
- (Bio polish: 7-10 Rs. per piece, Colour:20-30 Rs. per piece, Transport :50 Rs per round, Electricity 8,500/month, Monthly Production: 25,000-30,000 piece)
- Labour salary: 2,60,000/annum (skilled workers needed) X 4 (no. of labours reduced) = ₹10,40,000/annum approx.
- Machine repairing: ₹80,000/annum approx.
Taxes: ₹2,00,000/annum approx.
Cost of 1 unit (only 1 machine needed): 13 lakh rupees. (indiamart)
Total expenditure: 94.4 lakh/annum

Normal industry:
- ₹77,00,000/annum
- (Bio polish: 7-10 Rs. per piece, Colour: 20-30 Rs. per piece, Transport: 150 Rs per round, Electricity 50,000/month, Monthly Production: 25,000-30,000 piece)
- Labour salary: 1,60,000/annum X 10 (no. of labours) = ₹16,20,000/annum approx.
- Machine repairing: ₹1,80,000/annum approx.
- Taxes: ₹2,00,000/annum approx.

Cost of 1 tumble dryer: 80k-3 lakh rps (indiamart)
Cost of 1 hydro-extractor: 80k-3 lakh rps (indiamart)
Cost of 1 washing machine: 1-2.5 lakh rps (indiamart)

Total cost (machinery): 7.5 lakh rupees.
Total expenditure: 104 lakh/annum

Source for machinery prices is Indiamart.

Current status and competitiveness of the idea

- Currently air dyeing technology is being used in an Indian textile industry.
- Since, the technology is new, labourers will have to learn to use it. And it will be challenging for all to adapt new air dyeing technology.
- Since, it solves the water consumption & pollution problem drastically, it is gonna completely replace the old technology in future.
- Not many industries are using it, because they will have to change their setups & already grown industries are not willing to take risks in their businesses.
## VII. Stakeholders and Funding Support

<table>
<thead>
<tr>
<th></th>
<th>Air Dyeing Technology</th>
<th>Relocation of Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owners</td>
<td>They will have to buy new machinery and need more space for these machines.</td>
<td>They will have to buy new plot and see to the construction of new factory. Owners will have to look for new labourers near the industry.</td>
</tr>
<tr>
<td>Labourers</td>
<td>They will have to learn to operate new machines.</td>
<td>—</td>
</tr>
<tr>
<td>Producers</td>
<td>—</td>
<td>They will have to reduce the cost as route for transport will greatly reduce.</td>
</tr>
</tbody>
</table>
VIII. CUSTOMER VALIDATION

- Considering the solution of shifting the industry, owner Shyam Verma (name changed) wasn’t very comfortable with the idea as according to him shifting the industry will not only require a good amount of capital investment but also the customer base might get reduced.

- But Shyam sir was very enthusiastic with the second solution proposed. He said that they will definitely do the purchasing of the new machinery system after some time but will not stop the usage of older machinery as his staff is well equipped with the earlier technology.

- Customer’s point of view towards the solution was somewhat mixed as being a loyal customer, shifting of industry by some kilometers won’t affect his relation with the owner.
- The second solution will not be affecting him as it will be the personal matter of the owner to buy machinery and he is still happy with the service.

IX. CONCLUSIONS: UNIQUE SELLING POINTS (USP)

1. Reduces energy usage, water consumption & green house gas emissions drastically.
2. People are getting more aware about the planet, hence switching to sustainable brands. So, switching to a sustainable technology would attract more customers.
3. Maintenance of only one machine is required & not too many.
4. Switching to this technology will so much cost from less energy consumption & that will all fall under profit.
5. If money is invested in this technology, in 5 years, all of the investment can be covered up.
D. **XYZ REFRACTORIES**

I. **INTRODUCTION TO REFRACTORY INDUSTRY**

Refractory are materials that is resistant to decomposition by heat, pressure, or chemical attack, and retains strength and form at high temperatures. More heat resistant than metals, it is used to line the hot surfaces found inside many industrial processes.

**Location:** Kolkata (suburbs)

**Year of Establishment:** 1983

**Industry:** Refractory bricks

**Product:** Alumina Refractory brick (also known as fire brick)

**Clients:** Power plants, Rolling mills, Steel industries, Copper Industries etc

**Annual Turnover:** 35 cr

**Raw Materials (for mixture):** Bauxite, Fused alumina, Calcined Alumina, Diaspore, Plastic and Non-Plastic fire-clay

**Raw Materials (for firing):** Grade B and Grade C coal

**Environmental threat:** Air pollution

**Pollution control expenses:** (Capital expenditure) 50 lakhs (in 2010)

II. **DATA COLLECTION**

Sources of Data collection are divided into 2 parts that are

**Primary Data collection**

**Step 1** Understanding the MSME through telephonic and email survey. We send emails and call different MSMEs to get information about their MSME, what they do, how they do, where and others. After that we select one MSME out of them and continue our survey.

**Step 2** Factory visit. We have gathered some questions and prepare an interview regarding the MSME and during factory visit we interview the factory owner and also some of the workers who work there.

**Step 3** Survey through telephones and emails. As we were not able to cover all the details that we require in the factory visit we send some emails and also do phone calls to get the necessary information.

**Secondary Data collection:** We gather the data we required to do our research through Government guidelines, policies and Acts Research papers And other trusted sources.
III. PROCESS MAPPING

Figure 2-1D: Flow Chart for Process Mapping

IV. PROBLEMS IDENTIFICATION

**Emissions in Existing Firing Process:** In firing process, in tunnel kiln they use coal as a fuel which emits high amount of both particulate matter and gas. Annual emission: 3253 tonnes of CO2 Measured Emission Factors 4,5
Table 2-1D: Emission concentration of PM and Gases

<table>
<thead>
<tr>
<th>g/kg of fired bricks</th>
<th>CO₂</th>
<th>Black Carbon</th>
<th>PM</th>
<th>CO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>166.3</td>
<td>negligible</td>
<td>0.24</td>
<td>3.31</td>
</tr>
<tr>
<td>Range</td>
<td>NA</td>
<td>NA</td>
<td>0.175 – 0.31</td>
<td>2.45 – 4.18</td>
</tr>
</tbody>
</table>

V. BEST MANAGEMENT PRACTICES

Methods: -

● Dust Control Systems
  (Should be installed in whole plant)
- **Ventilation:** Systems called Local Exhaust Ventilation (LEV) use extractor fans to raise dust particles into ducting. Usually, these ducts lead to collection bags where the dust can be removed for proper disposal.
- **Dust Seal Partitioning:** Partitions, screens, curtains and doors for the manufacturing and disposables sectors
- **Fogging:** Fogging works by filtering out the dust from the air via tiny water droplets that are the same size as the dust particles.

**Sources of Dust:**
- **Loading & Unloading:**
  - Dust Control measurements should be taken.
  - Closed chamber for loading and unloading.
  - Fogging system should be installed in whole plant.
  - Systems called Local Exhaust Ventilation (LEV) use extractor fans to raise dust particles into ducting.
- **Partitioning of different areas:**
  - Partitioning of storage, crushing, screening, mixing, forming, drying, firing, cooling, finishing, packaging and shipping areas with screens, doors and curtains to prevent spreading of dust.
  - Fogging system (Dust Suppression System) should be installed in this areas.
  - Proper ventilation should be ensured.
- **Firing and Drying:**
  - Electric kiln or Microwave processing system can be installed to get rid of pollution emitted by existing firing process or Tunnel Kiln.
  - Without changing the current technology different types of filter (Membrane filters, Bag filters, nano filters) can be installed in the chimney
- **Health and safety of workers:**
  - Anti-Dust Mask: High risk of exposure to airborne particles, so it should be mandatory for the owner to provide standard quality mask.
  - Infection control including hand washing, sanitizing surfaces, masks and gloves.
Table 2-2D: Impact assessment results for each management option: reuse, recycling and landfilling, per ton of each refractory waste type

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Unit</th>
<th>Reuse</th>
<th>Recycling</th>
<th>Landfill</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>MgO-C brick</td>
<td>MgO-C brick</td>
<td>High-alumina shapes</td>
</tr>
<tr>
<td>GHG emissions</td>
<td>Tonne CO2-eq</td>
<td>−3.20</td>
<td>−0.77</td>
<td>−1.15</td>
</tr>
</tbody>
</table>
Non-renewable energy demand  | GJ  | −28 | −3.1 | −10.4 | 0.2
---|---|---|---|---|---
Land use  | m2yr | −108 | −7.1 | −47.6 | 3.0
Water use  | m3 freshwater | −70 | −4.1 | −21.4 | 0.7

The environmental impact of waste collection, transport and processing is lower than the impact of producing the equivalent amount of primary raw materials.

**Pollution Control Systems**

**Electric Kiln Installation:** Electric kiln should be used instead of Coal based kiln. For electricity, Solar plant should be installed.

**Microwave Processing:** Microwave energy can be used to create high temperatures (> 1700° C for alumina) in refractory materials. Energy conversion takes place with a very good efficiency (90% in the conversion process of microwaves to thermal energy) if an appropriate applicator is utilized.

**Anti-Dust Mask:** For the safety and health of workers, Anti Dust Mask should be provided.

### VI. SCOPE OF INTERVENTIONS

**IDEA PITCHING (COVID situation and sustainable approach)**

Covid & China’s impacts on this Industry

**Covid impact**

- Because of worldwide lockdown, all activities were halted. The suspension of production due to the lowered demand, supply chain bottlenecks, and to protect the safety of their employees during the COVID-19 pandemic.
- Transportation of raw materials was stopped that caused disruption in supply chain
● While the government took efforts to keep the essential and continuous process sectors such as steel, power plants, petrochemical plants and cement among others running, refractory was kept out of that purview.

China’s impact:

● Refractory Industries in India are very much depended on China for its raw materials supply. More than 40% of the raw materials for refractory companies in India are sourced from China. There are other raw material suppliers like Europe, Brazil, South Africa and Turkey, with cost 30-40% higher. Also, in recent years, ongoing trade tension between India and China is forced Refractory manufacturers to find an alternative solution for raw material supply.

Measures to be taken for business continuity planning during the pandemic:

● Proposition for refractory and refractory raw materials supply chain to be brought under the Essential Services Maintenance Act 1981 and allowed to function uninterruptedly because they are essential inputs for thermally intensive industries such as iron and steel, thermal power plants, petrochemical plants, cement, non-ferrous metals and glass.

● The industry is heavily dependent on China for supply of raw materials such as magnesite and bauxite. The current outbreak is likely to lead to some realignment in supply chain for finished products.
VII. PROCESS MAPPING

Process Mapping

Regular Process

Collaboration with similar companies

Collaboration for waste recycle

<table>
<thead>
<tr>
<th>Factory</th>
<th>Process Handling</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Storage, Drying, Firing, Cooling, Milling, Finishing</td>
</tr>
<tr>
<td>2</td>
<td>Weathering, Calcining, Drying</td>
</tr>
<tr>
<td>3</td>
<td>Crushing, grinding, Screening, Classifying</td>
</tr>
<tr>
<td>4</td>
<td>Storage, Mixing, Forming</td>
</tr>
<tr>
<td>5</td>
<td>Storage, Dry-mixing, blending</td>
</tr>
<tr>
<td>6</td>
<td>Packing, Shipping</td>
</tr>
</tbody>
</table>

Normal Brick

- Lightly bonded
- Heavier in weight
- Compressive strength is around 35 Kg/cm²
- More porous
- Thermal conductivity 1.25 – 1.35 W/m²°C
- Water absorption 20-25%

Fly Ash Brick

- Dense composition
- Lighter in weight
- Compressive strength is around 100 Kg/cm²
- Less porous
- Thermal conductivity 0.90-1.05 W/m²°C
- Water absorption 6-12%
SPATIAL MAPPING

Enterprise Level Spatial Planning

Figure 2-2D: Present Plan
Figure 2-3D: Proposed Plan
<table>
<thead>
<tr>
<th>S. No</th>
<th>PROBLEMS</th>
<th>IMPACT</th>
<th>IDEAS</th>
<th>BENEFITS</th>
</tr>
</thead>
</table>
| 1     | Electricity and coal are two sources of energy consumption | • Cause air pollution through coal burning  
• Depletion of resources                                              | Use of Solar panels. Total cost of 35 kw system is 13.3 lakhs and it payback in 3.5 years. | Environment friendly and there are govt. Policies like one sun one world one grid |
| 2     | Adjacent to national highway                  | Smoke and dust coming from factory directly hits the people driving on the highway | Change location away from highway at least 500m                       |                                                                          |
| 3     | No set backs                                  | In case of fire  
  ● there is no space for fire truck movement  
  ● Also in that case fire truck will stand on highway and block the highway movement | Proper set backs should be provided                                    | There will be different gates for visitors, trucks, emergency exit, employees which helps in better circulation and ease of access. |
| 4     | Working at full capacity in low demand        | Using all machines for producing single type of product                | Collaboration with similar companies and divide the processes like A company make dried bricks and B | Extra consumption of fuel will not be there.                             |
Company fire those bricks and C company do the finishing work.

| 5 | Entry/Exit to the factory | There is only one entry for all type of uses which is used in all kind of situations like emergency evacuation | Provide sufficient entry/exit for normal and emergency conditions |

**Neighborhood Level Spatial Planning**

**Plus Points**
- The Refractory is located 15 km away from the main city
- There are only some shops & residential buildings in 500m radius.
Figure 2-4D: Neighbourhood Plan
<table>
<thead>
<tr>
<th>S.No</th>
<th>PROBLEMS</th>
<th>IMPACT</th>
<th>IDEAS</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Water bodies</td>
<td>There are two small ponds in 500m radius which are being affected indirectly by smoke and dust released by factory, after that the water is being used for crops</td>
<td>This factory should use modern dust collectors like Inertial separators, Fabric filters, Wet scrubbers, Electrostatic Precipitators to reduce the amount of air pollution.</td>
<td>The people and the animals who gets the food and water of the pond will get cleaner water and food. According to TERI guideline this MSME doesn’t need to shut their factory time to time.</td>
</tr>
<tr>
<td>2</td>
<td>Crops</td>
<td>This factory is surrounded by crops and the air pollution created by factory is polluting the crops</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Population density</td>
<td>Population density here is too low as compared to cities but new residential buildings are being constructed</td>
<td>No more buildings with more population should be constructed near the factory and also outside the city. As the factory constructed long before any other building here.</td>
<td></td>
</tr>
</tbody>
</table>
### Bcp (Business Continuity Plan)

**Business continuity plan as per Covid 19**

- Create a Coronavirus Task Force to make local decisions quickly and according to the local reality.
- Work from home provisions for all employees who can perform their jobs remotely.
- Keep reserve fund for adverse situation.

**Work in shifts**

- Employees work in shifts and get paid on an hourly basis. Each employee has work that helps decrease labour migration & after post-pandemic, there will be no labor shortage.
- Employee divided in a way that half of the workers from each process work in another shift. And the production process continues without any interruption.

**Storage area**

- Increase storage area for raw materials & as well as for finished products.

**The National Institute of Disaster Management (NIDM)**

- The Institute has a well-stocked library exclusively on the theme of disaster management and mitigation. The Institute provides training in face-to-face, on-line and self-learning mode as well as satellite-based training.

### VALUE PROPOSITIONS OF IDEA

**Proposed Process**

Alternative fuels can be used instead of using coal.
One of alternative of coal can be solar rooftop which will drastically decrease these emissions and considered as eco-friendly.

**Problems**
Although solar rooftops cannot be used all the time throughout the year. It has to have some backup so that during rainy season or cloudy season factory can still run well.

For that factory needs to have external electricity connection. Which will cost Rs 1,05,800 per month

**Solar rooftop system**

**Minimize energy consumption**
- Electricity consumption: 434kwh/day

**To run machines : Solar rooftop system**
- Total cost of 115 kw system is 41.4 lakhs and it payback in 3.5 years.

**Solar Rooftop Calculation**
- Average solar irradiation in WEST BENGAL state is 1156.39 W / sq.m
- 1kWp solar rooftop plant will generate on an average over the year 4.6 kWh of electricity per day (considering 5.5 sunshine hours)

1. Cost of the Plant:
   - MNRE current Benchmark Cost: Rs. 36000 / kW
   - Cost for 115kw: Rs. 414000

1. Total Electricity Generation from Solar Plant:
   - Annual: 158700 kWh
   - Life-Time (25 years): 3967500kWh

1. Financial Savings:
   - a) Tariff @ Rs.8/kWh - No increase assumed over 25 years:
     - Monthly: Rs. 105800
     - Annually: Rs. 1269600
     - Life-Time (25 years): Rs. 31740000

**Thumb rule for solar panel**

1. **Direction:**
   - In the northern hemisphere, the general rule for solar panel placement is, solar panels should face true south (Usually this is the best direction because solar panels will receive direct light throughout the day)

2. **Angle:**
A general rule for optimal annual energy production is to set the solar panel tilt angle equal to the geographical latitude. For example, if the location of the solar array is at 50° latitude, the optimal tilt angle is also 50°. The latitude of Kolkata, West Bengal, India is 22.572645.

Carbon dioxide emissions mitigated is 3253 tonnes. This installation will be equivalent to planting 5205 Teak trees over the life time.

**CURRENT STATUS AND COMPETITIVENESS OF THE IDEA**

- Global production of refractories is amounted to 36.9 million tonnes in 2014, with China alone accounting for around two thirds of this production.
- 49% of the total mass of refractories is ultimately consumed or dissolved in slag, meaning that close to 20 million tonnes of spent refractory waste materials need to be managed globally every year.
- Refractory Materials, as consumables, account for 2-3% of steel production cost. However, they have much greater indirect influence on steel production.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Production (tons)</td>
<td>NA</td>
<td>1,136,289</td>
<td>1,199,871</td>
<td>1,159,467</td>
<td>1,284,654</td>
<td>1,415,081</td>
<td>1,346,159</td>
</tr>
<tr>
<td>Volume growth</td>
<td>NA</td>
<td>-5.29%</td>
<td>3.48%</td>
<td>-9.77%</td>
<td>-9.21%</td>
<td>5.11%</td>
<td>6.23%</td>
</tr>
<tr>
<td>Sales turnover (in 000,000$)</td>
<td>NA</td>
<td>667,186</td>
<td>654,007</td>
<td>607,570</td>
<td>569,559</td>
<td>545,822</td>
<td>485,966</td>
</tr>
<tr>
<td>Value growth</td>
<td>NA</td>
<td>2.01%</td>
<td>7.64%</td>
<td>6.67%</td>
<td>4.34%</td>
<td>12.31%</td>
<td>26.09%</td>
</tr>
</tbody>
</table>
VIII. STAKEHOLDERS AND FUNDING SUPPORT

Stakeholder involvement

Raw material supplier: China, and parts of India (The main producers of refractory Bauxite is based on China accounts for 85% of production.)

Calcutta Port Authority: (for foreign imports) In according to terms of CIF (Cost, Insurance, and Freight)

In-land transporters: (for domestic procurement and shipment)

Skilled and unskilled Labour: for the production process

Customers: End-User Industry (Iron & Steel, thermal power, petrochemical, Non-Ferrous Metals, Cement, Glass, waste management and pulp & paper)

Neighbours: They get affected from all the waste that is released.
The owners: The higher the profits, the more they benefit, at the same time if the company fails to meet prerequisite norms, they are liable to be held accountable.

Schemes for MSMEs in India
Promoting manufacturing in India:
Scheme 1: Prime Minister Employment Generation Programme and Other Credit Support Schemes
Scheme 2: Development of Khadi, Village and Coir Industries
Scheme 3: Technology Up gradation and Quality Certification
Scheme 4: Marketing Promotion Schemes
Scheme 5: Entrepreneurship and skill Development Programme
Scheme 6: Infrastructure Development Programme
Scheme 7: Scheme of Surveys, Studies and Policy Research
Scheme 8: National SC-ST-HUB
Scheme 9: Scheme of Information, Education and Communication
Scheme 10: Scheme of Fund for Regeneration of Traditional Industries (SFURTI)
Scheme 11: A Scheme for Promotion of Innovation, Rural Industries and Entrepreneurship (ASPIRE)

Govt. Propositions for Indian Refractory Industry
The government’s thrust on Atmanirbhar Bharat is an opportunity for the domestic refractory manufacturers to cater to the domestic requirements and can mutually benefit the domestic steel industry which is very much dependent upon imports for refractory demands. Under this proposition Steel Authority of India Limited (SAIL) has decided to increase usage of domestically produced refractory products across its integrated steel plants.

IX. CUSTOMER VALIDATION

Benefits for the MSME:
1. Using modern dust collectors like Inertial separators, Fabric filters, Wet scrubbers, Electrostatic Precipitators to reduce the amount of air pollution.
   Benefit: The people and the animals who gets the food and water of the pond will get cleaner water and food and according to TERI guideline this MSME doesn’t need to shut their factory time to time.
2. The waste can be recycled and there are policies like National Resource Efficiency Policy 2019 which can help recycle solid waste.
   Benefit: Both the environment and the MSME will get profit as the factory will not dump waste in the environment and government is helping them to recycle the waste.
3. Proper setbacks should be provided
   **Benefit:** There will be different gates for visitors, trucks, emergency exit, employees which helps in better circulation and ease of access.

4. Collaboration with similar companies and divide the processes like A company make dried bricks and B company fire those bricks and C company do the finishing work.
   **Benefit:** Extra consumption of fuel will not be there.

**X. CONCLUSIONS: UNIQUE SELLING POINTS**

1. **Reducing waste and making business more profitable through collaboration**
   The waste can be recycled and there are policies like National Resource Efficiency Policy 2019 which can help recycle solid waste. Both the environment and the MSME will get profit as the factory will not dump waste in the environment and government is helping them to recycle the waste.

2. **Reducing indirect use of fossil fuel in the form of electricity by using electric kilns and solar panels**
   Electricity and coal are two sources of energy consumption. This causes air pollution and depletion of resources through coal burning. We therefore propose use of Solar panels. Total cost of 35 kw system is 13.3 lakhs and it will pay back in 3.5 years
E. **BHANU CERGLAZE PRIVATE LIMITED**

I. **INTRODUCTION OF MSME**

The selected MSME is a manufacturer of ceramic glaze powder. Ceramic glaze is an impervious layer or coating of a vitreous substance which has been fused to a ceramic body through firing. Glaze can serve to color, decorate or waterproof a tile.

**Name:** Bhanu CerGlaze Private Limited

**Location:** Kalyan Nagar, Hyderabad, Telangana. The factory is located at the outskirts of the city in an Industrial Area with many pharmaceutical factories, and a cement producing factory nearby.

**Year Of Establishment:** 1984

**Nature Of Business:** Manufacturer Of Ceramic Glazing Powder

**Number Of Workers:** 26-50. Most of the workers reside near the industrial area as it is close to their workplace.

**Annual Turnover:** 1 Cr.

**Products Supplied:** Abrasive Bonding Frits, Glaze Frits, Tile Frits, Opaque Frits, China Clay Powder, Satin Matt Powder Frit, Powdered Frit, Etc.

**Work Process:** B2B

II. **DATA COLLECTION**

**Primary Data Collection:**

The methodology incorporated to carry out the field research went through the following stages:-

**Stage 1: Telephone Survey with Administration department**

Before finalizing the MSME, a telephonic survey was carried out with the administration department to understand about the MSME and a brief about how it works. A slot was fixed to allow our group mate to carry out the primary survey along with a factory visit.
Stage 2: Participant observation & Factory Visit (Primary Survey by a factory visit- Personal interview)
Method of data collection:
- Through questionnaire-
  A series of open-ended questions were prepared by all the members of the group in order to make the site visit as productive as possible. Interview was carried out on the factory’s plant incharge ‘K. Sivaramudu’.
- Through observation-
  During the primary survey, in order to understand the site context and identify visible problems and gaps, observation was an important data collection strategy.

Stage 3: Telephone Survey with Administration department
Method of data collection:
- Through questionnaire

Secondary Data Collection:
Through Research papers and Government publications
  1. Research paper- to understand the process of manufacturing and respective problems faced by the process
  2. Government published papers- To understand the codes and policies set for such MSME’s.
  3. Looking for case studies and Best Management Practices related to our MSME.

III. PROCESS MAPPING

Universal

Production process for a ceramic tile factory and detecting the glazing stage.
The following flowchart describes the ceramic tile manufacturing process and identifies the glazing process.
Figure 2-1E: Production process stages for a ceramic glaze factory
Raw materials extraction:
Raw materials are extracted from a quarry near Hyderabad. *Feldspar, Quartz, Dolomite, Calcite, Borax, Boric acid, ZnO, Alumina, Soda ash, China clay*

Buyers: Buyers from this MSME are the Ceramic Tile producing factories of Gujarat and Maharashtra.

Specific
Production procedure followed by the MSME:

Procurement of Raw Materials:
The raw materials are procured from a quarry as minerals in the form of fine powder (with the particle size of approx 45 microns) in bags.

- The list of all the raw materials used:
  *Feldspar, Quartz, Dolomite, Calcite, Borax, Boric acid, ZnO, Alumina, Soda ash, China clay*

Batching/Sorting:
Depending upon different particle sizes the raw material is sorted and filled in different bags. They are then transported to the Blender machine via Hopper.

- Hopper: It is a particulate collection container like a cart to transfer materials from one stage to the other.
  - This stage is important as most problems with glazes come from simple things, like incorrect weighing, mistakes in identifying raw materials or not sieving the glaze correctly.
  - **Waste Generation:** While transporting via hopper powder spreads on the floor causing wastage of raw material.
  - **Problem:** Dust creates an inhospitable atmosphere for the workers to work.
**Blending/Mixing:**
The raw materials are mixed per batch into a homogeneous mixture which is then transported to the Furnace/Smelter via Hopper. In between the transfer process through the hopper a lot of powder spreads out as dust.

➔ **Waste Generation:** It is manually collected and put back into the Blender or the Smelter, but ultimately produces a lot of waste.

**Smelter:**
The smelters are coated with a layer of insulation and on top of that layer refractories are lined up similar to the brick kilns.

➔ **Waste generation:** During the process of smelting, continuous corrosion and erosion takes place.

Corrosion - Furnace/Smelter melts the powder. The molten material sometimes sticks to the refractories and corrodes the insulating material.
Erosion - When the smelter is set to oscillation, due to friction the molten mixture eroses on top of refractories. As a result the thickness of refractories decreases in time. They are frequently changed. Lifespan of the refractories used are 2 months. But sometimes they break down due to this corrosion and erosion. These refractories are recyclable, and when they can no longer be recycled, in that case it would be a large amount of solid waste. Almost 5 tons of solid waste is generated in 2 months.

Problems: Generation of harmful gases

Quenching and the Final Product:
The molten material is then transferred into a high stream of water, from which the final product in a crystalline form is obtained.

Waste Generation: No such waste generation, water once used is reused again for almost a year. This water is mixed with minerals and is non potable. Total quantity of water used in a year is 1,00,000 litres.

Problem: Sometimes groundwater is used in this process, which is already polluted due to the waste disposal by the surrounding pharmaceutical factories.

Packaging:
The different products are packed into different bags depending upon the type of product. A particular product is also packed in different bags depending upon the particle size.
Testing in the Laboratory:
Small sample from the bag is taken for laboratory check, and is matched with a reference product. If they are similar, the product is good.

Sold to other factories:
The product is sold to ceramic tile manufacturer factories where it is melted and laid in the form of sheets and then is burnt and laid on the tile.

IV. PROBLEM IDENTIFICATION

Waste (Liquid & Solids)

Refractories In Smelter

- **Corrosion:** Furnace/smelter melts the powder. The molten material sometimes sticks to the refractories and corrodes the insulating material.

- **Erosion:** When the smelter is set to oscillation, due to friction the molten mixture erodes the top of refractories. As a result the thickness of refractories decreases in time, hence they are frequently changed. Lifespan of the refractories used are 2 months.

Almost 5 tons of solid waste is generated in 2 months.

Water Used In Quenching

Water is constantly reused for about a year and then discharged directly into neighboring water bodies without treating. The moisture level of the product is more than required which increases time for packaging and testing.

Waste of Raw Material

This is generated during the changeover in the production from one frit to another. (almost 5Kg per mixing)The mixing of raw material...
is done with buckets and shovels.

**Pollution**

**Air Pollution**
Release of harmful gases directly into air:
Nitrogen dioxide, Carbon dioxide, Carbon Monoxide, Sulphur Trioxide, etc.
**Reason:** Outdated Chimney without dust collectors
Fuel is burnt a lot, a problem for the factory, which increases the cost of production

**Problems In Current Technology**

**Direct Rotary Frit Kiln**
- It consists of a firebrick-lined steel drum resting on rollers. It is gas-or oil-fired.
- It leads to emission of fumes which contain condensed **metallic oxide**, **mineral dust** & **hydrogen fluoride**.

---

**V. BEST MANAGEMENT PRACTICES (BMP)**

**Microwave Processing Of Glass Frits**

**Significant energy reduction**
Compositions for glazing frits are typically complex and contain materials with strong dipoles and ionic conductors, which make them favorable to heating via microwaves.
It is found that the structure and transition temperatures of their microwave-heated material are similar to those of a commercial frit with similar composition produced in a traditional gas-fired continuous furnace.
## Study of Devitrification of Ceramic Frit Waste To Produce Glass Ceramic Materials

**AIM:** An attempt to manage industrial processes with zero residue in order to improve the environmental conservation for future generations by analysing the capability of devitrification of ceramic frit waste.

**PROCESS:** The ceramic frit waste, from the industrial manufacture of soda-lime type frits, was standardized by mixing to ensure its homogeneity and representability from the total waste.

- The ceramic frit waste has been wet micronized by means of alumina ball mill with a load of 150 g distilled water, 150 g of sample powder and 250 g of alumina balls as milling agents, enough to obtain a particle size less than 45 microns, proceeding to subsequent drying period.
- The glassy powder after being micronized under 45 micrometres was wetted at 10%wt and afterwards, it was screened again through a 45 micrometres mesh, in order to remove lumps and to prevent cracks in the pressed pieces.
Thermal treatment:

- The glassy tiles were fired in a muffle kiln (Nannetti) at different temperatures such as 800°C, 825°C, 850°C, 875°C and 900°C, following the cycle indicated in Table 1.

<table>
<thead>
<tr>
<th>Step</th>
<th>Initial temperature (°C)</th>
<th>Final temperature (°C)</th>
<th>Time (min)</th>
<th>Heating rate (°C/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>30</td>
<td>T. max</td>
<td>18</td>
<td>48.3</td>
</tr>
<tr>
<td>Step 2</td>
<td>T. max</td>
<td>T. max</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Step 3</td>
<td>T. max</td>
<td>30</td>
<td>90</td>
<td>-9.7</td>
</tr>
</tbody>
</table>

The chemical composition of ceramic frit waste:

- The frit waste presents as majority elements Si, Ca and Na with a LOI around 3 wt%. It means that the potential crystals appeared after the thermal treatment could belong to the Si-Ca-Na system.

<table>
<thead>
<tr>
<th>Na₂O</th>
<th>MgO</th>
<th>Al₂O₃</th>
<th>SiO₂</th>
<th>K₂O</th>
<th>CaO</th>
<th>TiO₂</th>
<th>Fe₂O₃</th>
<th>ZrO₂</th>
<th>BaO</th>
<th>PbO</th>
<th>ZnO</th>
<th>LOI</th>
</tr>
</thead>
<tbody>
<tr>
<td>10,40</td>
<td>0,00</td>
<td>3,96</td>
<td>57,70</td>
<td>1,84</td>
<td>20,30</td>
<td>0,00</td>
<td>0,00</td>
<td>0,10</td>
<td>0,54</td>
<td>0,27</td>
<td>1,09</td>
<td>3,14</td>
</tr>
</tbody>
</table>
### VI. SCOPE FOR INTERVENTION

Problems and Opportunities & Idea Pitching (Covid Situation And Sustainable Approach)

Process- Problems and Opportunities

<table>
<thead>
<tr>
<th>S.no.</th>
<th>Process</th>
<th>Problem</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Batching And Sorting</td>
<td>Waste of raw material; Inhospitable environment due to excess dust</td>
<td>Closed container while transferring raw material</td>
</tr>
<tr>
<td>2.</td>
<td>Blending And Mixing</td>
<td>Waste of raw material; Inhospitable environment due to excess dust</td>
<td>Closed walls</td>
</tr>
<tr>
<td>3.</td>
<td>Smelter (Heating)</td>
<td>Air pollution- release of harmful gases (Nitrogen dioxide, Carbon dioxide, Carbon Monoxide, Sulphur Trioxide, etc.); Outdated machinery; Solid waste generation- Refractories</td>
<td>Repairing chimney and filters; switch to different technology-heating with convection(Microwave processing)</td>
</tr>
<tr>
<td>4.</td>
<td>Quenching</td>
<td>Water pollution of nearby water bodies.</td>
<td>Treating waste-water; to get rid or reusing.</td>
</tr>
<tr>
<td>5.</td>
<td>Obtaining Final Product</td>
<td>The product has to be kept for a long time to dry.</td>
<td>Using a dryer to make the process fast.</td>
</tr>
<tr>
<td></td>
<td>Batching And Packaging</td>
<td>If the product is not upto mark goes to waste.</td>
<td>Using a method to reverse a few stages and reusing.</td>
</tr>
<tr>
<td>---</td>
<td>------------------------</td>
<td>-----------------------------------------------</td>
<td>---------------------------------------------------</td>
</tr>
<tr>
<td>7.</td>
<td>Sold To Ceramic Factories</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Spatial Mapping**

**Enterprise Level:**

**Existing:** Currently there are no partitions in the working space, so the inner atmosphere gets filled with the dust particles.

**Proposed:** As their circulation was already efficient and well designed, so it was not altered. Proposed changes in spatial planning:

2. Segregation of spaces through partition, **Effect:** Saving of raw material loss and better work environment
3. Admin office addition, **Effect:** A separate management space at site for smooth functioning. For the current COVID-19 situation, this room can also help in testing and sanitising.
4. **Effect:** Proper toilets attached to the building which were earlier away
Figure 2-9E: Spatial Mapping at Enterprise Level
Neighbourhood Level

Existing:
- Good connectivity for transportation of raw materials and finished products:
- Well connected to highways
- Easy transport with internal roads connecting the factory to the highway (NH-9) are 2 lane roads.
- Sufficient open/buffer spaces around the site

Figure 2-10E: Neighbourhood Level Planning
Proposed:

a. A common ETP with nearby chemical factories.
- **Effect:** Decreased groundwater and waterbody pollution
- **Policy:** Canara Bank (associated with the MSME)
- Cluster based approach to lending: Area/Cluster specific schemes are introduced giving due consideration to the potential for the benefit of MSMEs.

b. **Converting open land into green area**
   - **Effect:** Environment and Emotional Well-being

c. **Common parking space**
   - **Effect:** Structured parking facilities for visitors, owners & workers.

---

**Figure 2-11E: Packing Unit**

Existing Industries Around The Msme: The site(marked red) is surrounded by 4 chemical factories(marked blue)

**BCP (Business Continuity Plan)**
**Purpose:** The first priority is to protect people, our employees and visitors to our premises. The second is to protect your business, fulfilling your contractual obligations to the customers and users, meeting social responsibility and contributing to the local society and economy.

**Scope:** This BCP will be introduced to the production factory.

**Table 2-1E: Prioritised Activities**

<table>
<thead>
<tr>
<th>Internal Resources</th>
<th>Buildings, equipment, machinery, tools, stock, materials, IT systems and documents.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Human resources</td>
</tr>
<tr>
<td>Essential Utilities</td>
<td>Electricity, Gas, Fuel, Water and Sewage, Communication network (phone and internet) and Transportation network.</td>
</tr>
<tr>
<td>Supplies</td>
<td>Direct &amp; Indirect supplier, Customers</td>
</tr>
</tbody>
</table>

**Table 2-2E: Risk and Recovery Plan**

<table>
<thead>
<tr>
<th>Risk</th>
<th>Recovery Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Natural Disaster</strong></td>
<td></td>
</tr>
<tr>
<td>Prioritized Activities</td>
<td>Assumed Damage</td>
</tr>
<tr>
<td>Internal Resources</td>
<td>Evacuating during a natural disaster</td>
</tr>
<tr>
<td>Factory building</td>
<td>- Evacuation of building.</td>
</tr>
<tr>
<td></td>
<td>- Lock of record cabinet.</td>
</tr>
<tr>
<td></td>
<td>- Cutting power supply to the kiln.</td>
</tr>
<tr>
<td></td>
<td>- Storing kiln fuel and phosphorus nitrate at a desert and fire proof site.</td>
</tr>
<tr>
<td>Category</td>
<td>Issue</td>
</tr>
<tr>
<td>-------------------</td>
<td>------------------------------</td>
</tr>
<tr>
<td>Inaccessible</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>- Long term</td>
</tr>
<tr>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Inaccessible</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>- Short term</td>
</tr>
<tr>
<td>Equipment/machinery</td>
<td>Outdated machinery</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Damaged Smelter</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Documents</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Raw material soiled</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shortage of raw material</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Human Resource</td>
<td>Injured at site</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Essential Utilities | Power Supply (Electricity) | Short term | - Contact TSSPDCL  
- Mixing of raw materials  
- Drying frits.  
- Use of kiln fuel instead of electricity.  
| Long term | - Preplanning shifts of workers according to power supply.  
- Giving perks to workers if shifts are unreasonable.  
| Water | - ETP to treat water for reuse  
- Contact  
- Use groundwater for short period  
| Communication network | Government shuts off the internet | - Shifting records to hard copy.  
- Contacting buyers through a remote local.  
| Transportation network | Roads damaged to get raw material | - Keeping data charts of material usage. (Sufficient stock available)  
| | Road damaged causing inability to supply final production | - Finding local merchants (multiple market)  
- Alternative solution  
| Supplies | Direct supplier | Lockdown in the state | - Local merchant (Alternate  
- Collaboration  
- Warehouse stock  

This table outlines the issues and proposed solutions related to various utilities and networks. The table is structured to show short-term and long-term solutions for each category, with examples of actions to be taken in response to specific challenges.
| Customers | Company in loss (Unable to buy final product) | - Advance payments  
- Alternative for the payment required. |
|-----------|-----------------------------------------------|-----------------------------------------------------------------|
|           | Inability to send sample to buyer             | - Using fast tag delivery.  
- Supplying samples through e-commerce websites. |
|           | Customer unable to pay advanced credits       | - Creating a bridge between Buyer and enterprise through a third party. |

<table>
<thead>
<tr>
<th>Risk</th>
<th>- Pandemic</th>
<th>Recovery Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prioritized Activities</td>
<td>Assumed Damage</td>
<td></td>
</tr>
<tr>
<td>Internal Resources</td>
<td>Factory building</td>
<td>Surfaces causing virus spread</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Routine sanitation every 2-3 hours especially in common areas that include lunch rooms and common tables</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lack of equipment for sanitization</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Sterilise boxes and wrapping brought into factory premises</td>
</tr>
<tr>
<td></td>
<td>Equipment/machinery</td>
<td>Sanitization</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Ensure no sharing of tools or workstations to the extent possible. Provide additional sets of tools if needed.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Social distancing compromised. (Mixing process requires multiple workers)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Providing automatic mixers to workers.</td>
</tr>
</tbody>
</table>
| Inventory | Shortage of raw material | - Good relations with similar msme's and industries.  
- Delivery of goods in shifts. |
| Human Resource | Transmission of virus by humans. | - Factories at full production capacity should consider one hour gaps between shifts. |
| | Psychological effect of covid 19 | - An isolated accommodation for positive workers to safeguard their family members. |
| Essential Utilities | Power Supply (Electricity) | Short term | - Mixing of raw materials  
- Drying frits.  
- Use of kiln fuel instead of electricity. |
| | | Long term | - Preplanning shifts of workers according to power supply  
- Giving perks to workers if shifts are unreasonable. |
| Financial aid and Investments | Canara Banks shut off | |
| Transportation network | Delay in raw material | - Keeping data charts of material usage. (Sufficient stock available) |
| | Delay in repair personnel | - Finding local merchants  
- Alternative solution |
| Supplies | Direct supplier | Lockdown in the state | - Local merchant  
- Collaboration  
- Warehouse stock |
| Customers | Companies can’t acquire samples | - Selling samples on an E-commerce website. |
Value Propositions of Idea

Idea pitch: New Credit score: Involving stakeholders on a credit score system

Figure 2-12E: credit score system
Collaboration: Closed loop refractory management.

![Collaboration Diagram]

**VII. STAKEHOLDERS AND FUNDING SUPPORT**

Stakeholder: **STATE GOVERNMENT**

The state government invests in the MSME and also provides various policies which benefits the MSME as well as the Government. There are certain benefits from the policies which the MSME can take if they registered (through govt.) and follow certain norms-

- Protection against the delay in payment from Buyers i.e. maximum period for payment for purchase from MSME shall not exceed 45 days, in case of delay, the buyer is liable to pay interest to the supplier, at 3 times of bank rate
- **Fee reduction**- 50% reduction in fee for filing patents and trademarks.
- **Govt tenders**- Exemption provided while applying for government tenders.
- **Import subsidies**- Under bank loan, 15% import subsidy on fully automatic machinery (capital subsidy for modern technology).
- **Foreign Exposure**- Financial support for participating in foreign business exposure from the Government of India.
• Concession in electricity bills

Stakeholder: CANARA BANK

Canara Bank is the other stakeholder which invests as well as gives loans to the MSME.

- Collaboration of MSMEs with each other eases the procedure of taking loan from the bank.
- Bank has established Specialized branches for focused attention to MSMEs (both existing and prospective clients).
- Online system of submission of applications by MSMEs with a tracking facility is introduced.
- No collateral security and/or third party guarantee to be taken for loans upto Rs. 10 lakhs to Micro & Small Enterprises and coverage of all such eligible loans under Credit Guarantee Fund Schemes are made mandatory.
- Scheme of SME Debt Restructuring and Scheme of Rehabilitation of SICK Micro and Small Enterprises as per RBI guidelines are put in place.

RESTRUCTURED STAKEHOLDER INVOLVEMENT

- **Partnership** collaboration between stakeholder characterised by Joint agreement

- **Co-decisions and Co-productions** : Balanced share of power and participation.

**Consultation** : Opportunity to participate in policy/ project process.
VIII. CUSTOMER VALIDATION

Attributes of Customer validation
- Target customers - to whom the product is being sold - Tile industries
- Actual Product - preparation of sample prototype for validation
- Real environment - identifying the actual users and value the product after conducting validation tests for further improvements

Customer validation test stages
- Alpha - To evaluate the stability of the product (ceramic frit) by technical users and identifying quality issues in the real environment.
- Beta - To evaluate satisfaction by taking targeted customers to a comprehensive product tour in the tile industry.
- Field - To evaluate adoption, targeted customers focused on the real-world customer experience which is the actual users like common people who bought the finished tiles.

After analysing the customer validation, improvements shall be made to fulfill the flaws then repeat the whole process.

IX. CONCLUSION: UNIQUE SELLING POINT (USP)

New Credit Score:
- Helps in procurement of money for raw materials and ease in getting advance payment.
Labourers will not have to leave their job

Collaboration with other refractory factories helps in reducing waste and benefits both the MSME and the environment.

Installment of ETP: Helps all the 4 surrounding factories and protects local water bodies. A lot of water wasted can be saved by reusing it.

E-commerce: Connecting with customers online for placing orders for samples and products which was important especially in the Covid-19 scenario.
<table>
<thead>
<tr>
<th>Msme</th>
<th>Client</th>
<th>Bank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Payment security</td>
<td>Quality checked</td>
<td>Interests on loaned money.</td>
</tr>
<tr>
<td>Advance for buying raw material</td>
<td>Contact-less sample testing</td>
<td>-</td>
</tr>
<tr>
<td>Cost cutting</td>
<td>Transparency</td>
<td>-</td>
</tr>
</tbody>
</table>
F. ELECTROPLATING INDUSTRY

I. INTRODUCTION TO MSME | NEW SAILJA ENTERPRISES

ELECTROPLATING INDUSTRY
Electroplating involves the deposition of a thin protective layer (usually metallic) onto a prepared surface of the metal, using an electrochemical process known as Electrolysis.

Steps involved in Electroplating:
1. Pretreatment
   1. Cleaning, degreasing, and other preparation steps
   2. Solvents | Chlorinated Hydrocarbons, Strong acids, Caustic Soda
2. Electrolysis/Plating
   1. Machinery | Rectifier, Electrolytic bath tanks
   2. Chemicals | Metal to be plated, Water
   3. Types | Acidic, Alkaline, Complex agents like Cyanides
3. Rinsing
4. Passivating (For increased life)
5. Drying

Main Resources used in Industry:
Electricity | Water | Chemicals | Metals | Human Labour

Electroplated Metals in Industry:
- Pure metals | Cu, Ni, Cr, Zn, Sn, Au, Pb, Ag, Cd, Pb
- Alloys | Zn-Ni, Sn-Pb, Cu-Zn, Pd-Ni, Ni-Co

Waste Generated:
- Wastewater effluent
- High in toxic cyanides, metal ions, and organic waste
- Properties | High BOD/ COD, SS, DS, TS, Colour, and turbidity and there is depletion of oxygen
- Vapors and Gases
- Volatile Organic Compound, Volatile Metal Compounds
MSME DETAILS
- **Owner:** Sudhir Sharma
- **Factory Location:** Plating Zone, Sector 58, Faridabad, Haryana
- **Plot Area:** 210 sq.m.
- **No. of workers:** 16-17
- **Range of Work done in the factory:** Zinc Plating, Chromium Plating, Powder Coating, Hard chrome, Nickel Chrome, Hardening

Pollution Norms followed of Haryana Pollution Control Board:
- Each Electroplating factory needs to have its own ETP for waste disposal. At Plating Zone, Government has clustered 300 -350 such factories together and provided them with a common ETP.
- Two- Pipe system carries acidic and alkaline wastewater separately to the plant and is connected to every such MSME of the Plating Zone. This step has considerably reduced the quantity of untreated waste and reduced MSMEs’ cost of operation

II. DATA COLLECTION

PRIMARY DATA COLLECTION

Process:
- Phone Interviews with Owner Mr. Sudhir Sharma once or twice every week.
- Site Visit to observe the workflow and the condition of work.

Information Collected:
- Basic Details
- Work Sources
- Process Flow
- Chemicals and Machineries
- Treatment Policies and Procedure
- Safety Measures for workers

Important Observations:
1. **Chemicals required in the process**  
   **Sourced from certified dealers and shops**  
   Can be tested at the site or be sent to Testing labs before use.

2. **Electrolysis:**
   - **Independent factors** | No. of pieces to be electroplated, their area, the thickness of the metal layer
   - **Dependent factors** | Time of Bath, Chemicals required, % of metal, Current

3. **Wastewater generation**
   - **Daily Wastewater** | Water used in pre-treatment and post-treatment stages
   - **Monthly Wastewater** | Water and organic and metal sludge left after cleaning and filtration of the Electrolytic Bath tank.

**Work Sources:**
- Big Companies like Escorts and Maruti have their certified Plating MSMEs to which they outsource their plating work.
- Other small factories may contact them through mutual contacts and word of mouth.
- Due to a lot of competition, Owners need to ensure high quality of work done and safety measures for their laborers.

**Effect Due To Covid:**
The initial period of complete lockdown had a major impact on the earnings during that period. But now, after the unlocking has begun:

   - **Work demand** | more or less the same
   - **Laborers** | Shortage due to migration
   - **Cost** | Extra cost goes in purchasing new safety, disinfection materials and cleanliness drives

**SECONDARY DATA COLLECTION**

**Research Process:**
- Searching and reading relevant research papers from trusted sources
- Reading up on any case study available
- Reading up Papers on Business Continuity Plan

**Existing Emission Guidelines:**
Emission levels for the design and operation of each project must be established through the Environmental Assessment (EA) process, based on country legislation and The Pollution Prevention and Abatement Handbook as applied to local conditions.

1. **Air emission:** A 90% recovery of the quantity of VOCs released from the process is required.
2. **Liquid Effluents:** Electroplating plants should use closed systems where feasible or attain the following effluent levels.
3. **Sludges:** Sludges must be and stabilized, and disposed of in an approved secure landfill. Where feasible sludges may be reused provided toxics are not released to the environment.
4. **Noise:** Noise abatement measures should achieve either the levels given below or a maximum increase in background levels of 3 decibels.

**Steps Of The Electroplating Process:**

**Surface preparation** though is not a part of the electroplating process but is necessary for ensuring strong and uniform adhesion of the coating on the substrate. It includes smoothening of the substrate surface (item to be coated) before the plating operation.

**Pre-treatment** aims to prepare and remove the contaminants from the items for plating. Contaminants include: oil, grease, dirt, mineral oils, miscellaneous organic soils, polishing compounds, miscellaneous solid particles, oxides, scale, smut, rust. The different activities involved in pre-treatment methods are:

- Acid activation
- By chlorinated hydrocarbons
- Electro cleaning
- Ultrasonic cleaning

**Post-plating process**

The purpose of Post-treatment operations is to enhance the physical appearance of the item, To improve the corrosion resistance of the item, and to enhance the aesthetic values.

Post plating treatment includes different techniques as following:

- Sealing is conducted in hot water at a temperature about 200°F (93°C). It is done in order to trap the dye which is located in the pores from leaking and prevent absorption of undesired molecules.
- Dying is a process of absorption of organic or inorganic molecules in the pores of the object after plating. Dying provides an excellent decorative appearance to the plated object.
- Conversion Coating is a process of formation of a film of a chemical compound on the object surface to prevent corrosion and to limit the growth of salts which may harm due to corrosion. This reaction differs from a conventional coating applied on the substrate surface as it does not change its chemical state.
Minimization Of Wastes:

1. **Minimizing the resource use:** Inventory Planning. Usually, the raw material is purchased in excess due to the lack of planning that results in:
   1. Purchase of excess of raw material remains unused and thus enhances the cost of the process.
   2. In case of excess of raw material, there is a tendency to overuse the surplus raw material.

2. **Modifying the process:**
   1. **The use of sensors:** Water level sensors are present to indicate the level of water in tanks instead of human intervention will definitely improve the efficiency of the process. By modifying the process, the efficiency of the process can be increased and waste generation can be minimized.
   2. **Use of suitable plating baths:** The simple way of calculating the amount of electrolyte using the basic principle of chemistry can help in deciding the size of the bath. Thus, the smaller size of bath (optimal range) will reduce the waste generation.
   3. **Using a sludge dryer:** In place of using sludge press will minimize the waste stream.
   4. **Modifying the product:** Use of product substitution of certain chemicals is a better way to reduce hazardous wastes. For eg. trichloroethylene is generated as a small waste stream during pre-treatment. Trichloroethylene is used to clean parts before plating. This can be easily replaced by another solvent that cleans effectively i.e. Isopropyl alcohol.
   5. **Minimization of drag-out losses:**
      (i) By providing sufficient drainage time so that excess of electrolyte falls in the plating tank.
      (ii) Drainboard systems can be installed between the plating tank and rinse tanks.
      (iii) Reducing the speed of withdrawal of objects from bath tank to drag-out tank.
      (iv) The concentration of the process bath can be lowered.
   6. **Modified Rinsing techniques:** Once the plating operation is over, the plated object is put in a Drag out tank. Drag out tank is a rinse tank that is filled with pure water for rinsing the plated object. Usually, more than one tank is available for rinsing. 90% of the water used in the electroplating industry is consumed in rinsing (estimate given by a survey done in Moradabad).

**Chemical Recovery:** During the electroplating process, the electrolyte is consumed partly in the deposition of metals on the cathode and another part is lost in rinsing off the plated object. The major part of electrolyte is lost in drag out, containing metals (Nickel, silver, copper etc). This flows down as waste in the rinsing process. This wastewater containing the metals and chemicals require strict procedures for treatment and disposal.

1. **Evaporation method for Chemical recovery**
2. **Ion-Exchange**
3. Reverse osmosis (RO) for the recovery of chemicals
4. Electro Dialysis
III. PROCESS MAPPING

UNIVERSAL PROCESS MAPPING

Figure 2-2F: Universal Process Mapping
ONSITE PROCESS MAPPING

Figure 2-3F: Process Mapping
IV. PROBLEM IDENTIFICATION

Environmental And Waste Management
 Irresponsible handling of toxic chemical and hazardous waste resulting in its poor management.
 Improper Waste Management
 Lack of Awareness regarding technologies and processes for recycling of chemical solutions

Chemical
 Demand of Cyanide and Chrome based plating despite of alternatives

Site Safety Problems
 Prolonged exposure of workers to harmful chemicals like cyanide
 Small Sized factories cause a Space Constraint

Process And Efficiency
 Unplanned and small scale enterprise, leading to small scale finances and cost of ET.
 Poor working practices due to unskilled labour and improper layout of the working space
 Adoption of traditional manual methods of plating

Working Environment
 Interiors of the industry are not well organised and inefficiently planned.
 Unhealthy working conditions for workers and labourers perspective.
 Improper process flow and spatial planning.

Finances
 Lack of Finances for large long term expansions and developments.
 Individual MSME don’t hold enough financial resources.

V. BEST MANAGEMENT PRACTICES

Prevention
 • **Minimizing the resource use:** This is the very first step to be followed for minimizing the waste. It is done in the initial planning required for the purchase of raw material termed as Inventory Planning.
● **Substituting polluting chemicals:** Use of product substitution of certain chemicals is a better way to reduce hazardous wastes. For eg. trichloro-ethylene is generated as a small waste stream during pre-treatment.

● **Minimization of drag-out losses:** When plated parts are withdrawn from a plating process unit, they retain some part of the plating bath solution, termed as “drag-out”. The drag out that causes loss of material should be minimized to save both chemicals and water used for rinsing.

**Modification**

● The use of machines or electronic sensors can improve the efficiency & minimize waste generated.

● Use of sensors

● Use of suitable planting baths

● Using efficient rinsing techniques

**Shared Practices**

● Shared ETP

● Shared Testing Labs

**Case Study:**

● **Metals recovery in National Electroplater, Ludhiana, Punjab**

● The unit carries out nickel, chrome and zinc plating on automobile parts. Chrome and Nickel are being recovered through the Ion Exchange process as chromic acid and nickel sulphate respectively with a recovery rate of 15-20 kg of nickel and chromium per day. The recovery has been practised by the unit for the last 15 year.

● Cyanide free Alkaline Zinc process is being used. The effluent generated from degreasing and membrane regeneration is treated in the settling tank and subsequently passed through Reverse Osmosis. The RO permeate is recycled in the process and rejected and sent to ETP.

● **Zero Liquid Discharge (ZLP in CETP, Ludhiana)**

● The components of CETP consist of (i) Storage tank (ii) Equalization tank (iii) Tube settler (iv) Bioreactor (v) Clarifier (vi) Reverse Osmosis (viii) Multiple Effect Evaporator. The CETP is equipped with a water recovery system through RO. The part of the permeate from RO is reused by dyeing units located nearby to CETP and the rest used in CETP boilers & for irrigation within the premises. The reject is evaporated in the Multiple Effect Evaporator and salt generated is stored in an interim sludge storage facility within the CETP premises along with sludge from chemical treatment. The sludge finally is disposed off in TSDF at Nimbua
VI. SCOPE FOR INTERVENTIONS

- The MSME is doing good business and its location within the cluster does provide many advantages, but faces many issues, which if catered to would exponentially increase the efficiency and outputs of the business.

PROBLEMS AND OPPORTUNITY - BCP

Figure 2-4F: Risk and Probability Matrix (General)
<table>
<thead>
<tr>
<th>RISKS</th>
<th>IMPACTS</th>
<th>ACTION PLAN</th>
</tr>
</thead>
</table>
| Low manual efficiency and Human errors | **Workflow time ↑**  
Process efficiency ↓ | 1. Change the spatial layout for most efficient working conditions and minimum lags  
2. Regular Workshops to educate and train workers  
3. Maintaining a healthy hierarchy and competition amongst staff for high efficiency and informal learning from peers  
4. Planning of the factory for optimum working conditions by design elements |
| Skill Deficiency            | **Workflow time ↑**  
Process efficiency ↓ | 1. Regular training sessions  
2. Perks to experienced staff |
| Labour Shortage             | **Workflow time ↑**            | 1. Maintain healthy relations with staff  
2. Importance to staff wellbeing  
3. Safety measures in place |
<table>
<thead>
<tr>
<th>Process</th>
<th>Technical Failures</th>
<th>Man-Made disasters (Fires, Chemical Spillage, Machine Blast)</th>
<th>Unavailability of Chemicals</th>
<th>Natural Disaster</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Delay in the production line</td>
<td>Machines and Building damage</td>
<td>Delay in the production line</td>
<td>Machines and Building damage</td>
</tr>
<tr>
<td></td>
<td>Extra Cost incurred</td>
<td>Potential life threats</td>
<td>Extra Cost incurred</td>
<td>Potential life threats</td>
</tr>
</tbody>
</table>

### Technical Failures

1. Collaboration with other Plating MSMEs for hiring shared technical staff
2. Regular Inspections and replace low efficiency machines with newer high efficiency ones
3. Educating workers about the machineries and equipping them to handle small disruptions.

### Man-Made disasters (Fires, Chemical Spillage, Machine Blast)

1. Installation of Sensors and appropriate Safety measures
2. Regular emergency drills and awareness sessions
3. Evaluate damage and calculate the impact period.
4. Collaborate with other MSMEs to continue business

### Unavailability of Chemicals

1. Keep contacts with different suppliers in case of emergency situations.

### Natural Disaster

1. Installation of Sensors and appropriate Safety measures
2. Regular emergency drills and awareness sessions
3. Evaluate damage and calculate the impact period
<table>
<thead>
<tr>
<th><strong>Process Inefficiency</strong></th>
<th><strong>Unaccountable losses</strong></th>
<th><strong>Profit</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Work is disrupted</td>
<td>Extra Cost incurred</td>
<td>4. Collaborate with other MSMEs for self-help groups and for seeking outside help</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of work/tenders</td>
<td>Business loss</td>
<td>1. Change the spatial layout and working for most efficient process and minimum lags</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. RFID based Electroplating Process Management System on the production line</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Inventory Planning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Efficient process for minimizing waste generated i.e. drag out losses, rinsing methods, polluting chemical</td>
</tr>
<tr>
<td>Negative Social Image/ Publicity</td>
<td>Potential business loss</td>
<td>1. Maintain healthy relations with primary work sources</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Maintain Quality Control and provide high-quality service</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1. Maintain a positive social image by publicizing achievements and certifications</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Use social media to connect MSME with the outside world</td>
</tr>
</tbody>
</table>
### IDEA PITCHING - PROCESS - RADIO FREQUENCY IDENTIFICATION (RFID) MANAGEMENT PRODUCTION SYSTEM

As the electroplating process operates at high temperature and humidity environments, traditional barcodes are hard to read. Workers needed to closely monitor the process and manually record the time each item spent in a chemical tank. After that, quality-control staff manually reported any errors or

<table>
<thead>
<tr>
<th>PARTNERSHIPS</th>
<th>Disruptions of Public Utilities</th>
<th>Disruption at the primary supplier’s end</th>
<th>Changes in Government Policies</th>
<th>Inability to collaborate with Competitors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Delay in the production line</td>
<td>Delay in the Production line</td>
<td>Extra cost incurred in input supply</td>
<td>Lost opportunity to share resources</td>
</tr>
<tr>
<td></td>
<td>Extra Cost incurred</td>
<td>Extra Cost incurred</td>
<td>Extra cost incurred in input supply</td>
<td></td>
</tr>
</tbody>
</table>

<p>| | | | | |</p>
<table>
<thead>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

1. Calculate and maintain an immediate backup for water (storage tank) and electricity

1. Keep contacts with different suppliers in case of emergency situations.

1. Stay updated with the latest codes and guidelines
2. Buy machineries and workflow keeping in mind the future possibilities.

1. Maintain healthy relations with neighboring MSMEs
2. Digital platform/organization for all MSMEs in Plating zone to come interact, seek help and collaborate
defects found in a product prior to packaging for shipment. The manual data record caused error occasionally and delayed the reporting process. To collect the work-in-progress data automatically, we propose the RFID-based Electroplating Process Management System on its production lines.

A metal RFID tag is attached on a carrier bar above each carrier rack that is used to transport products and components down the line on a carrier bar. This tag is selected because of its chemical resistance and durability around extreme temperatures. By eliminating the need to input data manually and making production faster and more visible, the new RFID system will increase the workflow efficiency, reduce the record discrepancy, and create a record for product historical analysis. Management can now get real-time information of the production lines, such as what product is undergoing electroplating, how long it spends in the electrolyte tank, and when the process completes. The company also uses the data for business analytics to better understand what kinds of conditions may lead to improperly plated products or when production errors are most often occurring.

Figure 2-5F: RFID Process Explanation
VALUE PROPOSITIONS OF IDEA

1. No need to input manual data (no manual errors)
2. Creates Record for product historical analysis.
3. Real time Monitoring of production lines.
4. Recorded data can be used to identify production errors & analysis business statistics.

CURRENT STATUS AND COMPETITIVENESS OF THE IDEA

This technology is very popular in different industries but its application in the Electroplating Industry is unexplored. The cost of installation is a bit high and hence is expected to popularise a bit slow, but would reduce many redundant costs and lead to efficiency.

SPATIAL PLANNING: ENTERPRISE LEVEL

<table>
<thead>
<tr>
<th>Current Status</th>
<th>Proposed Layout</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Site Area</strong></td>
<td><strong>Key Changes</strong></td>
</tr>
<tr>
<td>210 sq. m.</td>
<td>Open up back walls to bring in light and ventilate the factory.</td>
</tr>
<tr>
<td><strong>Ground Coverage</strong></td>
<td>Keep the production lines together instead of keeping the same functions together.</td>
</tr>
<tr>
<td>60%</td>
<td>Bring in partitions in the center to double up as working desks and storage.</td>
</tr>
<tr>
<td><strong>Building Footprint</strong></td>
<td><strong>Benefits</strong></td>
</tr>
<tr>
<td>120 sq. m.</td>
<td>Same Building Footprint - Greater efficiency in all production lines.</td>
</tr>
</tbody>
</table>

**LEGEND**

- Pre Treatment Stages
- Electrolytic Bath Tank
- Post Treatment Stages
- Loading Area + Drying + Dispatch
- Rectifier + Other Machineries
- Office + Washrooms

**Figure STYLEREF 1**

11: Current Spatial Planning
Figure 2-6F: Proposed Spatial Planning
NEIGHBORHOOD LEVEL: Present Status

- Central green – lung space for the industrial park.
- Green belts at the periphery to act as a buffer.
- Proper orientation of the plots so that they better ventilation throughout.
- For raw materials like chemicals some factories are located.

Figure 2-7F: Neighborhood Spatial Planning
Proposed Changes

Parking: To avoid truck parking on-street in a disorganised manner, parking is required at:

- a) Park level (overnight stay)
- b) Zone/cluster level (temporary stay)
- c) Plot level (loading/unloading).

For the vehicles of workers, every zone should have a dedicated parking lot. For passenger cars/motorbikes, adequate parking can be provided:

- overnight stay
- parking close to individual plots

Public Facilities

- Provisioning of social infrastructure like Public toilets, drinking water facilities, Health care facilities.
- Recreational-socio cultural areas for the benefit of workers by utilisation of green areas.

Signage

Appropriate information signage should be provided.

Fencing can be made all around with definite entries and exits so that outer traffic can be controlled.
VII. IDEA PITCHING - STAKEHOLDERS AND FUNDING SUPPORT - FEPCO

300-350 individual Electroplating MSMEs form the Faridabad Electroplating Cluster Organisation. These MSMEs need to be organised and unified to form the Electroplating community, with an aim to solve common issues that these MSMEs face, but are not able to tackle individually.

Problems:
1. Each MSME is independent and responsible for itself.
2. No Support in case of Threats like COVID.
3. Financial investment to ensure resilience is very high.
4. Poor checks by the Local Authority.

Aim:
1. Organise MSMEs and create a platform where common issues can be resolved.
2. FEPCO would ensure the resilience to the MSMEs against any potential disaster.
3. Responsible for elevating MSMEs and providing fair competition in the Market.
4. Environmental Protection and Providing basic Utilities.

Table 2-2F: Finances and Stakeholders for FEPCO

<table>
<thead>
<tr>
<th>STAKEHOLDER</th>
<th>FINANCIAL CONTRIBUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSME</td>
<td></td>
</tr>
<tr>
<td>Owner</td>
<td>Monthly fees for association with FEPCO</td>
</tr>
<tr>
<td>Labour</td>
<td>--</td>
</tr>
<tr>
<td>Suppliers</td>
<td>Commision for Raw Material deals</td>
</tr>
<tr>
<td>Customers</td>
<td>Commision for each Electroplating order</td>
</tr>
<tr>
<td>Governmental Authority</td>
<td>Subsidiaries</td>
</tr>
</tbody>
</table>

Further Finances can be Raised by proper Investment Plans
Plan:

1. **Online Trading Platform:**
   a. Online Registration of each MSME into a common Portal. Each Client can compare between MSMEs, to get the right Deal.
   b. The MSME can also approach client tenders, to get the right consignment.
   c. Clients and MSMEs can maintain strong dependable relations through the same portal.
   d. Clients who had to resort to Big Companies can provide a combined order to a group of MSMEs.
   e. Expansion to International Markets.
   f. The Suppliers can also associate in the same way.

2. **Logistics Management:** A Major expense in the functioning is Logistics, transportation of unprocessed goods, raw materials, finished products. The FEPCO will ensure the management of Logistics for the cluster, while minimizing the round trips.

3. **Machinery and Raw Materials:** The FEPCO will host spare Machinery and Raw Materials, to ensure rental availability in case of any dysfunction the process would not stop.


5. **Cluster Development and Labour Concern:** Being Sensitive to Workers needs and rights. Also ensuring Spatial Development of Cluster and neighbourhood, like creation of coaggregation spaces.

6. **Threat Management:** In case of any Threat to business, like Fire Accident, COVID situation etc, provide help and support to recover from the accident.

**VALUE PROPOSITIONS OF IDEA**

<table>
<thead>
<tr>
<th>STAKEHOLDER</th>
<th>INCENTIVE / VALUE ADDITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner</td>
<td>1. Solution and Support in everyday common issues, which might stop or delay the process, like Machinery Failure or Chemical inavailability.</td>
</tr>
<tr>
<td></td>
<td>2. A fair chance to compete with big industries, exposure to a larger Marketplace and Customer Base.</td>
</tr>
<tr>
<td></td>
<td>3. Better and Standardised price for each Deal.</td>
</tr>
<tr>
<td></td>
<td>4. Take care of basic utilities like water and electricity supply.Logistics is taken care of.</td>
</tr>
</tbody>
</table>
| Labour | 1. Labour Laws and Rights Protected.  
| Suppliers | 1. Better and Standardised Prices.  
|          | 2. Logistics is taken care of.  
|          | 3. Digitisation of Trade. |
| Customers | 1. All logistics and overhead expenses are taken care of by the organisation.  
|          | 2. Accredited, Assured and Insured transaction.  
|          | 3. Standardisation of Rates and assured best price deals.  
|          | 4. Digitised Trade. |
| Governmental Authority | 1. Ensuring optimisation of Resources at the Cluster Level.  
|                         | 2. Adherence to Policies and Guidelines for each Cluster.  
|                         | 3. Engagement in development of Renewable Resources. |

**CURRENT STATUS AND COMPETITIVENESS OF THE IDEA**
There are many Trade Organisations like FICCI, but no such organisation operates at a local level. Such Organisations are formed to ensure Fair Trade and promote Business and Networking at National levels. But the FEPCO would manage and cater to individual MSME interest at local level. This organisation will maintain overall efficiency in the Platting Zone.

**VIII. CUSTOMER VALIDATION**

<table>
<thead>
<tr>
<th>S.NO.</th>
<th>PLAN</th>
<th>MSME</th>
<th>LABOUR</th>
<th>CLIENTS</th>
<th>SUPPLIER</th>
<th>AUTHORITIES</th>
<th>CUSTOMER VALIDATION</th>
</tr>
</thead>
</table>

ARN 415: Live Studio (B. Arch 4th Year)
<table>
<thead>
<tr>
<th></th>
<th><strong>Spatial Planning</strong></th>
<th><strong>Positive</strong> to layout alteration, organises the process</th>
<th><strong>Neutral</strong>: Roof, require investment, time and halting of production</th>
<th><strong>Positive</strong>, Elevates their Working conditions, provide a healthy environment</th>
<th><strong>Positive</strong>, Leads to healthy industrial practices, ensuring good working conditions and efficiency.</th>
<th>MSME, Labourers and Authorities all hold Positive Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td><strong>Business Continuity Plan-COVID</strong></td>
<td><strong>Positive</strong>, Provide a Threat Control Plan and ensure running business, in case of these tough COVID times</td>
<td><strong>Positive</strong>, the BCP caters to Labour needs and provides jobs in safe working conditions</td>
<td><strong>Positive</strong>, as their orders are fulfilled</td>
<td><strong>Positive</strong>, as their business is maintained</td>
<td>MSME, Labourers, Clients, Suppliers and Authorities all hold Positive Response</td>
</tr>
<tr>
<td>S.NO.</td>
<td>IDEA CATEGORY</td>
<td>PROBLEM IDENTIFIED</td>
<td>TARGET GROUP</td>
<td>SOLUTION</td>
<td>VALUE ADDED</td>
<td>MSME and Clients are positive but Labours condemn the idea.</td>
</tr>
<tr>
<td>-------</td>
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<td>-------------------------------------------</td>
<td>-------------------</td>
<td>-----------------------------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>1</td>
<td>Spatial Planning and Building Envelope</td>
<td>Inefficient Layout Poor IEQ - Human Inefficiency</td>
<td>MSME Profit Workers</td>
<td>Reformed Spatial Planning Fenestrations, Roof Profile</td>
<td>Higher work standards Economics - Unseen losses eliminated, Workers - Healthier and efficient</td>
<td>MSME, Labourers, Clients, Suppliers and Authorities all hold Positive Response</td>
</tr>
<tr>
<td>2</td>
<td>Neighbourhood Planning</td>
<td>Public Spaces, Parking</td>
<td>Labours MSMEs</td>
<td>Designing and Planning of Public Spaces</td>
<td>Interaction and seatings away from Industry</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Business Continuity Plan- GENERAL</td>
<td>Process Inefficiency Technical Errors Human Inefficiency</td>
<td>MSME Profit Machineries Workers</td>
<td>Varying</td>
<td>Threat Resilience</td>
<td></td>
</tr>
</tbody>
</table>
| 4 | **Business Continuity Plan- COVID** | Psychological trauma
Humans as carriers of virus, Clients’ economic availability | MSMEs, Clients, Workers | Provide resources to workers, collaboration among MSMEs, Improved financial options | Improve community interaction, Added value for workers, Responsible financial decisions |
<table>
<thead>
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</thead>
<tbody>
<tr>
<td>5</td>
<td><strong>Business Development</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>1. RFID System</strong></td>
<td>Manual errors &amp; Inefficient Process</td>
<td>MSMEs, Workers, Clients</td>
<td>RFID technology</td>
<td>No manual errors, Efficient production, Record Management</td>
</tr>
<tr>
<td></td>
<td><strong>2. FEPCO Plan</strong></td>
<td>Unorganised individual</td>
<td>MSMEs, Clients, Govt. Authorities, Suppliers, Workers.</td>
<td>Online Trading System, Resource and Logistics Management, Collective Organisation</td>
<td>Greater Market Exposure, Standardised and Accredited Deals, Resource pooling and Management, reduced operational costs</td>
</tr>
</tbody>
</table>
3. Conclusion

The assignment was designed in such a way that students understand the real life issues, act on multi-disciplinary level, and increase connections with stakeholders and among class in spite of them working virtually. The problem was approached in a methodical manner to identify different problems faced by the MSMEs. In order to come up with solutions to these problems, initially understand of the impact that these problems have in the various domains of running an industry was done. This later lead to successfully coming up with intelligent solutions tailored enough to suit the needs of the various stakeholders involved and were implementable. The approach taken by each group is based on their understanding of their respective industry along with solutions in terms of policy, Socio-economic and environment impact, customer validation, architecture and planning. The practical viability of the projects was done by asking them to validate their solutions, which was a learning that things are polls apart in theory and on-site. The following points were the summation of students learnings:

- Became familiar with business jargon
- Understood the significance of MSMEs for India’s economy and the challenges they can face owing to their scale and size.
- Understood how different disciplines come together to make a company work.
- Learnt and practised lateral thinking
- Got an experience is solving real world problems in a real world setting
### I. Comparative Matrix

<table>
<thead>
<tr>
<th>CASES</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID Response</td>
<td>Forceful purchase orders from the government led to accumulation of Chromium inventory resulting in additional maintenance cost and loss of operating money.</td>
<td>Industry faced lack of labour force, financial crisis and guidelines were difficult to follow due to lack of infrastructure.</td>
<td>Decrease in the labour force. Decrease in the demand. Imposed Fixed Cost during lockdown (electricity bills, etc.)</td>
<td>workers retrenchment, availability of raw materials, funding, less demand.</td>
<td>1. Impact on Employees, workers. 2. Demand of ceramic products. 3. Financial loss - no investor as market is down. 4. Impacts on construction field. 5. Face difficulty in inter and intra-state transportation.</td>
<td>1. Reduced workforce and efficiency. 2. Extra cost in Disinfection and Safety Drives. 3. Loss of business. 4. Emotional and Financial stress on Workers.</td>
</tr>
<tr>
<td>Impact</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Solutions</td>
<td>Approach multiple markets but diversifying the products that are being manufactured.</td>
<td>Introduce worker safety measures, Evaluate supply chain agility making it more resilient, Digitization of MSMEs, finding newer fund sources.</td>
<td>Taking COVID situation in consideration, the industry can adapt dyeing of those products which are most needed, like masks. Safety measures for equipment and facilities and identifying resources that support processes are needed.</td>
<td>working hours can be reduced and wages can be divided on hourly basis Temporary shelter for workers.</td>
<td>Providing proper equipment like masks, sanitizers and daily thermal checkup to all the employees, workers &amp; visitors and following proper rules and guidelines made by the government about the COVID. Proposing new business model with latest scheme of investment through bank.</td>
<td>1. Financial support and ensure resource availability. 2. Enforce social distancing norms. 3. Invest in industries, which grew during the pandemic. 4. Provide emotional and social support to workers and equip them with the practical knowledge needed.</td>
</tr>
<tr>
<td><strong>Business Continuity Plan</strong></td>
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<td>--------------------------------</td>
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</tr>
<tr>
<td>Approaching multiple markets</td>
<td>Replace furnaces with aqua smelting</td>
<td>Approaching New Industries which manufactures clothes</td>
<td>Collaboration with similar companies.</td>
<td>The first priority is to protect people, our employees and visitors to our premises</td>
<td>Efficient Spatial layout to reduce lags</td>
<td></td>
</tr>
<tr>
<td>Diversification of material procurement</td>
<td>Revisit their sourcing strategies, and line up alternate suppliers</td>
<td>Determining critical staff, backups, and skill sets.</td>
<td>Collaboration with other companies for solid waste recycle</td>
<td>The second is to protect our business, fulfilling our contractual obligations to the customers and users, meeting social responsibility and contributing to the local society and economy.</td>
<td>Collaboration with other Plating MSMEs for hiring shared technical staff</td>
<td></td>
</tr>
<tr>
<td>Safety measures for equipment and facilities</td>
<td>Increasing amount of mechanization</td>
<td>Safety measures for equipment and facilities</td>
<td>Safety kit and masks for dust full environment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preserving stocks of raw materials and products</td>
<td>Digitization to increase outreach and reduce human contact</td>
<td>Identify resources that support processes &amp; machinery availability.</td>
<td></td>
<td>Regular Inspections &amp; workshops for training</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flood Management Plans</td>
<td></td>
<td></td>
<td></td>
<td>Efficient process for minimizing waste generated</td>
<td></td>
<td></td>
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<tr>
<td>Emergency Stocks</td>
<td></td>
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<td></td>
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<tr>
<td>Transparency of Business</td>
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<tr>
<td>--------------------------</td>
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<td></td>
</tr>
<tr>
<td><strong>Legalization</strong></td>
<td>Current laws related to operation of chemical factories in UP requires industries to be transparent in their production workflow.</td>
<td>Excessive government legalities leading to mostly opaque workflows, difficulty in collecting data, data collected on basis of confidentiality terms</td>
<td>The Industry is not legal due to many threat by government like the Industrial Disputes Act, 1947 to limitation on firm size, IS: 2296 Relevant Indian Standards, The Water (Prevention and Control of Pollution) Act, 1947, etc</td>
<td>This company is MSME certified but violets minor rules and regulations regarding pollution and structure planning</td>
<td>Industry is certified in 1985, since then all the documents are renewable occasionally. This MSME has a few temporary issues regarding proper pollution control, which could be resolved with few changes.</td>
<td>The enterprise is a certified MSME. The owner has been very cooperative and transparent in providing us with all the good and bad details.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Environmental</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Present state</strong></td>
</tr>
<tr>
<td>Resources Used and Not Managed</td>
</tr>
<tr>
<td>-------------------------------</td>
</tr>
<tr>
<td>The industry uses a lot of water in its production workflow but manages it efficiently. Chromium water a byproduct of the process recycled effectively instead of being dumped.</td>
</tr>
<tr>
<td>Possible Solutions</td>
</tr>
<tr>
<td>Use of better chimney filters, complete plastic separation, Avoid acid dumping</td>
</tr>
<tr>
<td>Minimizing resource use, Minimize dragout losses, Substituting polluting chemicals, Efficient Recycling and waste management</td>
</tr>
</tbody>
</table>
### Economic

<table>
<thead>
<tr>
<th>Present Model</th>
<th>Unorganised sector mostly</th>
</tr>
</thead>
<tbody>
<tr>
<td>The factory buys its raw materials from the waste product of Pharma companies. Upon processing, the chromium sulphate so produced is then sold off to middlemen or directly to leather industries.</td>
<td>Considering Present Model, it might take 8 years for the company for generation of profit. i.e., the payback period for the industry will be 8 years which is higher in number so the scope of improvement is less and would not buying of new and better machinery and for generating a better profit.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source of income</th>
<th>Recyling gives lead alloy, plastic (which is reprocessed) and sodium sulphate used in detergent industry but only profits of lead alloy taken</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profit earned by selling the product to suppliers and direct customers.</td>
<td>Self</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>From Products only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loans and credit based investment from Canara Bank</td>
</tr>
</tbody>
</table>

| Each MSME of the Plating Zone is an independent party handling all the finance matters internally. Our MSME has tied up known companies which outsource plating work to them and in return pay for the services after completion and partly as advance. | All the transactions are associated with Canara Bank. Canara Bank has a branch dealing with MSME with regards to the finance of the company. Few schemes given by this bank for the cost cutting by providing 10% discount on the raw material bills and also pays back the balance amount to the MSME. |

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| Proposed | None | Economic opportunities in Acid recycling and Plastic processing could be harnessed, further plastic shredders could be installed at site | Proposed Model, it might take 5 years for the company for generation of profit. I.e., the payback period for the industry will be 5 years. After that there is a better scope of improvement with buying of new and better machinery and generating a better profit and the overall cost expenditure is less of 10 lakh compare to current model and also reduces the labour force that include. | Introducing New Credit Score system - a complete financial model. | 1. Organise MSMEs and create a platform where common issues can be resolved. (FEPCO) 2. FEPCO would ensure the resilience to the MSMEs against any potential disaster. 3. Online Trading System, Resource and Logistics Management |

<p>| Fund sources | The factory seldomly take loans of any kind. They are easily able to fund themselves through their profit itself. | Getting help from bigger companies who are dependent for raw materials | Getting help from clothes manufacturers who needs to get their products dyed for better sales. | Bank and Tile Industries. | Contribuition from each MSME &amp; commission from Suppliers, Clients |</p>
<table>
<thead>
<tr>
<th><strong>Social</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Labour laws</strong></td>
</tr>
<tr>
<td>Proper uniform including shoe, socks, head gear, mask etc. Cover head with airtight shower cap and wear mask during working hours. Use disposable cotton ear plugs and nails need to be trimmed and cleaned to ensure no lead dust gets collected. Periodic examination for Blood Lead Levels.</td>
</tr>
<tr>
<td>Fixed term employment, Employee's provident fund “Modify labour laws (such as the Industrial Disputes Act, 1947) to remove limitation on firm size and allow manufacturing firms to grow”</td>
</tr>
<tr>
<td>Better equipments with safety kit like Mask and Gloves should provide to workers</td>
</tr>
<tr>
<td>Rights and safety of all workers and employees be ensured by providing them safety equipments and other facilities like washrooms, canteen, etc.</td>
</tr>
<tr>
<td>Safety of Labourers ensured. The labourers are provided with required safety gears like aprons, gloves and masks for working. Any injury/ mishap on the factory premise is the responsibility of the MSME Owner.</td>
</tr>
<tr>
<td><strong>Neighbourhood disturbances</strong></td>
</tr>
<tr>
<td>Setup mandated in industrial area due to hazardous nature, heated environments and air pollution</td>
</tr>
<tr>
<td>The industry is currently in low density residential zone. The raw materials for dyeing has to be imported from other zones.</td>
</tr>
<tr>
<td>The company situated 15 km away from the main city</td>
</tr>
<tr>
<td>Spatial planning has been improved so that the dust and noise pollution will not disturb the neighbourhoods.</td>
</tr>
<tr>
<td>The Plating Zone has been planned on a site level carefully to ensure proper routes, open spaces and buffer zones.</td>
</tr>
</tbody>
</table>
II. Comments from Mentors on Learning curve

Prof. Mahua Mukherjee: Live Studios are always very encouraging as this provides to explore different combinations of pedagogy. This facilitates to think innovatively where architects are not generally asked to tread on. The Pandemic COVID19 challenged the education system uniquely. So this time our class remotely worked in group to understand the risk of Pandemic on livelihood issues. Role of design and solutions for business continuity was a novel area for many of us. Presence of guest mentors at regular intervals could help the students to handle the MSME-centric with broader understanding. So role of group work, learning newer aspects of design from experts and importance of innovation is most valuable learning of this live studio which could be organised mostly online. Credit goes to both students and mentors to appreciate the problem and sincerely work towards the same. It was new learning for us too.

Dhaarna: I was assigned as a Teaching Assistant for the Live Studio (AR 415) with Prof. Mahua Mukherjee and I received a call from Professor with the idea of working on MSME, COVID-19 impact on MSMEs and environmental issues. The idea was very intriguing and I was totally on board to explore the new waters. Being from the Architecture and Planning background, it was inspiring to see student’s work, enthusiasm and bringing new approach to solve real life issues and also, it was a learning from the esteemed guest mentors who are expert of their fields. The exploration of this new assignment, arranging online classes, meeting experts and learning with the students about MSMEs has been a satisfying experience.

Aditya Rahul: Being a research scholar, I was extremely glad to be part of this project. It was a knowledge enriching experience mentoring the young minds in this exceptional journey. It opened new horizons to me through exploration of various concepts pertaining to MSMEs. The solutions brought forward by students during this venture, truly was out of the box. Lastly my words will never be able to do justice to the enthusiasm showed by the students in this project.

Atul Kumar: Since the subject was ‘Live studio’ the class's idea initiated with the very situation of COVID-19 and nationwide lockdown that had affected the MSMEs function. I found this idea very interesting; being a disaster manager, it was a great learning experience about ‘how to turn disaster into an opportunity’ as the people witnessed the temporary improvement of the environmental situation throughout the globe. MSMEs are the most crucial part of the economy, so focusing on the Post-COVID scenario to restore industries' function concerning the benefit to humanity and the environment was a wonderful learning experience.
III. Students Comments and lesson learnt

**Group 1**

We were expecting something different from this subject as it's a part of the architecture curriculum but it turned out to be a different experience altogether. Initially we were a little confused on how we should choose a MSME, proceed forward with the problem identification, proposing solutions, pitching ideas, etc. But as the journey proceeds we get to know a lot about various things. What are the various processes that work in conjunction with each other to allow proper function of the MSME (Finance, production, marketing, waste management systems, legal authorities) Stakeholder involvement, certain terminologies (like BCP, Action Plan, business lingos). Although we are being trained as architects, by working on this project we have gained interdisciplinary skills, something which none of us thought was so important since we regarded ourselves as architects. However, this subject has taught us that for architects it is much more important to be exposed to new ideas and concepts that are not related to their field so as to enable them to develop relations between those two different fields. We as a group are glad that we were given such an opportunity to learn a new way of problem solving.

**Group 2**

To be honest, we were fussed out with the introduction of such a holistic project and were not sure to what extent we could help industry with our solutions. We were also in a fix whether the industry will be interested in our solutions. With help of Dr. Mahua Mukherjee and ADA team worked on different aspects of the project interacting with people from different fields giving us feedback and suggestions which not only helped us in improving the project but also learned a lot about pitching such ideas to industry. At the end we were able to pitch solutions to the industry and some of them were found implementable also while others were found relevant on the long run. Overall we learnt a lot from this project.

**Yash Bharani:** The initial stages of this problem were marked with confusion and obscurity, as we took our fair share of time to wrap our heads around the naive concepts of the subject at hand. But as we progressed through the semester we found ourselves much more organised and better connected in the pandemic ridden world finding our ways between innovations, mistakes, and new platforms and methodologies of presentation. We could relate to the client and industry we studied in relation to the larger challenges we face with the economic policies of our nation. Also with the creative out of the box solutions we glanced through in our studies and presentations by our fellow classmates opened our minds towards unconventional paths for conventional problems. Every challenge we faced in this semester long journey was comfortably defeated thanks to the enthusiastic participation of every member of the team and the ceaseless guidance of the mentors who in spite of the challenges of their respective homes responded at every call and solved our queries with honesty and passion.
| Group 3 | While it was introduced to us, looking at the problem was something different for us as all around our years in architecture, we haven't learned about it. It was new on the one hand but, according to us, not related to architecture. As the session progressed, many new things were introduced to us, and we were able to learn many new things in these challenging times. It was not only my learning that affected me but also, we gained many things from others learning. It was often tiresome and hardly possible to meet all the requirements due to unusual situations. But meeting people of high order in the meetings, which would scarcely be possible in offline classes, was a good thing that kept us going and thrives for more. As we were learning about MSME, everyone couldn't get the onsite knowledge, and also, everyone was not willing to share their details for privacy purposes. It was a good learning experience for all of us, with some ups and downs all around the semester. |
| Group 4 | Challenges: We are people of Architecture background and having zero knowledge about business continuity plan. Further selecting a MSME which is ideal for our project with proper support from the MSME is way challenging. Finding problems and their solutions which are not get discovered by the MSME in their history until the Covid breakout. Everything in theory looks great but we don’t know that our proposed solution is going to work or not. Learning: Get to know that how to work in isolated environment for the unisolated environment in online sessions. Getting new experience other than architecture. |
| Group 5 | When the project on MSME was introduced to us, I was very nervous on how to go about it as it is not related to what we had studied so far. I was not sure if it would help me in my understanding in architecture or related fields. As we proceeded, I came to know how an industry functions and what problems it faces and most importantly how certain problems could be solved using our understanding of architecture. Throughout this journey of the project I got a chance to explore many new terms and technologies, and a little understanding about finance and marketing . I also got to learn about many other industries and solutions proposed by other groups. This was truly a unique and memorable experience for me and my group mates.  

**Parnika Goyal:** "When the project was introduced in the studio, I did not know where we were heading and whether our team would be able to bring the desired outcomes. With the project's completion, I see back and realize that though this journey was rough and exhausting, I have learned many new concepts, seen new vistas, and got the taste of working and solving real life situations. The project was a unique experience; while we struggled to understand an unfamiliar domain in the tight timespan, we also learned ways of brainstorming and working in groups remotely."

**Medhavi Jain:** “Throughout the project, the learning curve has been exponential. Along with my team, Ashish, Mayan, Mukul and Parnika, I have been able to gain a comprehensive understanding of the Industry under diverse fields of Architecture, Management, Economics, Finances, Policy Making, Environment and Entrepreneurship. I am really grateful to my professors for providing me with an opportunity to work on this project.” |
## 4. Brief Notes on Participants

### A. Guest Mentors

<table>
<thead>
<tr>
<th>Dr Suneel Pandey</th>
<th><strong>Dr Suneel Pandey</strong> is Senior Fellow and Director, Environment &amp; Waste Management Division, TERI. In addition, he is Adjunct Faculty at the TERI School of Advanced Studies. He has more than 25 years of consultancy/ research experience in the areas of municipal, industrial and hospital waste management, plastic waste management, waste-to-energy issues, impact assessment, air, water and soil quality monitoring, site assessments, performance evaluation of ETP and institutional strengthening and capacity building. He has obtained his Ph. D. degree in hazardous waste characterization from Nagpur University while working as Project Fellow at NEERI, Nagpur. He has MSc, Analytical Chemistry, Banaras Hindu University, India and did his BSc, Chemistry from Banaras Hindu University, India.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professor (Dr) K Mohan</td>
<td><strong>Professor (Dr) K Mohan</strong> currently heads GITAM School of Architecture, Visakhapatnam Campus. He completed his PhD from IIT Roorkee in 2012. He has published about 15 academic publications in the field of architecture. His pioneering work on pedestrian wind environment for safety and functionality was conducted in Wind Laboratory of IIT Roorkee and University of Auckland, New Zealand.</td>
</tr>
</tbody>
</table>
**Dr. Ranit Chatterjee** is a PhD in Environmental Management from Kyoto University, Japan. Trained as an Architect, Ranit did his masters in Disaster Management from Tata Institute of Social Sciences, Mumbai. His work focuses mainly on disaster management while spanning across architecture and heritage, governance, private sector and ecosystem services. He has worked previously with the UN agencies, national and local Governments in Asia and India in particular, local communities, private businesses and NGOs. In addition, he has been involved with National Institute of Disaster Management in training of engineers and architects. Ranit is a recipient of IRDR young scientist fellowship and CEM member of IUCN. He has authored several academic publications and reports on the topic of Disaster Management. He is an amateur photographer with a few publications in National Geographic.

**Mr. Rubaab Sood** is Head, Disaster Risk Management & Social Entrepreneurship at FICCI. He has over 17 years of demonstrated experience of public policy and strategic planning in the area of Disaster Risk Reduction (DRR) and promoting & advocating innovations and technologies for safe, environment-friendly and climate-resilient industrial infrastructure. He has spearheaded series of multi-stakeholder national-level policy advocacy discussions including advising state and central governments on policy change for safety & climate resilience in industries especially Oil & Gas, Chemicals, Pharma, Airports, etc. Prior to FICCI, he has worked at National Disaster Management Authority (NDMA), Govt. of India for almost 3 years primarily conducting extensive research contributing to the formulation of national policy guidelines impacting industrial safety, medical preparedness, etc under the Disaster Management Act 2005.

**Dr. Subhajyoti Samaddar** is an Associate Professor in Disaster Prevention Research Institute (DPRI), Kyoto University, Japan. His research interests are household preparedness behavior, disaster risk communication, risk governance and implementation science. He has an interdisciplinary academic background including PhD in disaster management from Kyoto University, Japan and Master of Planning from School of Planning and Architecture (SPA), New Delhi. He has been involved in different international research projects funded by JICA and JST on disaster risk management and climate change adaptation. Dr. Samaddar has conducted in-depth field studies in different countries including India, Bangladesh, Japan, Ghana and recently in Egypt under different disaster risk contexts such as flood, earthquake, water salinity and climate change induced risks. He is the recipient of international award “Hazards 2000” in 2016.
Dr. Repaul Kanji currently serves as Research Scientist & Program Manager at Gujarat Institute of Disaster Management. He is also co-founder and director of Risk & Resilience Institute (RRI) and CRRP. He completed his PhD from the centre of excellence in disaster mitigation and management at IIT Roorkee. He has authored about 20 academic publication in the disaster risk assessment domain.

Dr. Rajib Shaw is Professor in the Graduate School of Media and Governance in Keio University in Japan. Earlier, he was the Executive Director of the Integrated Research on Disaster Risk (IRDR), a decade-long research program co-sponsored by the International Council for Science (ICSU). Previously, he served as a Professor in the Graduate School of Global Environmental Studies of Kyoto University. His expertise includes disaster governance, community-based disaster risk management, climate change adaptation, urban risk management, and disaster and environmental education. He is the Chair of the United Nations Science Technology Advisory Group (STAG) for disaster risk reduction. Professor Shaw has published more than 45 books and over 300 academic papers and book chapters.

Professor Shaw has received the Prabasi Bharatiya Samman 2021.

Dr Rabibrata Mukherjee obtained his PhD from IIT Kanpur in 2007 under the supervision of Prof Ashutosh Sharma. He is presently Professor of Chemical Engineering at IIT Kharagpur, where he joined in 2009 as an Assistant Professor and Chairman of DST Sponsored SATHI. Prior to this, he was a Scientist at CSIR – Central Glass & Ceramic Research Institute (CGCRI), Kolkata between 1997 and 2009. His research area includes thin film instability, dewetting, soft lithography, colloidal self-assembly, structural super hydrophobicity, Electro-hydrodynamic instability etc. He has published 35 research papers in international journals, which includes journals like Nano Letters, ACS Nano, Advanced Materials, Advanced functional Materials Macromolecules, Langmuir, Soft Matter, ACS Applied Materials & Interfaces, etc. He received the CSIR Young Scientist award in 2007 and the MRSI medal in 2014. He obtained the highest teaching feedback in IIT Kharagpur in the Spring Semester 2015 for his course “Instability and Patterning of thin Polymer Films”. He is awarded SERB-STAR Award for 2020-21.
## B. Mentors

<table>
<thead>
<tr>
<th><strong>Mahua Mukherjee</strong> is Professor in the Department of Architecture and Planning IIT Roorkee and Head, Centre of Excellence in Disaster Mitigation and Management (CoEDMM) IIT Roorkee. Her expertise includes Urban Risk Management, Building Construction, Environmental Planning &amp; Management, and Climate Change education. Professor Mukherjee has published more than 100 academic research papers, including national and international and book chapters. She is the member of GAADRI and UNDRR-APSTAAG Board. She is Secretary-General for SAADRI –South Asia Alliance for Disaster Research Institutes.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dhaarna</strong> is a Ph.D. Research Scholar at Department of Architecture and Planning, IIT Roorkee working on Water-Energy-Food Nexus. She enjoys drumming, traveling, dancing, reading, and cooking.</td>
</tr>
<tr>
<td><strong>Aditya Rahul</strong> is a Doctoral candidate at Department of Architecture and Planning, IIT Roorkee working in the field of Urban Climate.</td>
</tr>
<tr>
<td><strong>Atul Kumar</strong> is a Doctoral candidate at Department of Architecture and Planning, IIT Roorkee working in the field of Urban Climate specifically in the area of Air quality, Urban thermal environment and Urban flood.</td>
</tr>
</tbody>
</table>
## C. STUDENTS

### Group 1

<table>
<thead>
<tr>
<th>Name</th>
<th>Quote</th>
<th>Name</th>
<th>Quote</th>
<th>Name</th>
<th>Quote</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aleesha</td>
<td>I am a human centered designer interested in impacting the daily lives of individuals through my work</td>
<td>Divyanshu</td>
<td>I love creating and exploring new and creative ways of interacting with technology.</td>
<td>Nikhil</td>
<td>Being an architecture student, I am interested in improving ways poor sections of our society can be given equal access to opportunities.</td>
</tr>
<tr>
<td>Pranshu</td>
<td>I love expressing myself through dancing, singing, stand-up and everything that lies in between them.</td>
<td>Prem</td>
<td>I want to learn and explore how I as an architect can bring changes to improve the lives of the impoverished in our country.</td>
<td>Muzzaker</td>
<td>I want to live my life to the fullest.</td>
</tr>
</tbody>
</table>

### Group 2

<table>
<thead>
<tr>
<th>Name</th>
<th>Quote</th>
<th>Name</th>
<th>Quote</th>
<th>Name</th>
<th>Quote</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avinash Garg</td>
<td>Interested in building economics, design management, green buildings, technological interventions in building design. Hoping to be an entrepreneur one day. Hobbies include cooking and reading books.</td>
<td>Dhirendra K. Godara</td>
<td>Believe in experience-based methods of learning. Better with numbers and technical aspects then art. Quick learner. Interest in Sustainable approach of design. Hobbies include travelling and listening to music.</td>
<td>N.V. Shivani Snigdha</td>
<td>Interested in sustainability, building construction, project management and technical aspects of architecture.</td>
</tr>
<tr>
<td><strong>Yash H. Bharani</strong></td>
<td>Still exploring newer domains relating to design and development of digital as well as physical products. I have a liking for abstract aspects of Art and Architecture assisted with modern-tech tools.</td>
<td></td>
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<tr>
<td><strong>Kartikeya Rai</strong></td>
<td>Interested in sustainable and vernacular architecture while having a technological approach in architecture processes. Hobbies include playing sports and travelling.</td>
<td></td>
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</table>

**Group 3**

| **Anjali Bathla** | “I like to explore new fields and increase my knowledge. Outdoor Sports are my second love.” |
| **Ashutosh Jindal** | “I connect with people to grow my network. I aspire to be the most successful man.” |
| **Mansi Rajesh Dengre** | “I love music. I sing & play ukulele in my free time. I also like to read books.” |

| **Shubham Verma** | “I read books and involve myself in different activities to learn new things” |
| **Vaibhav Singh Chauhan.** | “I have good photography & animation skills. I am also a fitness freak.” |

**Group 4**

| **Mansi Rajesh Dengre** | “I connect with people to grow my network. I aspire to be the most successful man.” |

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<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
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<tbody>
<tr>
<td>Abhishek Soni</td>
<td>I got to learn a lot of new things during this course like how MSME works, what are the problems they are facing, we tried to present technological and practical solutions to deal with the associated problems.</td>
</tr>
<tr>
<td>Akash</td>
<td>His ideas mostly revolve around material exploration and design functionality with a touch of aesthetics. He has various hobbies that include landscape photography, sketching, playing chess, listening to Hip Hop music.</td>
</tr>
<tr>
<td>Ashwani Kumar</td>
<td>I get to learn out of architectural context and the way people handle things in disaster situations and more importantly how to work in sync with others.</td>
</tr>
<tr>
<td>Komal</td>
<td>She is interested in design thinking and strategy. She enjoys problem solving and is extremely curious. In her free time she enjoys reading, cooking and listening to music.</td>
</tr>
<tr>
<td>Ravindra Mogare</td>
<td>In the duration of exercise, I learned some insights of the market, how a MSME works and by analysing that now we understand a little about what should be the priority of the company.</td>
</tr>
<tr>
<td>Sampat Prajapati</td>
<td>I am interested in doing paper art as a hobby. In this exercise, I learned that MSMEs are an important sector for the Indian economy.</td>
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**Group 5**

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<thead>
<tr>
<th>Name</th>
<th>17110004</th>
<th>Name</th>
<th>17110024</th>
<th>Name</th>
<th>17110025</th>
<th>Name</th>
<th>17110027</th>
<th>Name</th>
<th>17110030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Archie Bhanawat</td>
<td></td>
<td>Rohan Khadkar</td>
<td></td>
<td>Rupali Yadav</td>
<td></td>
<td>Shubham Singarya</td>
<td></td>
<td>Tapan Parmar</td>
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**ARN 415: Live Studio (B. Arch 4th Year)**
<table>
<thead>
<tr>
<th>Name</th>
<th>Student ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ashish Bungla</td>
<td>17110005</td>
</tr>
<tr>
<td>Mayan Sachan</td>
<td>17110014</td>
</tr>
<tr>
<td>Medhavi Jain</td>
<td>17110015</td>
</tr>
<tr>
<td>Mukul Choudhary</td>
<td>17110016</td>
</tr>
<tr>
<td>Parnika Goyal</td>
<td>17110020</td>
</tr>
</tbody>
</table>
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(Referred by the Students Group)

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Industry Type
I. Kanpur : Chemical Industry
II. Ghaziabad : Lead acid battery recycling Industry
III. Indore : Bio polish and Dyeing Industry
IV. Kolkata : Refractories Industry
V. Hyderabad : Ceramic Glazing Industry
VI. Faridabad : Electroplating Industry