The NAS (Need Assessment Survey) was conducted at Bardoli for the blacksmith cluster in 2012. The exercise covered 16 micro-scale units making various agricultural implements. The NAS focussed on collecting information about the manufacturing practices, problems and issues that the units face.

The methodology included: Questionnaire based survey of manufacturing units, Interviews with unit owners & employees, Observation of process and workplace, Market visit to dealers and stockists.

The objective of the information collection was to identify specific design opportunities that would help in the revival of the cluster.

The NAS focussed on:
- Raw Material at different stages of manufacturing
- Infrastructure setup and work stations
- Skill and techniques, Finishes
- Product form, shape and usage
- Tools and technology, Capability of manufacturing units
- Present Market status
- Current Competition
- Packaging, logistic and storage

Expected Deliverables:
The expected outcome of the need assessment survey is to be able to generate precise and indepth data on the products, processes and practices in the cluster. It seeks to identify product related issues, process related problems and other critical parameters related to distribution, packaging and marketing of the finished products.
ACKNOWLEDGEMENTS

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Shri Ram Kumar Singh and Mrs. Rama Singh, who have dedicated their lives to the upliftment of this cluster

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2. Shashank Mehta, Chairperson, MSME Designclinics
3. NID MSME Designclinics team Ahmedabad
4. All employees of the Suruchi Sakshat Vasahat Trust
DESIGNCLINICS SCHEME

Design Clinic Scheme for Design Expertise to MSMEs, a unique and ambitious design intervention scheme for the country’s large micro, small and medium scale enterprises, is an initiative of Ministry of MSME, Government of India has been launched under National Manufacturing Competitiveness programme. The main objective of the Design Clinic Scheme is to bring MSME sector and design expertise into a common platform and to provide expert advice and solutions on real-time design problems, resulting in continuous improvement and value addition for existing products.

This model brings design exposure to the door step of industry clusters for design awareness, improvement, evaluation, analysis and design related intervention. Design clinic scheme will assist industrial clusters to open a channel for design information inflow for creative, innovative and futuristic approach towards the product, process, operations, manufacturing and business design. The scheme will help generate insight for opportunity identification and design intervention for competitive and breakthrough solutions for MSMEs.

The National Institute of Design, Ahmedabad, has been setup as the nodal agency for the scheme. With its rich experience in design training and consultancy, NID will act as matchmaker to the MSMEs and design professionals. It shall also administer effective implementation of the plan. The report summarises the findings of the NAS attempting to identify the design opportunities, which would help in the upgradation of the cluster. Design sensitization seminars (Phase 1), need assessment surveys & design awareness programme (Phase 2) and design projects (Phase 3) will help MSMEs in various stages to develop competitiveness.
1.1 Location

Bardoli is a city and a municipality in Surat Metropolitan Region in the state of Gujarat, India. Bardoli is the east-most end of the Metropolis of Surat. Bardoli is one of the primary Satellite Towns of Surat Metropolitan Region. It is said that Bardoli is the Paris of India. Bardoli is located at 21°17′7″N 73°12′5″E. It has an average elevation of 23 metres (75 ft). Bardoli is also the center for most of the Taluks or Countries in South Gujarat. Due to its central location for many Taluks it is a major economic centre of Surat Metropolis. The Satyagrah movement was started by Sardar Vallabhbhai Patel. All the details of the Satyagrah with photos are now conserved in the “Sardar Patel Museum”. This Place is middle of bardoli town on station road.

As of 2001 India census, Bardoli had a population of 51,963. Males constitute 51% of the population and females 49%. Bardoli has an average literacy rate of 74%, higher than the national average of 59.5%; with 54% of the males and 46% of females literate. 9% of the population is under 6 years of age.

Bardoli, long ago nothing but a very small village, is populated due to the establishment of “Bardoli Sugar Factory”. It is presently, the largest sugar factory in Asia. It also has largest number of used car dealers in Gujarat. This is because the Bardoli region is home to a large number of Non-Resident Indians, who visit Bardoli once a year in December, buy a car and later on sell it when they leave.

The region of south gujarat, specifically the surroundings of the Dangs district, area south of the river Ambika, whole of Dangs district, part of Vadodara district (excluding nonavi and gandevi talukas), part of surat district (valod, vyara, uchchhal, songadh and mahuva receive an average rainfall of 1500 mm and more. The region is predominantly agricultural, with the soil (deep black with fine patches of coastal alluvium, laterite and medium block soil) and cultivated mainly with cotton, jowar, paddy, vegetables, horticultural corps, sugarcane and millet.
1.3 History of blacksmithy

Rural blacksmiths are traditional artisans who still play a very important role in the rural economy. Traditionally, they have been producing agricultural equipment such as sickle, hoes, croodars, ploughs, spades etc along with other implements of domestic use. Villages still depend a lot on these traditional blacksmiths and despite technological improvements taking place in the industrial mode of factory type production of blacksmithy products, this is also true that most of these blacksmiths have not benefitted by technical and financial assistance through government or non governmental efforts and they still work with age old technologies. At the same time they are still surviving because they provide products and services which are essential for day to day living and they are present everywhere whether it is a town or a remote village. Therefore it is essential to preserve, promote and support blacksmiths, who can in future play a key role in rural industrialization.

In the early civilization days, people used tools of stone, wood, bone and horn. Later on, with the advent of agriculture, the use of copper and bronze started. The excavation of the Indus valley civilization indicates the use of copper and bronze during 2600-1600 BC. Iron was the next discovery and finds a reference in the Vajravali. Texts of such Satapadi Barmhanas also refer to the use of iron. All the references indicate that by 700 BC the use of iron had become common in agriculture. Iron axes, plough shares and other tools helped clear the dense jungles and make them habitable and cultivable.

The Vedas contain references to various metal objects such as bows and arrows, swords, spears, javelins, lances, hatchets and discs. There are numerous references to iron in protective armours of warriors.

The Mauryan period (320-180 BC) was the period when townships came into existence. A tremendous growth in mining and metallurgy along with artistic activities such as smelting and forging took place during the period. During the Kusanas and Satvahanas blacksmiths enjoyed tremendous status and prosperity. Iron was exported to the African coast through Gulf of Cambay. The iron pillar at Qutub Minar in Delhi was erected in 400 AD and the quality of iron working is evident from the fact that the pillar has no sign of rust yet. It is recorded that the Dutch began the export of iron products from Coromandel to Batavia, the volume of which was incredibly high.

During the Mughal period, blacksmiths were divided into two categories: those catering to the market who worked in the imperial karkhanas making mainly weapons, settled in cluster form in and around Nagars and those tied to the village communities and served their daily needs related to agriculture and allied requirements.

British technology which invented furnaces, led to a substitution of indigenous iron with imported iron in the early 19th century. Thus imports of English grade wrought out parts of the domestic iron industry. Armament for blacksmiths supplied huge production of swords, guns was also replaced by western guns. This began the decline of the blacksmiths.
Blacksmiths in Gujarat belong to mainly 2 communities - Panchals who are the traditional blacksmith caste and tribals who have adopted the trade. In the blacksmith cluster at Bardoli, both the communities have been reached out to and documented.

The focus is not caste based, rather, the development of the trade in the geographical spread. In a diagnostic study of 132 families, it is revealed that:

**Family size:**
- 1-3 members - 28.78%
- 4-6 members - 56.82%
- 7-10 members - 12.88%

**Employment size:**
- Number of families - 132
- Total number in 132 families - 617
- Working members - 268
- Engaged in blacksmithy - 190
- Engaged in other professions - 78 (agriculture -59, jobs - 19)

Blacksmiths who are more than 10 million in numbers today are facing an unfortunate situation, as even after six decades of independence, their conditions continue to decline. This proud and respected community is today fighting for a survival. Many have given up and moved away from their traditional occupation. They have been deprived of the benefits and facilities, which would have enabled them to move with time and adapt new skills, technologies to consolidate their position in society. They are not finding comfortable space in the new economic and industrial order. The powerful marketing machinery supports market for other goods at the cost of artisan goods. The ongoing research and development efforts are oriented towards developing capital intensive processes and technologies which adversely affect the rural blacksmithy sector.

Some of the key observations from the sector are:

1. All the surveyed units and individual blacksmiths use mostly manual methods of forging. Forging is a labor intensive processes.
2. All units use the age old primitive method of production.
3. The quality of output is most of the time crude and of inconsistent quality.

4. Except one unit, all other surveyed units had low volume production and made products for local consumption only.

5. Market exposure is minimal, but the manufacturers exhibit tremendous knowledge about the local requirements and conditions. Every unit’s products look the same and the blacksmith claims to recognize his work by sight.

6. Similar-looking products available in all surveyed markets as most units produce same or similar products, sells in the same markets/dealers.

7. No appropriate process of costing followed. The cost is mainly calculated as a single purchase cost of the implement and at the same time, they charge money to sharpen the tools. This keeps inflow of money, however petty.

8. No consistency in prices between vendor to vendor, no one sticks to prices, in a way no standard price for products.

9. There is a complete lack of product standardization, with each blacksmith using his skill levels to achieve the product finishes. The knowledge of size and shape is however traditional and the local populace resents and resists change in design.

10. The current products such as sickles, axes etc are available for batch production, low production capacity only. This is also largely season dependent, depending on the crop that is currently sowed.

11. Work environment, workstation and ergonomic seating are major areas of concern in all units surveyed. The main problems include inhalation of smoke from the coal fire, improper working postures, lack of ergonomic handtools, usage of heavy forging hammer all contribute to musculoskeletal stress. Almost all units reported lower back pain, upper arm fatigue and drop in productivity.

12. Unavailability of workers, skilled workers is a serious concern for the larger units. There also seems to be a cultural bias between the two communities. The Panchals believe the tribes to be waywards and unreliable. The tribals, who have adopted this occupation are not completely committed as they vary between agriculture, menial jobs and blacksmithy.

13. The younger generation is not attracted to the profession due to the vagaries in the business. They prefer to undertake employment in the nearby sugar factory.
Redesign of handles according to ergonomic principles
Use of cultural motifs which cannot be machine made
is a good way of branding

The region of south gujarat, specifically the surroundings of the dangs district, area south of river ambika, whole of dangs district, part of val-sad district (excluding navsari and gandavi talukas), part of surat district (valod, vyara, uchchal, songadh and mahuva receive an average rainfall of 1500 mm and more. The region is predominantly agricultural, with the soil (deep black with few patches of coastal alluvial, laterite and medium black soils) and is cultivated mainly with cotton, jowar, paddy, vegetables, horticultural corps, sugarcane and millet.

The blacksmith community is involved in manufacture of agricultural implements of all shapes and sizes, ranging from simple hand held implements to fittings and accessories for tractors and heavy agri machinery.

The main products of the cluster include:
1. Sickle (Datarna / Datarni) classified on basis of size, curvature and crest for slicing of stems
2. Axes (Classified on basis of size of head and handle)
3. Digging hoes
4. Sugarcane stem cutters
5. Furrow attachment for tractor
6. Bill hook for branch trimming
7. Plough
8. Hand hoe
9. Four pronged digging hoe
10. Hand hoe
11. Three pronged digging hoe
12. Two pronged digging hoe
13. Rake
14. Seeder

Products made by cluster
Fit and finishing of the product need improvement
Production Process / Tools

A blacksmith uses several different types of tools to forge metal into the desired shape. The most basic implements are:

1. The coal furnace is a simple mud and brick construction that is covered from 4 sides leaving the mouth open to put the metal blank in.

Main issue: Smoke generated from coal is inhaled by the blacksmith which leads to severe respiratory illnesses especially from constant inhalation of carbon monoxide. Coal is increasingly getting difficult to procure. There are 2 sources of coal for the blacksmith - coal from forest wood and coal from illegal alcohol brewing that happens in the forest areas. The forest coal is expensive and difficult to get as the forest department keeps a tight vigil on the illegal felling of forest wood. The coal from alcohol pits are considered best for higher calorific value and is cheaper to procure. However blacksmiths have to procure this illegally, often smuggling it through police lines on the district borders.

OPPORTUNITY
Design of smoke free furnaces / furnaces which can be hermetically controlled / furnaces with alternate energy sources other than coal

2. Clamps of different sizes are used to clamp and hold the hot metal.

Main issue: Most of these clamps are locally made, of rudimentary construction and quality. The tools are unergonomic and are copies of old designs that have not changed from several decades.

OPPORTUNITY
Design of ergonomic “chimta” or clamps is necessary. Currently used clamps are basic, rudimentary and unproductive.

Design of smoke free furnaces / furnaces which can be hermetically controlled / furnaces with alternate energy sources other than coal.
Design of better anvils which improves finish & productivity

Design of ergonomic hammers can improve productivity & improve output

As compared to the TATA brand hammers, this design from Maharashtra gives better results and life.

Specific files can be developed with ergonomic handles for productivity enhancement.

3. Anvil is a block of solid steel that is tempered at a very high temperature. This makes it extremely hard and this is used as a base for all hammering. It is called 'yeran' in the local lingua.

Main issue: Anvils are locally made, of rudimentary construction and quality. The build quality of the anvil results in better or bad finish of the final products made by the blacksmith. If the anvil breaks, it is a complicated process to redo the head of the anvil. The cost of an anvil ranges from 2500-3000 Rupees. This is expensive by local standards. Trainee and amateur blacksmiths often buy second-hand anvils to start with.

4. A variety of hammers are used to hammer the hot metal into shape, primarily based on head size, these are called nothoda / hathodi in local lingua. There are 2 kinds of hammers available: TATA make and a local design that is sourced from Maharashtra. The TATA brand hammer is a generic hammer which is used in different hammering jobs whereas the Maharashtra design is a dedicated forging hammer with broader and flatter head. This hammer is not available in local markets. A few select blacksmiths have access to this and this is not shared by the blacksmiths in Maharashtra.

5. A variety of hand files are used to finish the forged piece. These include rough files for descaling, and fine files for polishing.

OPPORTUNITY

Design of forging hammers & hand files with ergonomic handles which would reduce the physical stress leading to higher productivity.

6. A T shaped jig is used to balance the job while filing. The anatomical position of the artisan is very awkward, as he has to balance the jig with his thigh and a clamp with his feet. A suitable design to address this immediate need would be instrumental in improving productivity immediately.

OPPORTUNITY

Design of a jig that could hold the blade of the sickles and axes is a strong and immediate requirement.
MANUFACTURING PROCESS

A sickle undergoes a 20 step activity before it is finally sold to a end user.

Image 1: The furnace is lit with a handful of coal and once the coals glow, more and more is added to raise the temperature of the furnace.

Image 2: A rod or strip of mild steel is heated till it is read hot. In this malleable state the metal is ready to take whatever shape the blacksmith want to give it.

Image 3: Placing the hot strip on the anvil, the blacksmith beats the metal into shape.

Image 4: The process of heating - shaping is repeated endlessly until the desired shape has been achieved.

Main issues

1. The temperature of the furnace is not controllable. The blacksmith has to rely on experience to get the combination of material and temperature correct.
   This has a direct result on the finishing of the implement. Every cutting implement degrades over time and usage and has to be sharpened.

2. Crouched working position causes extreme back pain. Added to it, low seating and heavy hammers cause physical strain.

3. An unorganised workspace adds to repetitive motion strain, where the blacksmith has to twist several times to reach the instruments.
Image 5: The handle is used as a template to achieve dimensional coherence. The metal is reshaped until it is accurate.
Image 6, 7: While hot, the metal piece is inserted into the wooden handle and hammered into place.
Image 8, 9: The forged metal is then quenched in a trough of water. This sudden drop in temperature causes the metal to harden, which is a desirable property of a cutting tool such as a sickle or axe.

Main issues

1. Badly designed and locally made clamps are extensively used. These cause extreme distress in terms of wrist and hand pains, which all surveyed blacksmiths reported. The incidence of injuries were high for trainee blacksmiths. Injuries and constant pain result in decreased productivity.

2. Constant inhalation of smoke from the burning furnace causes severe respiratory illnesses in most blacksmiths. Due to lack of medical facilities in the area, the problem could lead to compromised immunity and finally - tuberculosis.

3. The workstation or place of usage has to be designed according to the zone of reaching, such that repetitive tasks are placed closer to the blacksmith. This causes reduction in fatigue and less wasteful motion.
Image 10, 11, 12: Using a hand file the surface abrasions are removed.

Image 11: The cutting edge of the tool is sharpened using a fine file.

Main issues

1. Lack of ergonomic hand tools is another area which causes loss in productivity and added fatigue.
Image 13, 14, 15, 16: The cutting edge of the blade is notched with tiny ridges. This increases the cutting power of the tool several fold and adds an aesthetic appearance to the tool.

Main issues

1. There is an immediate and pressing need to design some jigs and fixtures that can alleviate the wrong working postures of the blacksmiths. In the absence of any, the blacksmiths use a combination of both feet and their arms to file the metal. This is completely unergonomic and the strain can be reduced with a designed, low cost jig.
Image 18, 19: At the end of all iterations, finally the toll is heated again and oil is applied using a broad brush to the cutting edge. This act permanently arrests the deformation of the metal and strengthens the edge further.

Image 20: The final product.

Main issues

1. The handle of the implement has a great role to play in the success in adaption by local populace, who are used to age old designs that have not changed since generations. The handle and the blade has to be ‘balanced’ such that handling the tool is easy. The handle also has to be designed in a way that facilitates usage, safety and carrying it around.

2. Competition from factory made implements is a serious possibility in the coming years, specifically implements from China. Though the blacksmiths today are enjoying a revival, given the fact that most of their produce is consumed in local markets, the threat of machine made, uniform finish implements looms large. The blacksmiths could look at ornamentation of cultural motifs on the handles that would not only increase the perceived value of the product, but also elevated the design from a ubiquitous product to a cultural design.
3.0
Design audit
Mukeshbhai Panchal

Mukeshbhai Panchal is a resident of Jamaniya, Taluka Valo, Zilla Tapi, Gujarat. Mukeshbhai inherited the business from his father and he has been involved with the shop as long as he can remember.

The main product range includes agricultural implements such as sickles, hoes, axes etc. He however also supplements his business by fabrication of grills, body repairing of tractors, threshers. His main activities are blacksmithy and welding.

Mukeshbhai's annual turnover is 6 lac rupees. His shop is 50X45' and has cutting machine, welding machine, drill and bending machines in his shop. He employes 4 people besides himself.

Main issues:
The agricultural implements have not changed in hundreds of years. They continue to made the same way, with no innovation or change whatsoever.

Mukeshbhai buys steel from Gujarat Steel, a dealer. The maximum assertion of quality of steel is through visual inspection only.

The seating near the furnace is extremely low which causes severe discomfort. The pain through long hours of working is localized in the lower back and shoulders. This has caused a drop in output.

There is no branding or promotion of name whatsoever. Having a branding coupled with good quality can improve sales.

There is zero interaction with other clusters or training. Training is often on the job.

Product development: Given the large space available, Mukeshbhai could look at large agricultural implements such as grain separators.
Currently the fabrication products are displayed on the innermost wall of the shop. There is a huge open space in front of the shop which could be used for display.

Product design intervention could focus on design of ergonomic handles for agricultural implements. There is also scope for branding which could help the unit.

- Lack of safety equipment during welding leads to eye problems and blindness.
- Unergonomic postures for welding.
- Rigid, hard seating will lead to spinal problems.
- Visibility and placement issues.
- Relocation of welding machine repeatedly.

The workspace inside the shop is extremely cluttered. Reorganising the space would offer more productive workspace as well as opportunity for storage.

- Placement at lower heights which is unergonomic leads to fatigue and low productivity.
- Electrical hazard.
- Haphazard placements of items in the workspace leads to overall loss of productivity.
- Naked electrical wires are a safety hazard.

Proposed interventions:
- Design of the layout of the workshop as per space design principles to facilitate storage, production and material handling with ease. The area for blacksmithy and other activities could be redefined with spatial differentiation.
- Assistance with New Product Development of agricultural machinery with a focus on technical design, industrial design, product standardization, value engineering, branding.
- Design of display and promotional collaterals in front of shop.
Main design intervention would be to design and build a workstation according to ergonomic principles, which focuses on placement of spaces which causes least physical stress to the user.

Placement of quenching pot in wrong position, leading to twisting of back constantly

Clutter in workspace

Ungrouted anvil leads to vibration and shock in fore and upper arms, leading to fatigue

Ishwarbhai Panchal

Ishwarbhai Panchal is a resident of Kanolpada, taluka Vasada, Zilla Navsari, Gujarat.

The main product range includes agricultural implements such as sickles, hoes, spades, plowers, deweeder, axes etc. His main activities are blacksmithy and welding. Ishwarbhai’s annual turnover is 50,000 rupees. His small shop is rented and has a cutting machine, welding machine, drill and grinding machines in his shop. He and his son run the shop.

As the design, Ishwarbhai states that from area to area, the design of the agricultural implements change. This is due to the different crops that are reaped and the usage patterns. The shop is small and stuffy especially with the smoke from the coal furnace. Ishwarbhai complains of tremendous back and knee pain and admits that this has affected productivity.

In an effort to increase sales, Ishwarbhai has used the inner back wall of the shop to build a display stand to arrange and demonstrate products for sale. He admits that this has helped in sales. From a typical process, Ishwarbhai procures steel from Vasad steel which is 10 km away in the form of 11” strips. The wooden handles for the implements are sourced from local carpenters who cater to all the blacksmiths in the area.

Main Issues:

The shop is very dimly lit and claustrophobic. This causes discomfort. Lack of safety equipment whilst using welding was observed and documented. This could lead to loss of vision and other vision disorders in the near future.

His training and exposure is limited to his ongoing activities with Suruchi Sakshat Vasahat Trust. He wishes that the products be displayed in a shop.

Product finishes need major improvement.
Extreme low lighting inside the shop causes severe issues in visibility. Added to it is smoke from the furnace which makes the working conditions quite dreary.

Lack of safety equipment during welding leads to eye problems and blindness.

Open coal furnaces cause inhalation of carbon monoxide and CO2, leading to impaired respiratory function.

Proposed interventions

Design of the layout of the workshop as per space design principles to facilitate storage, production and material handling with ease. The area for blacksmithing and other activities could be redefined with spatial differentiation.

Design of welding rigs

Assistance with New Product Development of agricultural machinery with a focus of technical design, industrial design, product standardization, value engineering, branding.

Design of display and promotional collaterals in front of shop.
Ashwinbhai Panchal owns and runs Varsha welding works and resides in Khamla, Vasada, Zilla Navsari, Gujarat. The main product range includes agricultural implements such as sickles, hoes, spades, plow, deweeder, axes etc. His main activities are blacksmithy and welding. The annual turnover is 3 - 4 lac rupees.

His main activity is sourcing not manufacturing. He sources good products from nearby small artisans and sells them in his shop. Since manufacturing forms a very small piece of his profile, the workstation is relegated into one corner and in an ignored state.

The designs of the products are age old standards and are modified as per the requirements of the villagers.

The innovation in Ashwinbhai’s approach is to mix welding and forging wherein the rigs to grip the handle are separately made and welded to the cutting head.

The main mode of marketing is the weekly market that is set up in the area on Fridays. The display is done on a table with the instruments laid out.

Main Issues:

The shop is very dimply lit and claustrophobic. This causes discomfort.

There is no branding or logo, making the product indistinguishable from several others.

There is no display in front of the shop including name boards, which makes the shop hidden amongst several others who do the same business.

The seating for the furnace is cramped and in one corner which causes tremendous discomfort.

Ashwinbhai Panchal
Crumpled working space
Cluttered layout of the shop
Low lever placement of welding station leading to uncomfortable working positions.

Improved product finishes are needed.
Designed exhaust for the coal fumes is a positive design feature.

Ungrouted anvil leads to shock and vibrations in arms, leading to fatigue.

Clutter and unorganised workspace leading to loss of precious space.

Jayantibhai Panchal

Ashwinbhai Panchal owns and runs Mahakali welding works and resides in Khirtha Jahapa, Vasada, Zilla Navsari, Gujarat.

The main product range includes agricultural implements such as sickles, hoes, spades, plougher, de weeder, axes and is currently involved in building a custom designed grain separator etc. His main activities are blacksmithy and welding.

The annual turnover is 2 lac rupees.

Jayantibhai is a very innovative person with a sound understanding of mechanical engineering fundamentals. Though not formally educated, his ability to design and develop machinery for specific tasks is widely known and recognised in the area.

He was the innovator and builder of the mechanical forge, a machine that completely replaced the manual and laborious method of hammering into a mechanical powered system. He is also credited with the ingenious development of the grain separator with blower that allows for separation of grain from husk. His initial prototypes have been very successful and he has several enquiries. However, his problems are financial as the government or banks are unwilling to help.

Jayantibhai suffers from back and knee pain.

His understanding of human factors related issues also comes to the fore as he has innovated to raise the anvil and the kiln. He has also built chimneys that channel the smoke away into the atmosphere thereby offering much better condition of work.

Jayantibhai wants to quit blacksmithy and focus completely on new product development of agricultural machinery.

Main Issues:

The reorganisation of the shop would allow more space to be effectively utilized. The shop could be redesigned with ergonomic and space related principles.

The current seating at the kiln and anvil is crude. This needs to be redesigned.
Clutter and unorganized workspace leading to loss of precious space.

Clutter and unorganized workspace could be a fire hazard.

Proposed interventions

- Assistance with New Product Development of agricultural machinery with a focus on technical design, industrial design, product standardization, value engineering, branding
- Design of the layout of the workshop as per space design principles to facilitate storage, production, and material handling with ease. The area for blacksmithy and other activities could be redefined with spatial differentiation.
- Design of display and promotional collateral in front of shop.
Dipeshbhai Panchal

Dipeshbhai Panchal owns and runs Balaji and Works in headpost Unnai, Taluka Vansda, Zilla Navsari Gujarat. His product range includes all agricultural instruments like axes, sickles etc but his specialty is spades of all kinds. He employs 3 people to work for him and generates Rs.3 lac annually.

Dipeshbhai claims an innovation to his credit, which he says has differentiated him from all competitors. He has figured out a technique to use a metal pipe instead of the wooden handle. He is well known for this work in surrounding areas and he claims less breakage because of this design.

He has also innovated the sugarcane cutter, a chopper blade that chops the knots of a sugarcane stalk. This has been a success in the area as south gujarat is a major sugarcane growing area.

The workshop is extremely cluttered and claustrophobic. The workshop is also a makeshift garage and the level of illumination is very low.

His interactions with other clusters is limited to SSVT, Bardoli Sangh and Navsari based organisations.

Main Issues:
The reorganisation of the shop would allow more space to be effectively utilized. The shop could be redesigned with ergonomic and space related principles.
The current seating at the kiln and anvil is crude. This needs to be redesigned.
He gets no technical assistance and his efforts are often trial and error.
Low workstations

Hard seating leads to fatigue and back problems

Placement of quenching pot leads to twisting of back

Placement of coal leads to twisting of back

Open coal furnaces cause inhalation of carbon monoxide and CO₂, leading to impaired respiratory function

Handle size and shape is not as per good ergonomic principles

Product finish has to be improved substantially

Proposed interventions

- Assistance with New Product Development of agricultural machinery with a focus of technical design, industrial design, product standardization, value engineering, branding
- Design of the layout of the workshop as per space design principles to facilitate storage, production and material handling with ease. The area for blacksmithy and other activities could be redefined with spatial differentiation.
- Design of display and promotional collateral in front of shop.
Kishanbhai Gamit

Dipeshbhai Panchal owns and runs Balaji and Works in headpost Urna, Taluka Wachherbha. Kishanbhai Gamit is a native of Khet Aujar, Bartad road, Urna, Navsari, Gujarat. He runs his unit in the front porch of his house. He makes all kinds of sickles, hoes, rakes, and commonly used agricultural instruments.

He does not own a welding machine and his work profile is limited to blacksmithy. His annual turnover is Rs.50,000 and employs 7 people including himself and his son.

Kishanbhai has a lot of space as the porch is very spacious. Hence the placement of the furnace and seating does not look cramped. However, the seating is low and this causes ergonomic issues.

His display of wares is limited to spreading the manufactured products on the ground on a sheet. There is no branding as such neither in the form of logos or trademarks or product differentiation.

He has established contact with the Netran cluster in Bharuch which allows him to procure as well as sell.

He has an immense problem in the procurement of coal as coal is a dwindling resource. He has to illegally obtain coal from the nearby forest and this often invites the ire of the forest officials who try to prevent the felling of trees for firewood and coal.

Main issues:
- Availability of coal
- Product finishing needs to be improved.
- Redesign of the furnace and seating at a raised height to facilitate production as per ergonomic principles.

Kishanbhai Gamit runs his unit in the front porch of his house. He makes all kinds of sickles, hoes, rakes, and commonly used agricultural instruments. He does not own a welding machine and his work profile is limited to blacksmithy. His annual turnover is Rs.50,000 and employs 7 people including himself and his son.

Kishanbhai has a lot of space as the porch is very spacious. Hence the placement of the furnace and seating does not look cramped. However, the seating is low and this causes ergonomic issues.

His display of wares is limited to spreading the manufactured products on the ground on a sheet. There is no branding as such neither in the form of logos or trademarks or product differentiation.

He has established contact with the Netran cluster in Bharuch which allows him to procure as well as sell.

He has an immense problem in the procurement of coal as coal is a dwindling resource. He has to illegally obtain coal from the nearby forest and this often invites the ire of the forest officials who try to prevent the felling of trees for firewood and coal.

Main issues:
- Availability of coal
- Product finishing needs to be improved.
- Redesign of the furnace and seating at a raised height to facilitate production as per ergonomic principles.
Open coal furnaces cause inhalation of carbon monoxide and CO2, leading to impaired respiratory function.

**Proposed design interventions**

- Redesigned workstations with raised seating and anvil
- Product development of simple instruments
- Display stands for display on the porch
- Name board / Branding
Haphazard placement of welding machine
Dilapidated shed which causes rain to seep in during monsoons
Old disused machined piled up, occupying space
Dilapidated shed which causes rains to seep in during monsoons
Dilapidated shed which causes rains to seep in during monsoons

Manoj Kumar Ramabhai Panchal is the owner of Shivkrupa Works, located at Mukampost Sealdah, Zilla Tapi, Taluk Valod, Gujarat. He has been independently managing this small unit single-handedly for 10 years. He has trained for 30 years with his uncle. His main work lies in blacksmithy (repair of instruments), grill fabrication, and other small fabrication jobs.

His main line of manufacturing includes axes, sickles, plougher and other small agricultural instruments.

The infrastructure setup consists of a mini hammer, grinder, welding machine, drill, hand tools. The total production capacity is 2000 pieces per annum. The annual turnover is 60,000 rupees. Manojbhai’s main markets are in Bardoli and Mandu.

The market exists for repair and refurnishment, and not new products, according to him. Since most of the scrap is reused to repair existing instruments, wastage is minimal.

Mainissues:
Availability of coal
Product finishing need to be improved
Redesign of the furnace and seating at a raised height to facilitate production as per ergonomic principles.

Manojbhai Panchal
Complete clutter in the workspace which does not provide efficient use of space or storage.

Proposed design interventions:
- Redesigned workstations with raised seating and anvil
- Redesign of workspace layout
- Product development of simple instruments
- Display stands for display on the road outside the shop
- Name board / Branding
Kalpeshbhai Manharbhai Panchal owns and operates Ambika Welding Works in Lohar Fadia, mukam post sealdah, district Tapi, Gujarat. His main line of manufacturing includes axes, sickles, small agricultural instruments, grills, doors, shed fabrication, electric clamps (Kamala Clamps) and also fabricates the mini forge occasionally.

The infrastructure setup consists of a mini hammer, grinder, welding machine, drill, hand tools. The unit employs 3 people including himself. The advantage that Kalpeshbhai has is the huge space available to him. However most of this space is not used and the brick structures (in pic) are in a bad, dilapidated stage.

The annual turnover is 80,000 rupees. Kalpeshbhai’s products are for local consumption and sells them from his house.

Branding is absent, but uses KP on the clamps that he manufactures.

Main Issues:

- Availability of coal is a serious issue as the coal has to be sourced from the illegal liquor dens in the nearby forests. The cost of coal has gone up to Rs.170 per sack.
- Product finishing needs to be improved.
- Redesign of the furnace and seating at a raised height to facilitate production as per ergonomic principles.
Proposed design interventions

- Redesigned workstations with raised seating and anvil
- Product development of simple instruments
- Name board / Branding
- Product design help for the design of mini-forges for various applications
Raised seating for helper is good, helps in reducing fatigue.

Fabricated display stand is good.

Dilipbhai Panchal

Kalpeshbhai Manharbhai Panchal owns and operates Ambika Welding Works in Lohar Fadia, Mukam post Sealdah, district Tapi, Gujarat. His main line of manufacturing includes axes, sickles, small agricultural instruments, grills, doors, shed fabrication, electric clamps (Kamala Clamps) and also fabricates the mini forge occasionally.

The infrastructure setup consists of a mini hammer, grinder, welding machine, drill, hand tools. The unit employs 3 people including himself. The advantage that Kalpeshbhai has is the huge space available to him. However most of this space is not used and the brick structures (in pic) are in a bad, dilapidated stage.

The annual turnover is 80,000 rupees. Kalpeshbhai’s products are for local consumption and sells them from his house.

Branding is absent, but uses KP on the clamps that he manufactures.

Main Issues:

- Availability of coal is a serious issue as the coal has to be sourced from the illegal liquor dens in the nearby forests. The cost of coal has gone up to Rs. 170 per sack.
- Product finishing need to be improved.
- Redesign of the furnace and seating at a raised height to facilitate production as per ergonomic principles.
Good display stands

Safety principles followed

Low workstations and crouched positions reduce productivity by fatigue

Open coal furnaces cause inhalation of carbon monoxide and CO2, leading to impaired respiratory function.
Ackward working postures cause long term occupational injuries resulting in severe back pain.

Open coal furnaces cause inhalation of carbon monoxide and CO2, leading to impaired respiratory function.

Vasantbhai Kokani

Chunubhai Gulbhai Dabke is a resident of Mukam post Jarada, Taluka Ahwa, Zilla Dang, Gujarat.

He is a tribal who belonged to a family which practised agriculture for a living. His father is a farmer. Sonirao became a blacksmith as a means of steady income in lean periods of agriculture. He started with no formal training and has been a practising blacksmith for 7 years. Chunubhai was helped by the Suruchi trust, Vagai trust and was greatly assisted by the government subsidy which allowed him to procure basic tools of the trade.

Chunubhai retails his wares in the saturday market & his annual turnover is around 50,000 a year.

He normally makes sickels, axes and other small cutting instruments, and also repairs existing instruments. He does not have a welding kit and all implements and tools are completely manual which includes a variety of forging hammers, anvil, blower and the furnace. An interesting aspect is the use of a different kind of forging hammer as compared to the conventional ones used in the cluster. This design apparently gives a better finish and is locally made by blacksmiths in the neighbouring state of Maharashtra.

He has practised New product development through Suruchi trust’s interventions and efforts to popularise new designs, as well as improve the quality of existing implements.

Main Issues:

Product finishing need to be improved.

Redesign of the furnace and seating at a raised height to facilitate production as per ergonomic principles.

Development of a display stand to exhibit wares.

Jigs and fixtures that assist in filing and finishing of the instruments.
No packaging or arrangement to carry many tools at once

Ackward working postures cause long term occupational injuries

Product improvements are needed spaciically with finishes, new designs and handles

Proposed design interventions

- Redesigned workstations with raised seating and anvil
- Redesign of workspace layout
- Product development of simple instruments
- Display stands for display on the road outside the shop
- Name board / Branding
Ackward placement of hand operated blower is likely to cause occupational stress and pain. The blower should be placed closer.

The wall space at the back could be used as a display/storage space. It is currently unused.

Low seating must be replaced with ergonomic seating. The current setting is a downer.

Sonirao Gonia

Sonirao Jyabhai Gonia is a resident of Mukam post Jarada, Taluka Ahwa, Zilla Dang, Gujarat. He is a tribal who belonged to a family which practised agriculture for a living. His father is a farmer. Sonirao became a blacksmith as a means of steady income in lean periods of agriculture. He trained for 4-5 months and has been a practising blacksmith for 7 years. Sonirao works in the fields during the sowing and cutting seasons and works as a blacksmith during the off-season.

The shop is run by his wife and himself. Sonirao does not reach out to customers by selling his wares outside, rather most customers are the walk in types. His annual turnover is around 50,000 a year. He normally makes sickels, axes and other small cutting instruments, and also repairs existing instruments. He does not have a welding kit and all implements and tools are completely manual which includes a variety of forging hammers, anvil, blower and the furnace.

An interesting aspect is the use of a different kind of forging hammer as compared to the conventional ones used in the cluster. This design apparently gives a better finish and is locally made by blacksmiths in the neighbouring state of Maharashtra. Sonirao purchased the set of hammers from a cluster on the border. Two different sizes (as seen in image on the left) are available for Rs.600 and larger for Rs.900.

He has practised New product development through Suruchi trust’s interventions and efforts to popularise new designs, as he improve the quality of existing implements.

Main Issues:

Product finishing need to be improved.

Redesign of the furnace and seating at a raised height to facilitate production as per ergonomic principles.

Development of a display stand to exhibit wares.
Weilding a heavy hammer in this position is likely to cause severe lumbar stress.

Open coal furnaces cause inhalation of carbon monoxide and CO2, leading to impaired respiratory function.

Proposed design interventions:
- Redesigned workstations with raised seating and anvil
- Redesign of workspace layout
- Product development of simple instruments
- Display stands for display on the road outside the shop
- Name board / Branding
Chinubhai Dabke

Chinubhai Gulibhai Dabke is a resident of Mukam post Jarada, Taluka Ahwa, Zilla Dang, Gujarat. He is a tribal who belonged to a family which practised agriculture for a living. His father is a farmer. Sonirao became a blacksmith as a means of steady income in lean periods of agriculture. He started with no formal training and has been a practising blacksmith for 7 years. Chinubhai was helped by the Suruchi trust, Vagai trust and was greatly assisted by the government subsidy which allowed him to procure basic tools of the trade.

Chinubhai retails his wares in the Saturday market & his annual turnover is around 50,000 a year.

He normally makes sickles, axes and other small cutting instruments, and also repairs existing instruments. He does not have a welding kit and all implements and tools are completely manual which includes a variety of forging hammers, anvil, blower and the furnace. An interesting aspect is the use of a different kind of forging hammer as compared to the conventional ones used in the cluster. This design apparently gives a smoother finish and is locally made by blacksmiths in the neighbouring state of Maharatshtra.

He has practised new product development through Suruchi trust’s interventions and efforts to popularise new designs, as to improve the quality of existing implements.

Main Issues:

Product finishing need to be improved.
Redesign of the furnace and seating at a raised height to facilitate production as per ergonomic principles.
Development of a display stand to exhibit wares.
Jigs and fixtures that assist in filing and finishing of the instruments.
Anvil and tools need to be of better quality for better finishes in products.

Proposed design interventions:

- Redesigned workstations with raised seating and anvil
- Redesign of workspace layout
- Product development of simple instruments
- Display stands for display on the road outside the shop
- Name board / Branding

No display / other visible marketing points, so most promotion is through work of mouth only.
Low seating and specifically sitting on unergonomic seating for long periods leads to severe back pain in later years.

Khalapbhai Ramubhai Kokani is a resident of Danadhar village, Nichlu fadiya, Taluka Vyari, Zilla tapi. He is a tribal who belonged to a family which practised agriculture for a living. Khalapbhai became a blacksmith as a means of steady income in lean periods of agriculture. He has been a practising blacksmith for 15 years. Sonirao workes in the fields during the sowing and cutting seasons and works as a blacksmith during the offseason. His family owns 2 bigha of land with plenty of water and he cultivates groundnut cash crop.

Khalapbhai does not reach out to customers by selling his wares outside, rather most customers are the walk in types. His annual turnover is around 25,000 a year.

He normally makes sickels, axes and other small cutting instruments, and he also repairs existing instruments. He does not have a welding kit and all implements and tools are completely manual which includes a variety of fogging hammers, anvil, blower and the furnace. He also makes the chula, ploughs and other tongs in addition to the other irregular implements.

He has practised New product development through Suruchi trust’s interventions and efforts to popularise new designs, as to improve the quality of existing implements.

He suffers from intense shoulder and back pain, which often impedes his work.

Main Issues:

- Product finishing need to be improved.
- Redesign of the furnace and seating at a raised height to facilitate production as per ergonomic principles.
- Development of a display stand to exhibit wares.
Design of better tools is needed to improve productivity and relieve occupational fatigue.

Improvement in product construction and finishes is needed.

Proposed design interventions:
- Redesigned workstations with raised seating and anvil
- Redesign of workspace layout
- Product development of simple instruments
- Display stands for display on the road outside the shop
- Name board / Branding
Amitbhai Manharbhai Panchal owns and runs Shivshakti Iron works and resides in Buhari, behind Gujarat School, Urna Road, Valod, District Tapi, Gujarat. The main product range includes agricultural implements such as sickles, hoes, spades, plougher, de weeder, axes and is currently involved in building several custom designed implements such as seeders, deweeders etc. His main activities are blacksmithy & fabrication.

The annual turnover is 6 lac rupees. Amit Panchal is a respected blacksmith whose products are in high demand. His shop is the best laid out, as compared to all units surveyed. The tools are neatly classified, the finished goods are beautifully displayed. He maintains a safety stock level of 1000 sickles and 3000 small slicers at all points of time. He regularly sells out because of the demand for his quality.

Of all the blacksmiths surveyed, Amitbhai Panchal appears the most innovative and versatile. He has innovated several implements to increase the efficiency or reduce manual labour. He has designed an edge cutting machine, which cuts serrations on the edge of sickles, reducing the time from around 15 minutes of manual cutting to less than a minute.

He exhibits a keen sense to understand and appreciate design as an enabler. He is eager to participate in design training / programes that could help in upgrade.

Main Issues:
Low workstation for forging is leading to fatigue, back troubles and other physical problems.

Lack of technical design inputs for bigger agricultural machinery.
Low seating and specific work postures, such as sitting on uncomfortable seating for long periods, can lead to severe back pain in later years.

Proposed design interventions:

- Redesigned workstations with raised seating and anvil
- Product design help for design of larger agricultural machinery and implements
- Technical assistance in manufacturing principles and marketing
- Advertising and promotion of products made through government assisted schemes
- Design of a brochure/leaflet
- Higher level of inter-cluster communication for better design and promotion
- Design of a logo, which would help in brand positioning and promotion
Nileshbhai Panchal

Nileshbhai Panchal is a resident of Sarbhon, taluka Bardoli, Surat district and owns Shiv Shakti Engineering Works. The main product range includes agricultural implements such as sickles, hoes, spades, planter, dewater, axes etc. His main activities are blacksmithy and welding. Nileshbhai's annual turnover is 200,000 rupees. His small shop is self-owned and has cutting machine, welding machine, drill and grinding machines in his shop. He employs 3 people.

Nileshbhai's main problems range from availability of coal to unavailability of labour. He employs tribals who he claims, are notoriously unreliable.

Nileshbhai's main line of work in welding and fabrication, rather than blacksmithy. Bad ergonomic postures were observed. Nileshbhai confirms severe back and shoulder pain as well as nasal allergy.

There is no branding of any kind.

He sells his wares to the Kamrej wholesale market which further retails the products. He confesses to very low demand for his products in blacksmithy.

Main Issues:

Like most blacksmiths in the area, Nileshbhai’s layout around the kiln is cramped, haphazard and unergonomic. He confesses to extreme back and knee pain during work.

Lack of safety equipment whilst using welding was observed and documented. This could lead to loss of vision and other vision disorders in the near future.

Product finishes need major improvement.

Nileshbhai's main problems range from availability of coal to unavailability of labour. He employs tribals who he claims, are notoriously unreliable.

Nileshbhai’s annual turnover is 200,000 rupees. His small shop is self-owned and has cutting machine, welding machine, drill and grinding machines in his shop. He employs 3 people.

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There is no branding of any kind.

He sells his wares to the Kamrej wholesale market which further retails the products. He confesses to very low demand for his products in blacksmithy.
Low seating and specifically sitting on unergonomic seating for long periods leads to severe back pain in later years.

Lack of safety gear of right specifications.

Open coal furnaces cause inhalation of toxic smoke of carbon and CO2, impairing respiratory function.

Proposed design interventions:
- Redesigned workstations with raised seating and anvil.
- Product development of simple instruments.
- Jigs and fixtures for ease of working and productivity enhancement.
- Display stands for display on the road outside the shop.
3.0
OCCUPATIONAL ERGONOMICS
Human factors and Ergonomics (HF&E) is a multidisciplinary field of the study of designing equipment and devices that fit the human body and human cognitive abilities. The International Ergonomics Association defines ergonomics or human factors as “Ergonomics (or human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance.”

Ergonomics has influences from disciplines in its study of humans and their environments, including anthropometry, biomechanics, mechanical engineering, industrial engineering, industrial design, information design, kinesiology, physiology and psychology. To assess the fit between a person and the used technology, human factors specialists or ergonomists consider the job (activity) being done and the demands on the user, the equipment used (its size, shape, and how appropriate it is for the task), and the information used (how it is presented, accessed, and changed).

Human factors is a critical discipline that focuses on safety and productivity of the human being through the design of objects, surroundings and others. Proper ergonomic design is necessary to prevent repetitive strain injuries and other musculoskeletal disorders, which can develop over time and can lead to long-term disability. Human factors and ergonomics is concerned with the ‘fit’ between the user, equipment and their environments. It takes account of the user’s capabilities and limitations in seeking to ensure that tasks, functions, information and the environment suit each user.

OBSERVED ERGONOMIC ISSUES

POSTURE OF WORKING

There are 2 recommended positions for blacksmith. One is the standing position and the other is the sitting position. The height of the placement of the anvil is calculated at the knuckle height of the blacksmith when standing erect. When sitting the anvil height should correspond with the height of the knees.
VENTILATION
The forge should be outfitted with a chimney to properly vent smoke, fumes and ash. Improper ventilation of carbon monoxide, smoke, ash and heat may cause serious health problems. Some blacksmiths prefer short handles on their hammers. However to achieve a heavier blow, either a heavier hammer head or heavier blows must be used with this shorter handle. A longer handle when held at the end will provide more velocity, thus more impact. The handle length should equal the distance from the bottom of the hammer head to the inside of blacksmith’s elbow. The handle should be customized to fit the user’s hand by rasping. Some blacksmiths trim down the first 3–4 cm beneath the hammer head to provide some flex to the handle, which absorbs some shock from the impact.

HEIGHT OF THE FORGE
The height of the forge should be what is comfortable for the user. Stooping should be avoided. Modifying the legs of the forge will create the perfect forge height.

There should be enough space on the forge hearth to conveniently hold a few tools for the task at hand. The workspace should not be cluttered. Another surface to hold additional tools should be near the anvil.
soot can cause chronic health problems, even death. Exhaust must be
removed from the room completely. The position of the anvil to the forge
is generally at a 90 to 180 degree angle from the forge, and about 1 to 2
steps away from the forge.

**HEIGHT OF THE FORGE**
The vise can be at 90 to 180 degrees from the forge, and also 1 to 2
steps away from the forge. The slack tub should be in close proximity to the
station, and convenient to quenching hot bars of iron. It should be large
enough to quench a bar for safe handling. It should be of non-flammable

**PLACEMENT OF ANVIL**
The anvil should be placed on a solid and secure base. Some anvil bases
are buried as much as three feet into the ground. If the anvil base is not
buried or anchored to the floor, make sure the anvil does not rock, slide or
pitch.
4.0
KEY OBSERVATIONS
The region of South Gujarat displays an interesting dichotomy — whereas Surat the main city in this region is one of the richest on account of it be- ing a diamond cutting hub, the nearby areas are completely dependent on agriculture and local crafts. The region of Dangs, bordering Navsari is a tribal belt which has a very different socio economic and socio cultural equation. The region’s blacksmiths belong to 2 communities: Panchals who are traditional blacksmiths and tribals — who have adopted this as a profession. Through the survey it was noticed that panchals are at nature entrepreneurs whereas the tribals who are the trainees. Most panchals consider the tribals to be unreliable and show a deep distrust towards their practices; the youth of the area possess a very low level of education and technical skills are absent. Iliteracy and lack of information on avail- able government schemes, coupled with the lure of diamond cutting and polishing in nearby Surat as well as minimal income from blacksmithry, a lot of youth have migrated, leading to a total glut of manpower. The revival of this cluster is important to maintain and nurture the delicate balance between agriculture and blacksmithy which caters to this need.

Upon a detailed study of the cluster it has been noted that almost all the units documented use manual processes to shape the metal into imple- 
ments. The working area of most units are a matter of concern. The workstation is small and the final product is often difficult to work. There is no consistency and the final product is sometimes ends up selling their products at minimum margin or at the cost rate. Lack of awareness about education, technology, work environ- 
mant and health consciousness are major issues. Low / no motivation for further development has been witnessed in many surveyed blacksmiths, who are unable to keep with the changing times.

1. The raw materials namely mild steel or carbon steel is procured from local traders. There is no consistency of material, the main way to test the malleability by bending a strip — if the strip bends easily it means that steel is of moderate quality. Hard steel means that it is brittle and it would be very difficult to work. There is no consistency and the final prod- uct of the blacksmith if often dependent on the raw material.

2. The design of the implements is hundreds of year old, and has hardly changed. It has also been reported that the local consumers often reject new designs or innovations, and hence the blacksmiths prefer to make the same designs as before. Also, there seems to be a complete lack of awareness of new designs and techniques developed in other parts of the country, as inter cluster comminication and networking is completely ab- sent. Exposure to creativity, design thinking to improve and develop new products to cater to current market demands is an immediate require- ment. Vocational training to make accessories, jewellery and/ or small utility products to create and provide employment during monsoons or lean seasons, with adequate marketing capabilities is also

3. The design of the implements is hundreds of year old, and has hardly changed. It has also been reported that the local consumers often reject new designs or innovations, and hence the blacksmiths prefer to make the same designs as before. Also, there seems to be a complete lack of awareness of new designs and techniques developed in other parts of the country, as inter cluster comminication and networking is completely ab- sent. Exposure to creativity, design thinking to improve and develop new products to cater to current market demands is an immediate require- ment. Vocational training to make accessories, jewellery and/ or small utility products to create and provide employment during monsoons or lean seasons, with adequate marketing capabilities is also

4. The working area of most units are a matter of concern. The workstation layout needs to be approached from a scientific and human factors per- spective, taking into account the sitting and working posture; such that minimal effort is exerted by the blacksmith. The working conditions also need improvement through various factors such as adequate illumination and ventilation. Burning coal emits carbon dioxide and carbon monoxide in large quantities. Carbon Monoxide is toxic and over a period of time, reduces the capacity of the lungs for oxygen absorption. This often leads to respiratory illnesses such as tuberculosis. Back pain and fatigue have been confirmed by almost all respondents. By the design of workstations that take into account better working postures, this fatigue can be allevi- ated and thus the productivity of the artisan increases.

5. There is a distinct vulnerability that similar looking, cheaper, mass pro- duced products might enter the market through dumping, thereby wiping out the large scale seasoned artisans. These blacksmiths try to keep the looks the same, they are similarly priced. This leads to a ‘commonisation’ of all products, and creates no product differentiation.

6. The entire cluster is a unorganised one, where production, labour manage- 
tment and time management are serious issues of reckoning.

7. There is absolutely no standardisation of designs, as the individual black- smiths follow what they have learnt earlier. These small lots are produced in batches and the production volumes are low. Suruchi Sakshat Vasahat Trans has been working and has attempted to standardize through mate- rial allocation, dimensional coherence and skill upgradation through train- ing. They supply good quality raw material and buy back the produced goods.

8. There is no consistency in the transaction of the raw materials, as suppliers are not aware of the product requirements of an individual blacksmith. Low / no motivation for improvement of the product.

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10. Understanding of business, costing, management is nil. The blacksmith sometimes ends up selling their products at minimum margin or at the cost rate. Lack of awareness about education, technology, work environ- 
ment and health consciousness are major issues. Low / no motivation for further development has been witnessed in many surveyed blacksmiths, who are unable to keep with the changing times.

Key Observations

- All the units produce the same implements and thus internall compete
- There is exposure to other markets in nearby cities as the most of the production is consumed in the same geographical area.
- Most units look to differentiation through addition of additional capabili-
ties such as welding, which gives them access to fabrication jobs of the i-
surrounding areas. These blacksmiths provide services for grills, gates and shutters in the developing real estate markets around.
- There is a distinct vulnerability that similar looking, cheaper, mass pro-
duced products might enter the market through dumping, thereby wiping out the large scale seasoned artisans. These blacksmiths try to keep the looks the same, they are similarly priced. This leads to a ‘commonisation’ of all products, and creates no product differentiation.
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duced products might enter the market through dumping, thereby wiping out the large scale seasoned artisans. These blacksmiths try to keep the looks the same, they are similarly priced. This leads to a ‘commonisation’ of all products, and creates no product differentiation.
reduce physical strain has to be inculcated.

16 There is a visible monotony in the entire product range of the cluster. Market penetration difficult without product variety and range. There is a need for diverse range of products as per contemporary market demands, specifically in other parts of the country or state even. The product range specific to the end user needs, usage and purpose should be developed.

17 Visual identity, branding, marketing support required in almost all cases as the products are virtually indistinguishable from each artisan to other. Development of a common (cluster) brand instead of multiple brands is also an immediate requirement. This cluster branding gives rise to visibility.

18 Better displays and retail outlets required to showcase products. More efforts to popularise the products such as organised weekly markets, a nodal sales center or sales in nearby towns and sectors should also be done.
DESIGN WORKSHOP REPORT
SESSION 1
INAUGURATION & INTRO TO BLACKSMITHY
31.01.2013 / Session 1 / 11-13:00 hours

The workshop commenced with a small inauguration and presentation of mementos to the designer by Shri Ram Kumar Singh and Smt Rama Ban. Invoking the spirit of Gandhian philosophy, Mr. Singh spoke at length on the formation of the cluster, history and the problems encountered till date.

He stressed upon the fact that the humble blacksmith was a very vital link in the agrarian cycle and without his services, no farming community could exist.

He also exorted upon the participants to come forth with their problems, resolve their differences and present a united front for solution of the problems.
The second session of day 1 was dedicated to explaining in detail the provisions and implications of the Design Clinics scheme. The benefits, motives, and objectives were explained in detail. Several participants wanted detailed information and the session was full of questions and answers.

Session 3 of day 1 was dedicated to the comprehensive presentation of the Need assessment done, methods used, and implications of the analysis.

Session 1 of day 2 was focused on discussions of specific and generic problems in the region for blacksmithy. The participants actively participated with several questions. The main questions that were discussed were:

- Introduction of mechanisation in the process: can we mould sickles? If so, what's the smelting and other issues?
- What is the melting point of steel in agri instruments?
- Is this MS or carbon steel?
- Forging/moulding/furnace temp control
- Mechanise the forging hammer
- Mechanise the grinding and serrations

Issues addressed in this session were the redesign of the workstation and tools. Using the existing furnace as a practical example, practical changes were made on the spot to demonstrate the principles of workplace ergonomics. Issues such as smoke inhalation, primary and secondary reach, seating and curvature of spine, handtools dampening were suggested and practically demonstrated.
Rupal Shah, a motivational trainer from the Junior Chamber International, Bardoli presented a seminar on improving business through positive thinking and application of generic management principles.

Smt. Ramaben demonstrated the newly developed charcoal making method which has been indigenously developed at SSVT to the participants. Using locally available twigs and dried leaves, charcoal pellets can be made through controlled burning, powdering, mixing with resin and extruding as pellets. The whole cycle was demonstrated to convince the participants to adopt the new method, which promises to address a huge issue of charcoal availability in the region.
SESSION 8
PRODUCT DESIGN & PROCESS IMPROVEMENTS
02.02.2013 / Day 3 / 12.00 - 14:00 hours

Session 8 was a detailed case study presentation into new product development which is non-technology based, rather purely human need based. Using examples and case studies, design thinking or problem solving with self-help methods were demonstrated through group discussion, live drawing and other methods which enforced that product design is the creation of objects of utilitarian value to people. Products function as part of larger systems, and the product designer’s role is constantly growing as she/her understands the larger implications of products, and the relationships with users.

SESSION 9
VISIT TO MN AGRO
02.02.2013 / Day 3 / 15.00 - 18:00 hours

MN AGRO is a promising rural entrepreneur who specialises in the manufacture of weeder, mini tractors and other agricultural equipment. A factory visit was organised as a fact finding mission to understand if there were any immediate project opportunities.

SESSION 10
INDIVIDUAL UNIT DISCUSSIONS
03.02.2013 / Day 4 / 10.00 - 17:00 hours

The final day was dedicated to the discussions and immediate design solutions to the blacksmith community present. The main solutions were provided in the improvement through workplace ergonomics and quality of output.

Individual sessions were held with Jayantibhai Panchal, Dipeshbhai Panchal, Kishenbhai Gamit, Diplipbhai Panchal, Vasantbhai Kokani, Sonirao Gonia, Chinubhai Dabke & Ishwarbhai Panchal amongst several others.

Questions ranging from production, design, marketing and other issues were addressed.
PROJECT OPPORTUNITIES

Projects:
1. Low cost manual charcoal maker
2. Ergonomic furnace for blacksmiths
3. Ergonomic working hand tools set for blacksmiths
4. New product possibilities for agriculture through blacksmithy