REPORT

Form generation tools for bamboo jewellery using bamboo strips

Design Project 2 | IDP 602

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CONTENT

Chapter 1

Introduction

This project aims to build a new relation for bamboo in a industrial context, using bamboo strips as an industrial material, which has been a traditional material widely used for weaving. The project is to design a set of precision tools for mass manufacturing jewellery using bamboo strips.

These tools are inspired by paper quilling craft tools. ("*Quilling or paper filigree is an art form that involves the paper strips. The strips are rolled, looped, curled, twisted and otherwise manipulated to create shapes* [1]"). In a mass manufacturing context and reduction of lead time in making the parts(jewellery shapes) is important which is achieved by reducing time for precise replication.

Ease in manufacture, assembly and replication and maintenance are its key features. The tool generated shapes can be used in other bamboo products.

1.1: Modernization of Bamboo

One of the most important features of industrialization is the mechanization of the working process along with standardisation of elements involved. Hence it is difficult to use a material like bamboo in the current industrial context. The way in which bamboo is currently used (processed into prefabricated products), helps standardise it. However this comes at the cost of destruction of its existing natural structure (bamboo is a grass having some properties similar to both wood and metal). '*Instead of industrializing, the "modernization" of bamboo should be the solution for the problem of utilizing bamboo in the industrial context (fig no. 1.1)*[2]'. Modernization here means building a new relation between the material bamboo and human's life needs in the industrial context (fig no 1.1).

How to create a sustainable system?
How to create a harmonic relation between bamboo and human in today's system?

These were some earlier question which I came across during my internship at uravu.

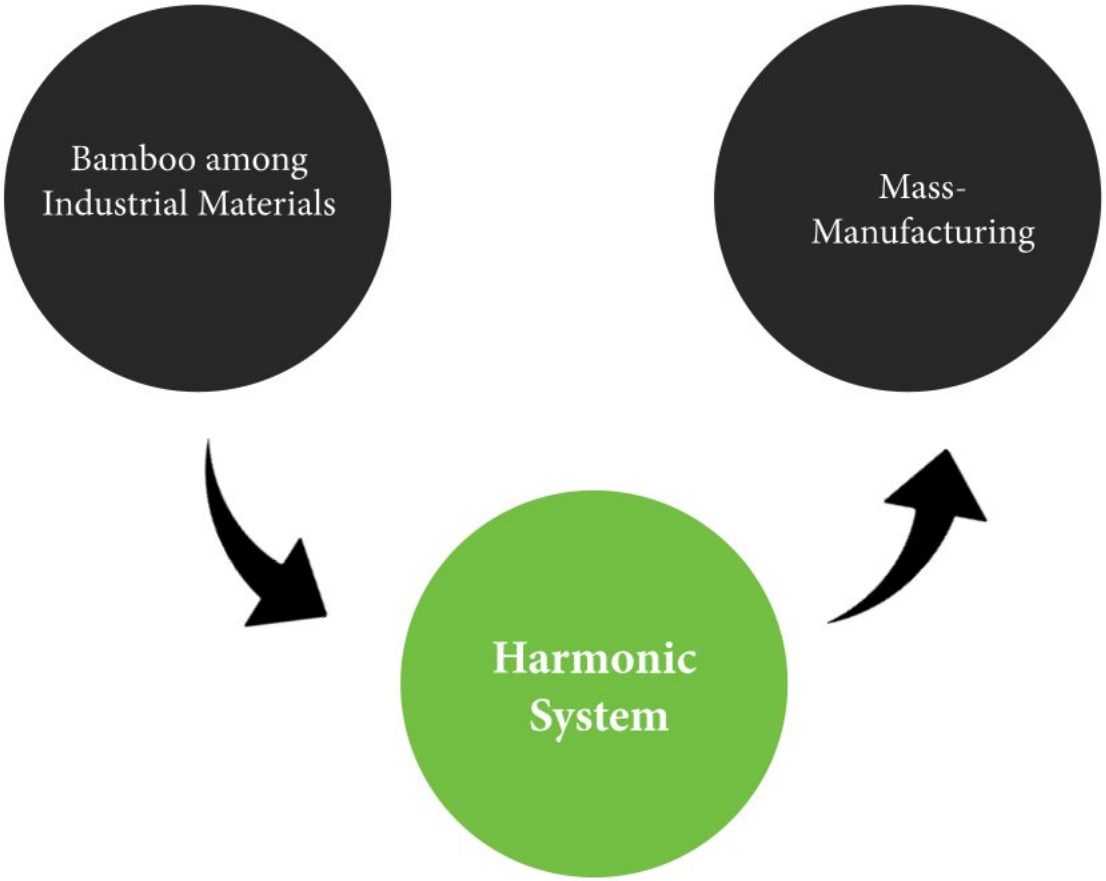

Fig no 1.1 - Showing a way to industrialize bamboo in a industrial context

Fig. No: 1.2

Fig. No: 1.3

Fig. No: 1.4

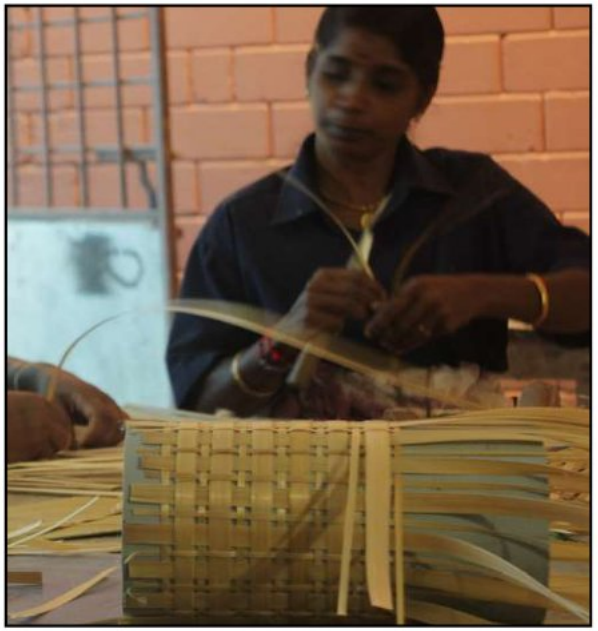

Fig. No: 1.5

I started my journey with bamboo during my project -1 where I went to Uravu & started to observe the artisans. Being with them and observing their lifestyle, made me understand the importance of bamboo in this industrial world and it also gave me a understanding of the need of using bamboo in an industrial context which incorporates artisan. They are deeply connected to the material as they have very good experience of handling bamboo, which will make base for introducing bamboo in this industrial world. The fig no (1.2 -1.5) shows artisans working with different type of bamboo strips along with different process and moulds used in the process.

Fig no 1.2 - Various width of strips are used
Fig no 1.3 -Wooden mould for weaving
Fig no 1.4 - Thick strips are used for making furniture
Fig no 1.5 - Cylindrical mould (PVC pipes) to make cylindrical form through weaving to make container of different cross section

1.2: Project 1
URAVU

"Uravu is a non-government organization (located in Thrikkaipetta village in Wayanad district, Kerala state, South India), which works with people, governments and businesses to implement programs for sustainable employment and income generation in rural areas. Uravu is a nonprofit trust, established in 1996, registered under the Indian Trusts Act. Uravu promotes social enterprises based on value addition of local, natural resources, especially bamboo, the 'green gold'[33]".

Fig. No: 1.6

Fig. No: 1.7

Fig. No: 1.8

The fig no (1.6 -1.9) shows different type of products of bamboo strips which are mass manufactured at uravu

Fig. No: 1.9

Fig. No: 1.10

Fig. No: 1.11

The following insights were gain by observing there process

Use of **mould** in mass manufacturing process (Fig no 1.2-1.5).

The entire process is like a **assembly line**, divided into stages and each stage is handled by separate set of artisans, who then pass along the work to next stage.
(Fig no 1.10- 11.11).

Fig no 1.10 - Strip making process
Fig no 1.11 - Finishing of the products

In Uravu, most of the lifestyle product are made using bamboo strips (fig no. 1.6-1.9).
Though it is difficult to standardise bamboo in today's industrial world because of its natural structure.
However, in our traditional practices, bamboo strips of different sizes, thickness and colour has been used to make products (Standardisation of bamboo). The strips are traditionally made by artisan or a craftsman.
And also mass manufacturing tools (like width sizer)are also developed for Standardising bamboo strips. But, strip thickness of less than 1 mm is difficult to achieve by a machine, and only a skilled artisan can make strips up to 0.3 mm which is suitable for coiling.

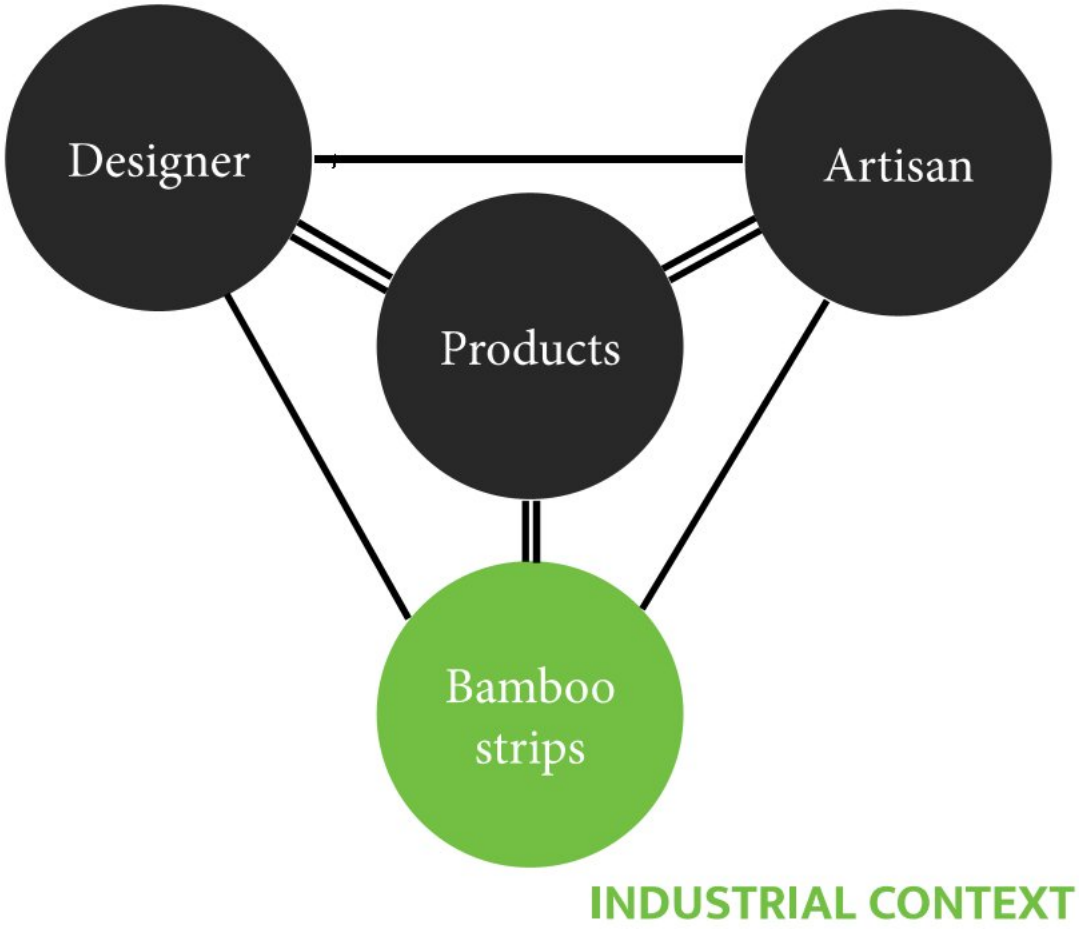

Fig no 1.12 - Shows a harmonic system between all major elements of my project. In this system inherent and traditional method of bamboo are kept as the base of the system.

Fig. No: 1.13

Fig. No: 1.14

At Uravu I also became a part of the product development team for 'Butterfly chair'(fig no. 1.13-1.16), designed by Shashank Gautam IDC PD 2014-16). Along with it I also designed some bamboo coiled products (goggles, key ring, globe & toy)

Fig. No: 1.15

Fig. No: 1.16

Fig no 1.13 - The Butterfly chair developed by Shashank Gautam.
Fig no 1.14 -Butterfly chair- developed for mass manufacture
Fig no 1.15 -Butterfly chair - existing prototype development
Fig no 1.16 - A stool using same mould of Butterfly chair

Along with the chair I also did a self initiated project titled, 'Bamboo as a material for life-style accessories's, where the major aim was to create some bamboo accessories which later became "bamboo coiling exploration (fig no. 1.17-1.22)". After having a discussion with Prof. A G Rao Sir I understood the further scope of the project.

Fig. No: 1.17

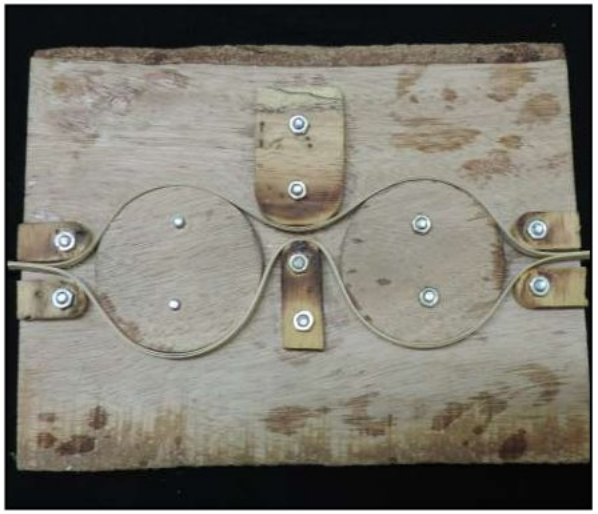

Fig. No: 1.18

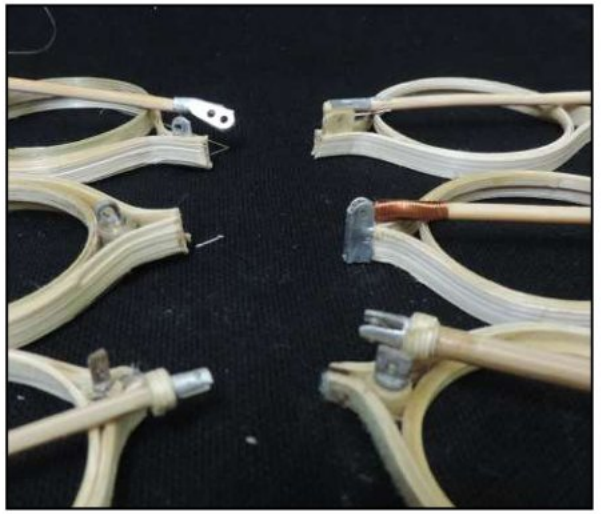

Fig. No: 1.19

Fig no 1.17 - Coiled goggles
Fig no 1.18 - Mould used for goggle
Fig no 1.19 - exploration of joinery

Fig. No: 1.20

Fig. No: 1.21

I used coiling to primarily make goggles (fig no. 1.17-1.18), which lead to exploration.
Key ring (fig no. 1.20), blow toy (fig no. 1.22) and globe (fig no. 1.21) were mainly an outcome of the exploration. During the development of goggles I had to make its mould (fig no.1.18) for the dimension of the glass to fit in, which later can developed into product specific tool for goggles frame.

Fig. No: 1.22

Fig no 1.20 - Key ring
Fig no 1.21 - Globe
Fig no 1.22 - Blow toy

Chapter 2

Secondary Study

The initial study was about understanding bamboo in an industrial context and how to make a harmonic relation in this contemporary society. The opportunity was hidden in our traditional techniques where bamboo strips are used. Traditionally bamboo/cane strips are used to make jewellery in india (majority in north-east), where only traditional tools for strip making are used, no specific tools are used for jewellery making. So I looked into many types of commonly used tools and techniques. Which gave me important insights about the tools and the processes involved in the jewellery making.

2.1
Paper Quilling

My project - 2 started with understanding the need of the tools as well as their importance in creating a harmonic relation.
During the study of different type of tools I came across paper quilling products(fig no. 2.1 -2.4) Which became a starting point for me, where i made some prototype (fig no.) Using the paper quilling tools I made some shapes using bamboo strips instead of paper strips.

Fig. No: 2.1

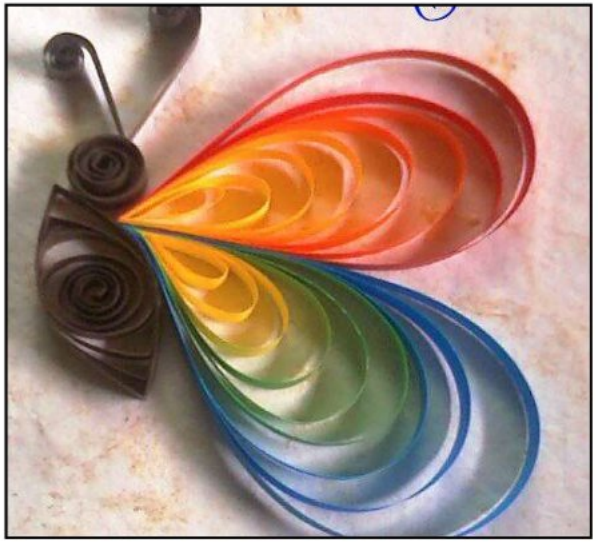

Fig. No: 2.2

Fig. No: 2.3

Fig no 2.1 - World map made by paper quilling
Fig no 2.2 - butterfly made using loose quilling of different colour strips
Fig no 2.3 - Flower made by quilling comb tool

Fig. No: 2.4

Fig. No: 2.5

Fig. No: 2.6

Fig. No: 2.7

Quilling or paper filigree is an art form that involves the use of strips of paper that are rolled, shaped, and glued together to create decorative designs. The paper is rolled, looped, curled, twisted and otherwise manipulated to create shapes which make up designs to decorate greetings cards, pictures, boxes, eggs, and to make models, jewellery, mobiles etc (fig no 3.1 - 3.3). Quilling starts with rolling a strip of paper into a coil and then pinching the coil into shapes that can be glued together. There are advanced techniques and different sized paper that are used to create 3D miniatures, abstract art, and quilled flowers among many things.

In the 18th century, quilling became popular in Europe where gentle ladies of quality ("ladies of leisure") practiced the art. It was one of the few things ladies could do that was thought not too taxing for their minds or gentle dispositions [3].

Fig no 2.4 - 2.6 Some images of earring made out of paper quilling

2.2
Initial Trials

Initially to understand the scope of using paper quilling tools in bamboo coiling I created some forms using existing paper quilling tools(fig no 2.9)
I realised that bamboo strips can be used for quilling.
However the existing quilling tools need to be redesigns to make it suitable for bamboo strips

Right
Fig no 2.8 - Prototypes using bamboo strips

Fig. No: 2.9

Fig. No: 2.10

Fig. No: 2.11

Fig. No: 2.12

2.3
Market Study

During my market study I came across earrings & necklaces which are already made using cane and bamboo strips in different parts of India. And Uravu has a new collection of jewellery (fig no. 3.5-3.10) using bamboo strips which are similar to paper quilling craft. Cane is also a good material for weaved jewellery. Because of its flexibility, it is widely used in northeast for jewellery making. Only traditional tools(fig no. 2.14) are used for strip making and there are no specific tools used for creating jewellery out of bamboo strips.

Fig no 2.9 - Jewellery Incorporated with stones- Rs 1310
Fig no 2.10 - Earring of bamboo strip and cane as joinery - Rs 300
Fig no 2.11- Jewellery of bamboo strip and cane as joinery - Rs 795
Fig no 2.12- Earring of coiled bamboo strips and cane weaving as enter element - Rs 179

While going through one such website (shop.gaath.com), I found a description of bamboo crafts in Tripura province, India. *'The craftsman and artisans there use coiling and weaving techniques to make jewellery since 20-25 years. They also use soft bamboo (Bet bans, 1.5 yrs old) to make jewellery. This bamboo was used previously only to make components to build a house. Another interesting fact was that these people use only two tools to make jewellery. 'Takal', a knife which is used to split bamboo in thin pieces and 'Dao'(fig no 2.13), a curved broad knife. Then they use adhesives to stick elements of single piece together in neatly made loops. Lacquer is then used to give lustre as well as to waterproof he finished jewellery. Along with it I also studied jewellery tools and tools used for other Bamboo products* [4]'.

Fig. No: 2.13

Fig. No: 2.14

Fig no 2.14 and 2.15 - Image of Tripura artisans work area showing the strip making and mat weaving

Fig. No: 2.15

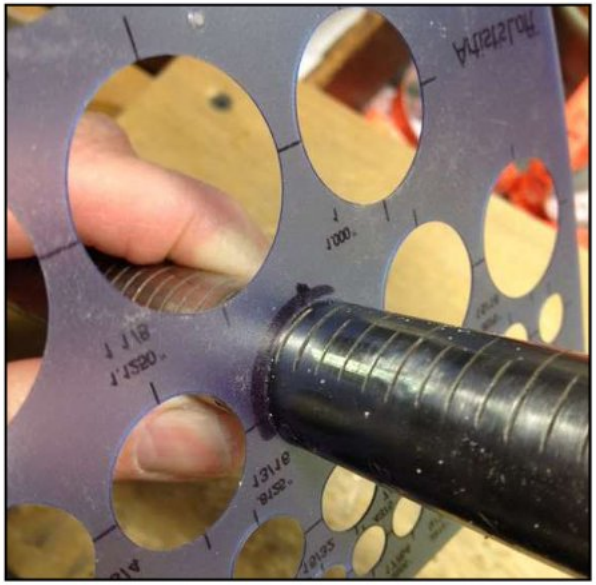

Fig. No: 2.16

Fig. No: 2.17

2.3 Study of Jewellery Tools

I looked into many stages involved in different jewellery making process .Different types tools and processes are used in jewellery making.

Some common tools and process used like Cutting, Holding, Clamping Drilling, Sanding ,Moulding and Sewing are commonly used in the process

Fig no 2.15 - jeweller's table having different types of tools

Fig no 2.16 - Use of positive and negative mould during the process

Fig no 2.17 - bench tools

2.4
IDC tools Study

Along with this IDC also has been connected to bamboo. Bambu Studio has been putting its effort to modernize bamboo in every possible way.

Different range of products tools(fig no. 2.18 - 2.24), manuals, workshop and tremendous amount of effort has being put for the artisans. It was an amazing experience when I entered Bambu Studio. So many possibilities through bamboo were on display, which made me realise the importance of the material. It is indeed a feeling of pride, to be in an institute which is so connected to the roots of India, which helped me a lot with day to day problems related to my project. Whenever I used to have problems I went to Rudrapal sir(artisan in Bambu Studio) to get feedback about the project.

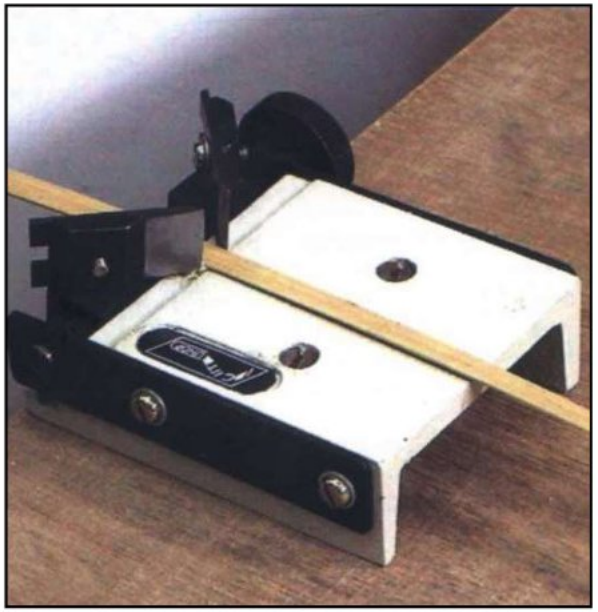

Fig. No: 2.18

Fig. No: 2.19

Fig. No: 2.20

Fig. No: 2.21

Fig 2.18 - Width sizer used for making strips of standard width by adjusting the blade.
Fig 2.19 - 2.21 - Coiling tools, mould and fixtures,which is used for making coaster, bowl, etc

Fig. No: 2.22

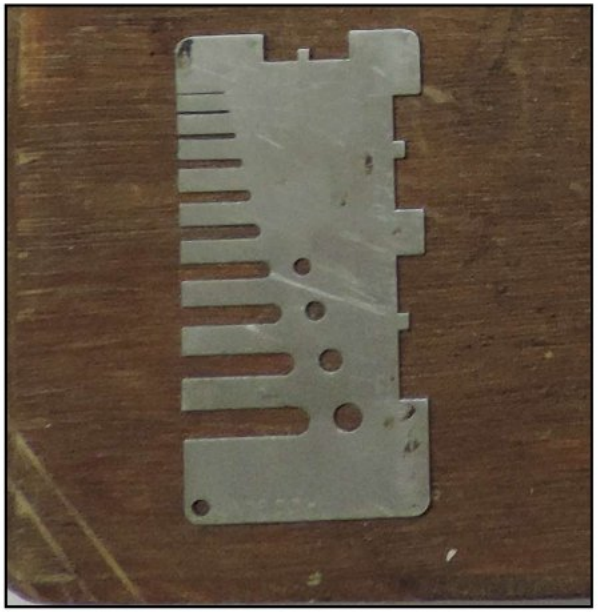

Fig. No: 2.23

Fig. No: 2.24

Fig no 2.20 - IDC Gauge, which is used to measure different thickness (upto 0.3 mm)
Fig no 2.21 - Sandpaper pad - for final finishing the strip
Fig no 2.22 - Splitting Knife - very useful for finishing strips

Chapter 3

Primary Study

My initial research was focused on learning and understanding the paper quilling ,during which I went to Panna (Madhyapradesh) where we (me with my three colleagues) taught paper quilling to kids, and understood the further scope of the project.

I also meet Mr SurendraNath (One of the Trustee of uravu) and discussed about the new jewellery arrivals(these jewellery have similarity to paper quilled jewellery) . along with that I also had a regular feedback session and discussion with Gangama and Rudrapal ji (artisan working at Bambu studio) during my user study which were useful in the development of tools.

3.1
Teaching Quilling

During the project I had gone to Panna (Madhya Pradesh) to teach paper quilling to kids. (fig no. 3.1 - 3.4)
In this activity kids made different types of tight coiled shapes using paper strips, which were later converted to jewellery (fig no. 4.4). This activity was planned for 1 day, where we assembled the shape to make jewellery which were quilled by kids

Fig. No: 3.1

Fig. No: 3.2

Fig. No: 3.3

Fig no 3.1 - smiling faces of kids with paper quilling earring
Fig no 3.2 - showing kids process of quilling.
Fig no 3.3 - kids making paper quilled shapes

Fig. No: 3.4

Fig. No: 3.5

Fig. No: 3.6

The following insights were gain by the activity

Lead time in making shapes(25 paper quilled jewellery and 1 bamboo jewellery (fig no. 4.5)) with the existing tools

I observed that the tool provides **multiple possibilities** of creating jewellery designs by using permutation and combination of shapes **Mass manufacturing** can be achieved in this industry by division of labour, similar to uravu.

I also realised that these tools could be effective in mass manufacturing unit as well.

Fig no 3.4 -3.5 - Earring made of paper strips
Fig no 3.6 - Tight coil earring made of bamboo strips

3.2
New jewellery designs

Use of bamboo laminates for jewellery making was suggested by Rao Sir to URAVU during my internship, Further taken by Prajakta student of Indian Institution Of Craft & Design. Later range of jewellery were further developed at uravu.

Fig. No: 3.7

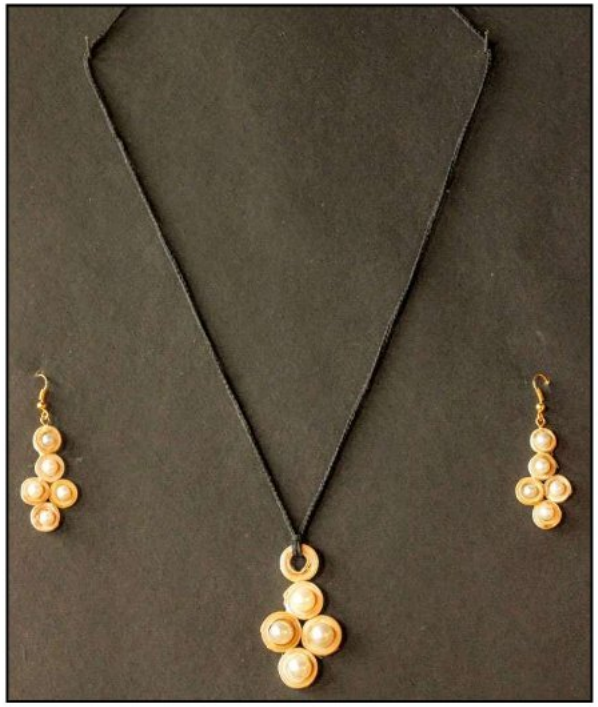

Fig. No: 3.8

Fig. No: 3.9

Fig. No: 3.10

Fig no 3.5 - Vortex coil jewellery
Fig no 3.6 - Incorporated with stones
Fig no 3.7 - Dome shape earrings
Fig no 3.8 - Different shapes and cross section of bamboo is used to make earrings

Fig. No: 3.11

Fig. No: 3.12

During discussion with Mr. Surendranath Sir (trustee of uravu), he told me about the unavailability of specific tools in the market for making bamboo jewellery.

Fig. No: 3.14

Fig. No: 3.15

Fig no 3.9 - Incorporating strips in existing jewellery tools
Fig no 3.10 - Jewellery dependent on hand skills

3.3
User Study

Gangama, a self employed artisan based in Mumbai, often comes to IDC for helping with training.
During the feedback of the tools she also inquired about the tools, and where to buy them(she needs tools but don't know which tools to buy and how to use them)

Fig. No: 3.16

Fig. No: 3.17

Fig. No: 3.18

Fig no 3.15 -Gangama teaching basket making Manipur workshop by IDC Bambu Studio
Fig no 3.17 and 3.18 - some weaved jewellery shapes made by her.

Fig. No: 3.19

Fig. No: 3.20

Fig. No: 3.21

I approached two artisans during the project to understand the issues and to get feedback about the tools

Rudra Pal sir a full time artisan at IDC Bambu Studio, from Tripura,India. He also introduced me his brother and cousin sister Ratna (both working in tripura) with whom I had a telephonic conversation. The following points were discussed his brother make 1 pair of jewellery in his leisure time which sells at minimum Rs 200 (depending on the design), where as his cousin Ratna makes full time jewellery, minimum 6-7 pairs of jewellery are made during the day which are sold to government organization. They don't use any specific tools for jewellery making. Also Ratna Di told about the same problem which I was facing with fast adhesives (sticking to hands during the gluing process)

Fig no 3.19 - Rudrapal sir working in bamboo studio
Fig no 3.20 and 3.21 - Jewellery made by Self employed Brother of Rudrapal sir working in Tripura, North east.

3.4
Opportunities

During may primary study a couple of insights and opportunities were noticed which are as follows

Use **coloured strips** will give value addition to system(Fig no 3.22)

Coiling only dependent on **hand skills**(Fig no 3.23)

Nonidentical shapes of the existing jewellery. (need of precise replication)(Fig no 3.23)

No specific tools for jewellery making (Trustee - Mr. Surendranath)(Fig no 3.25)

Fig. No: 3.22

Fig. No: 3.23

Fig. No: 3.24

Fig. No: 3.25

Chapter 4

Design Brief

To design Form/shape generation tools for Coiled bamboo jewellery

Primary need

Tool should allow mass manufacturing of different forms/shapes
Tools should be easily mass manufacturable and serviceable
Tool should reduce the time required to generate forms compared to current methods
Tools should support the artisan instead of replacing them

Secondary need

Tools should allow exploration & creation of new designs.
Tools should have gradual learning curve
Tools should be as frugal as possible in manufacturing & maintenance

Core benefits

Mass Manufacturing of jewellery
Increase of livelihood of artisan
Faster replication process

4.1: Need for Intervention

The decision of redesign the existing paper quilling tools was taken because its can be used to generate similar shapes which are similar to existing bamboo jewellery and re-design the tools is for the following factors:

The tools are not specifically designed for **jewellery making**. And are not made for using it in a **mass manufacturing** context. They are more like hobby tools.

Bamboo has **different property** that paper it much stiffer than paper which makes it Difficulty to use it in the existing paper quilling tools.

Some **existing process** used in paper quilling tools to achieve shape are **not useful** because of stiffness of bamboo (eg. quilling board '-ve mould' - the process involved to create loose coils and shapes, in which a Tight coil is placed in the -ve space inside of the desired shape mould and then it is released and adjusted to get the desired shape, this process is very difficult with bamboo strips are used)

Fig. No: 4.1

Fig. No: 4.2

Fig. No: 4.3

Chapter 5

Ideation

The major understanding of ideation process are described in the chapter.
Briefly I started with 'using bamboo strips on the existing tools' which gave me important understanding of 'process' involved during bamboo quilling which is not required to paper strips.
During which I also had discussions of tool with Prof A G Rao sir which lead me to re look idc coiling tools and comparing it with the existing paper quilling tools.
Mind maps were generated to understand the important aspects of the Tools and system around it.
And Brainstorming was done to start the exploration of tools and process involved in generating the shapes

5.1 Understanding the Process

During the initial quilling with bamboo strips, I was facing some basic problems like brittleness(fig no.) and splitting of strips(fig no. 5.1 and 5.2) during the starting of quilling, which got resolved during my discussion with Gangama, she suggested to use wet strips, that gave me further understanding of the importance of process (refer table) in the ideation of the tools. Some important insights

Effect of coiling using Wet and dry strips coiled

no 20 in fig no. 5.3- **Dry strips** for loose coils, but it is difficult to replicate the same type of losse coil not.

no 25 in fig no. 5.3 - **Wet strips** which can only be used to make ring shaped tight coils (using wet strips makes the strips more flexible)

Heating the formed shape to retain its shape(fig no.5.4)

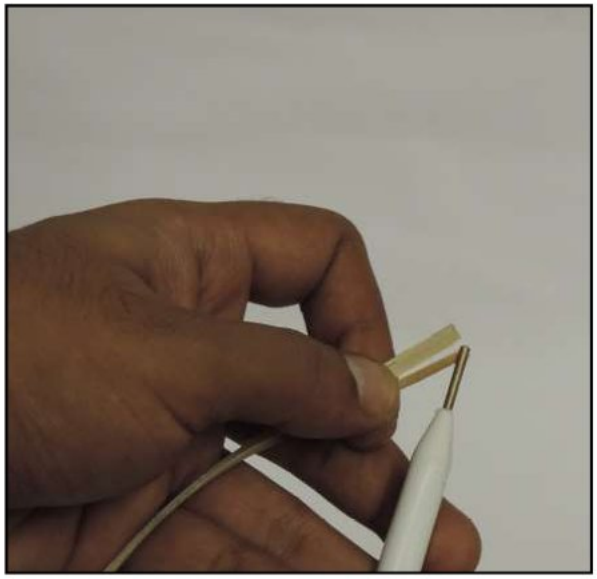

Fig. No: 5.1

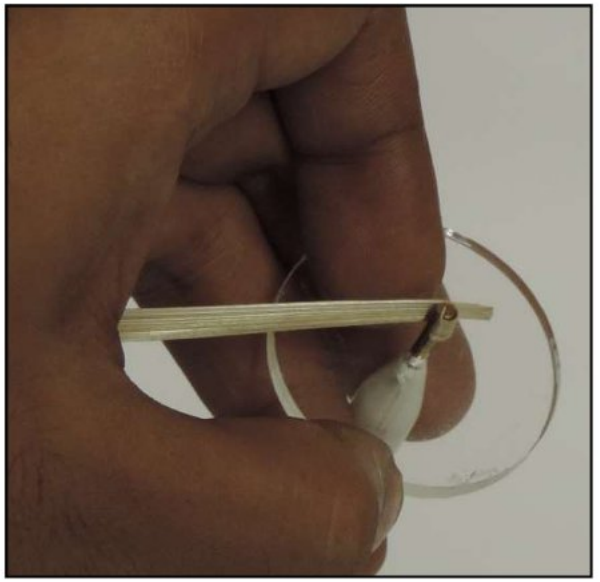

Fig. No: 5.2

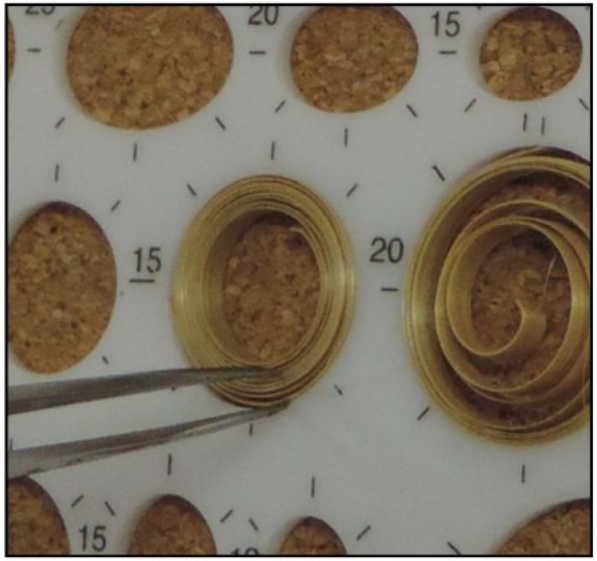

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Fig. No: 5.4

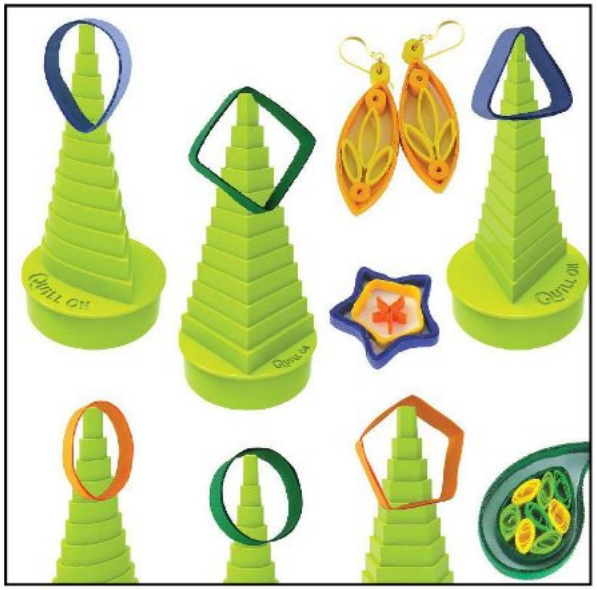


Fig. No: 5.5

Fig. No: 5.6

Fig. No: 5.7

Fig. No: 5.8

5.2 Comparison

After initial discussion with Rao sir I understood the similarity of paper quilling tools (fig no. 5.5 and 5.6) to jigs and fixtures (similar to the coiling tool and jig and fixtures-- for making coiled cup(+ve mold) and for outer border of of various basket (-ve)), the categorization was done on the basis of +ve mold and -ve mold

Both of them have distinct advantages, i.e. +ve mold provides precision in inner diameter and -ve for outer diameter. Since, my initial experience with quilling board (-ve mold) did not go so well, I decided to focus my exploration to +ve molds

The major advantage of paper qulling tools are that, it can be used for generating **different** shapes with many possibilities.

But the existing IDC coiling tools (which are used for making coaster, bowls and many other coiling products) are frugal. The tool are simplly designed so that it can be easilly manufactured in a local workshop, (which is an important aspect in a place like india where mostof the atrisan are at rural places which) makes it easy to maintain.

5.3
Mind maps

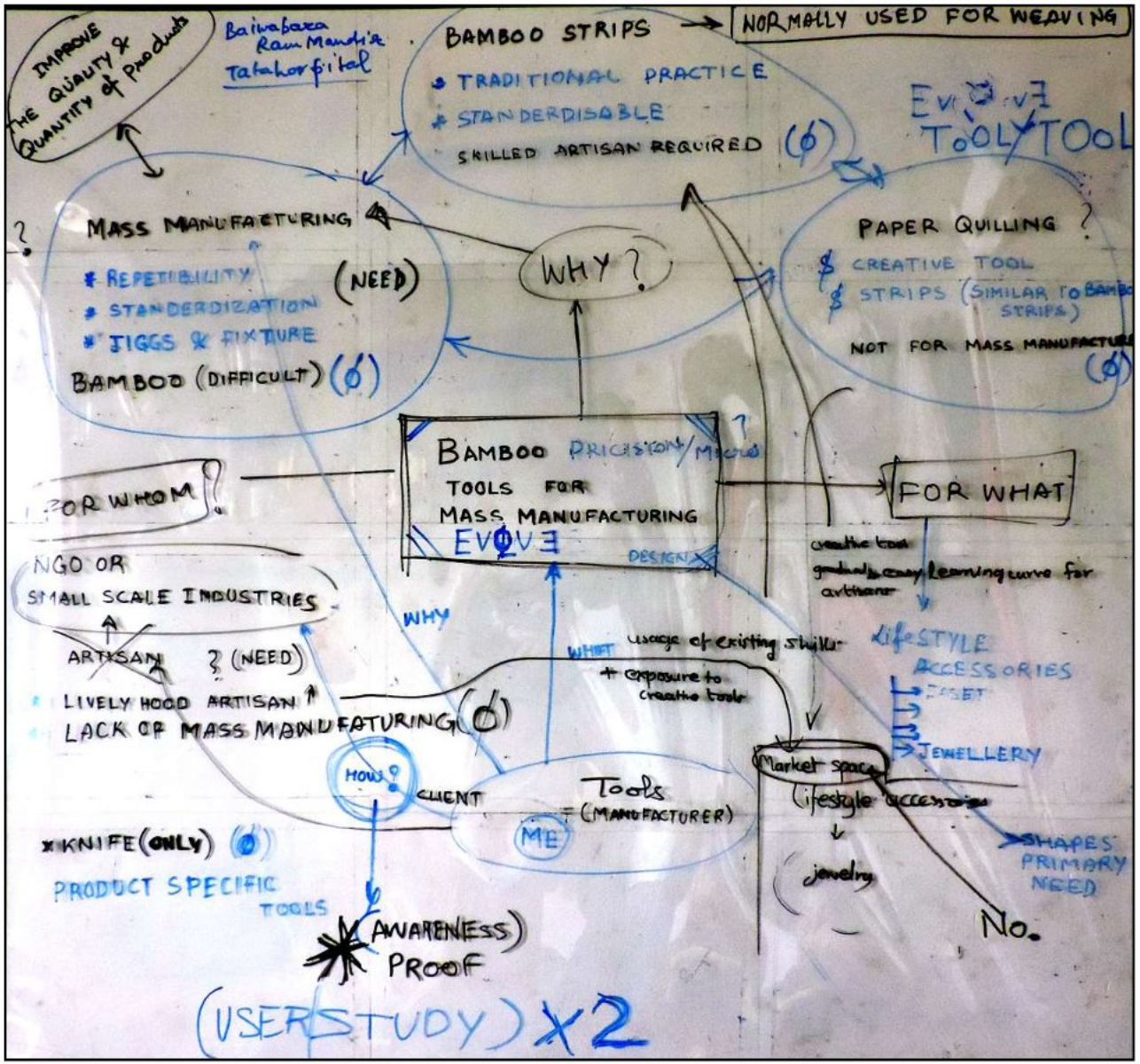


Fig. No: 5.9 - Mind map of the understanding of system

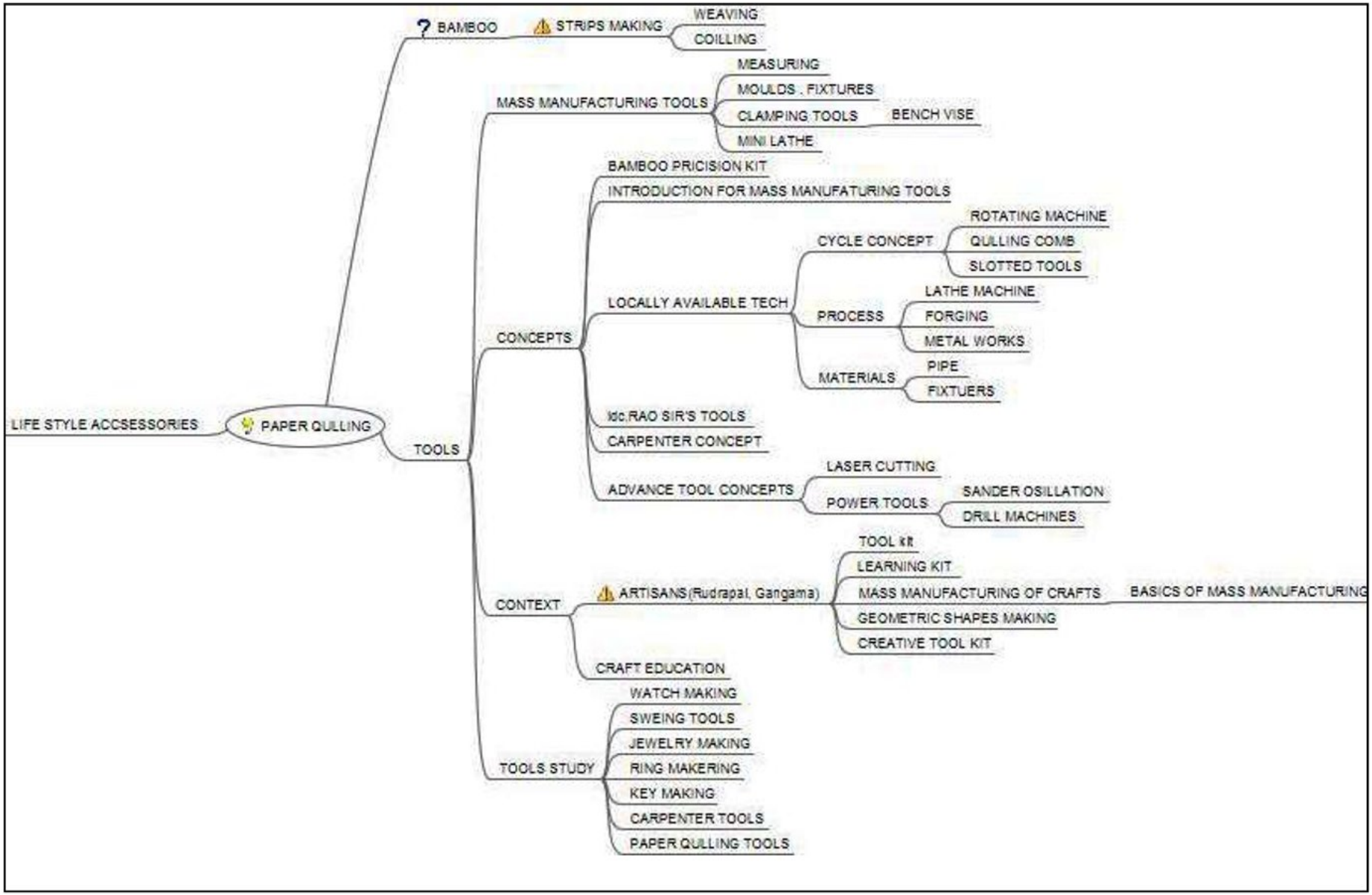


Fig. No: 5.10 - Mind map of the important aspects during the ideation

5.4
Exploration

It was difficult to categorise paper quilling jewellery on the basis of shapes (fig no 5.11 to 5.17), because multiple shapes are generated using the same tool but different process were involved in the process. Then the Categorization of paper quilling jewellery was done by identifying the different type of shapes along with the tools required to make them (due to involvement of different processes i preferred to explain it along the exploration process).
On the basics of which I decided to brainstorm to start redesign the existing tools.

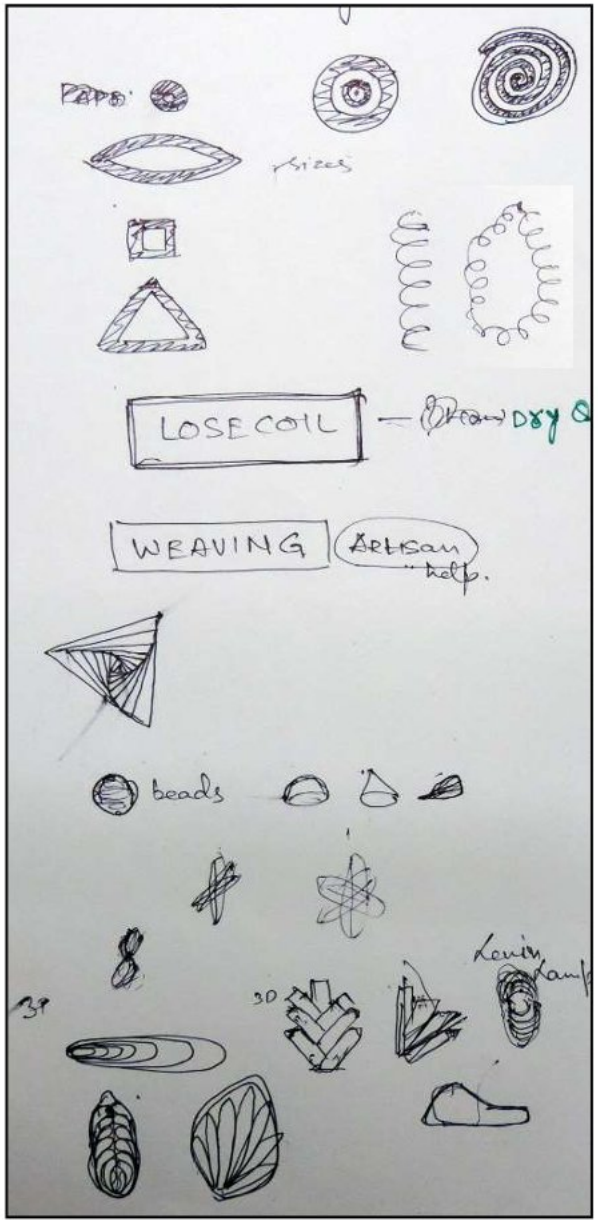


Fig. No: 5.11


Fig. No: 5.12


Fig. No: 5.13

Fig. No: 5.14


Fig. No: 5.15


Fig. No: 5.16

Fig. No: 5.17

5.5
Brainstorming

The first question that I asked myself was in how many ways the existing tools can be used for generating shapes using bamboo strips.

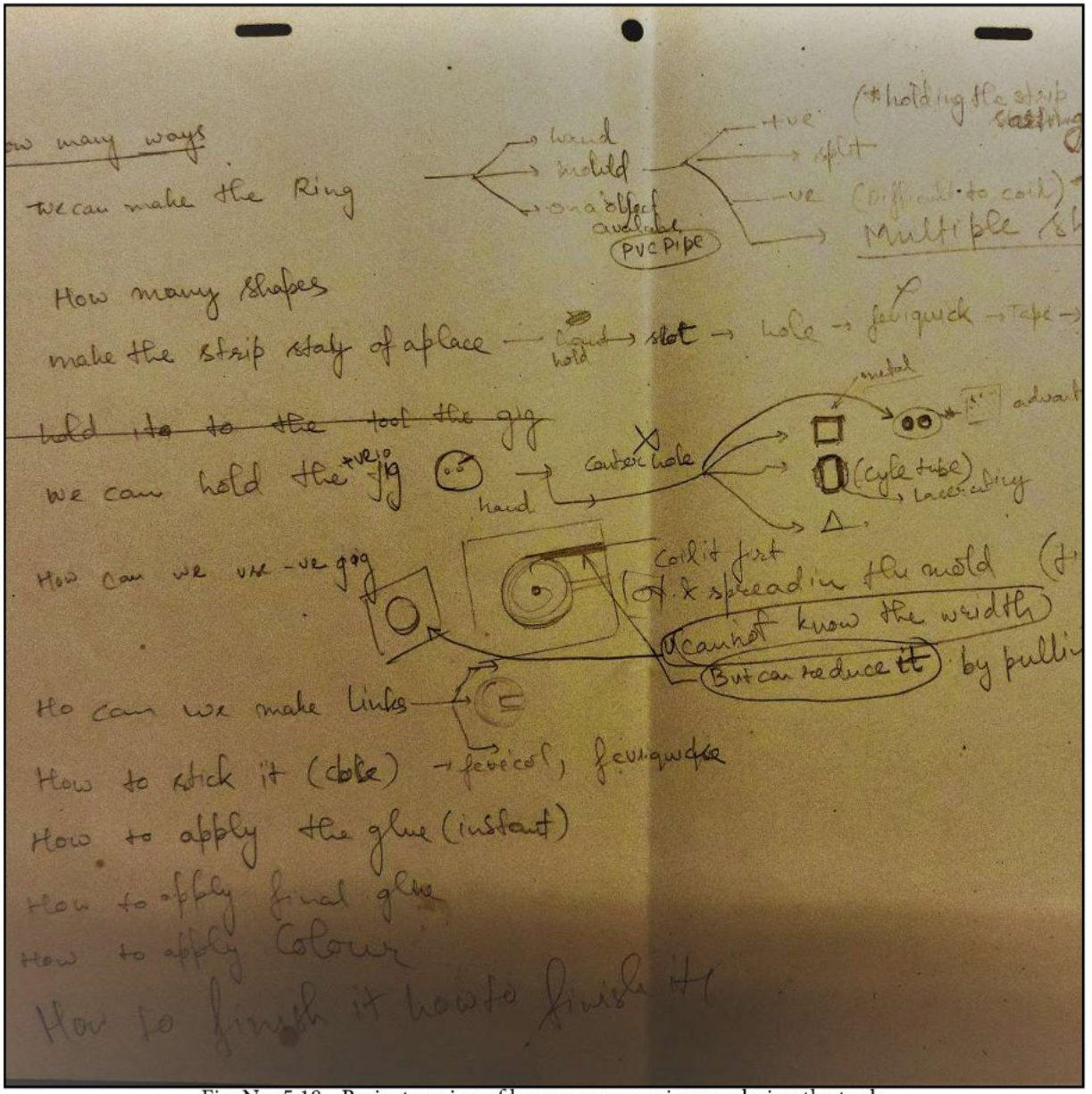


Fig. No: 5.18 - Brainstorming of how many ways i can redesign the tools

5.6
Slotted tool

I decided to start with the primary/basic slotted tool(fig. No: 5.19), because the slotted quilling tool is most often used to make paper-quilling coils and this tool is connected to two other tools - quilling coach (fig no. 5.21)and mini mould tool(fig no. 5.22)

The slot tool basically has a vertical slot at the tip(fig no. 5.19)on which the strip is placed and then the the tool is rotated to get tight coils (fig no. 5.20). the tight coil obtained from slot tool can be directly used to make jewellery (the form can be changed by cutting/chopping the coil and using various permutation and combination. I didn't have much problem in a injection moulded handle, but in case of a wooden handle due to the circular cross section of the slotted metal tip, it slips out of the wooden handle after repeated use.
So change of diameter or cross section could help in developing this tool and development of handle can aid in usability of the slotted tool

Fig. No: 5.19

Fig. No: 5.20

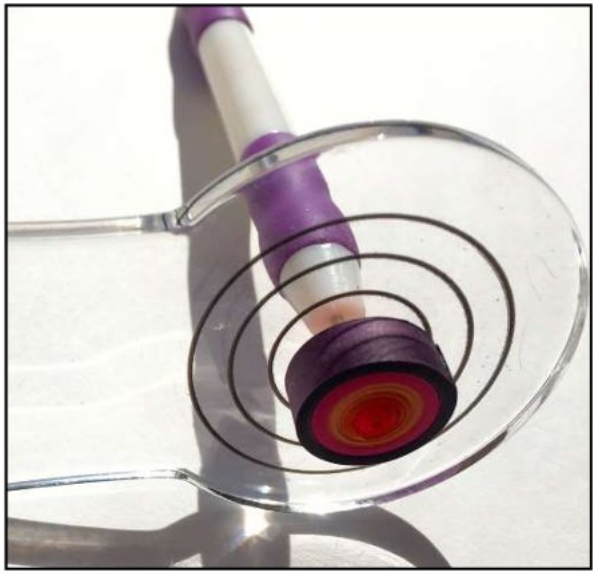


Fig. No: 5.21

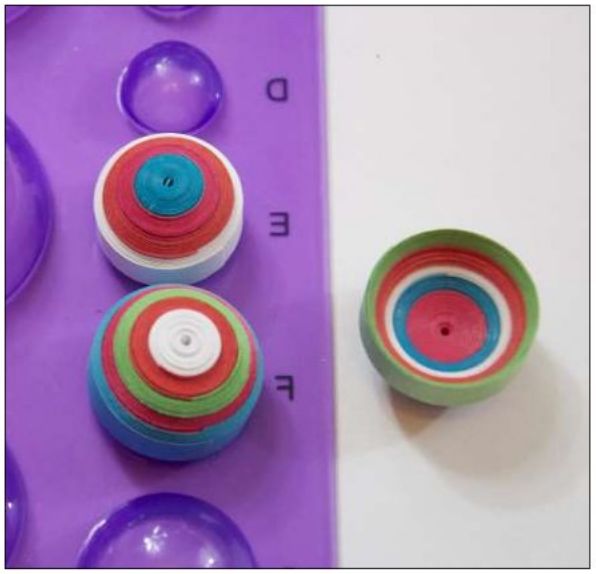


Fig. No: 5.22

Fig. No: 5.23

Fig. No: 5.24

Fig. No: 5.25

Fig. No: 5.26

Fig. No: 5.27

Fig. No: 5.28

Fig. No: 5.29

Fig. No: 5.30

Fig. No: 5.31

The following are the factor while designing the slotted tool

Development of the **handle** could be made out of wood ,bamboo or can be similar to some precision screw drivers like in fig no 5.23 to 5.25

Along with Changing the diameter, change in the slot thickness lead to the following tool.

The basic slotted tool of smaller diameter which is generally used for tight coils.
(fig. no: 5.27)
Thicker slot for coiling in which multiple coloured strips can play a important role.
(fig. no: 5.30)
Larger diameter - quicker and comfortable coils.(fig. no. 5.31)
Slotted Bamboo rod (fig. No: 5.26)
- which can already manufactured using bamboo **rod die** (fig. No: 5.28).(the cross grain of the bamboo rod will provide value to jewellery)
Cane or bamboo strips can be used to make grips (fig. No: 5.27)

During this phase I also developed a tool used to create vortex coil (fig no. 5.33)similar to bamboo coiled jewellery made in uravu (fig no. 5.32).
In paper quilling (and in uravu also) vortex coil generation is dependent upon hand skills. During coiling I also used the slotted tool (fig no. 5.35 to 5.37), which can also be used to make a specific vortex coil(fig no. 5.38)which takes a lot of time. This led to changing the cross section(fig no. 5.38) of the tool to make it suitable for making standard sizes of vortex coils with considerably faster process (fig no. 5.39).

During which i got following insights -

Slot on a flattened slotted rod made using forging (locally available process)
(fig no. 5.40)

Slotted laser cut steal plates (EN8, EN24 or EN12 - generally used for tools) - multiple slotted cross section (fig no. 5.38) or a set of tools have different sizes of cross section having slot (fig no. 5.39)

Also there is future scope of changing the cross section of the tip itself can led to a set of tools. (fig no. 5.34)

Fig. No: 5.32

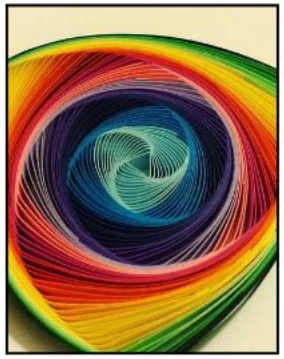


Fig. No: 5.33

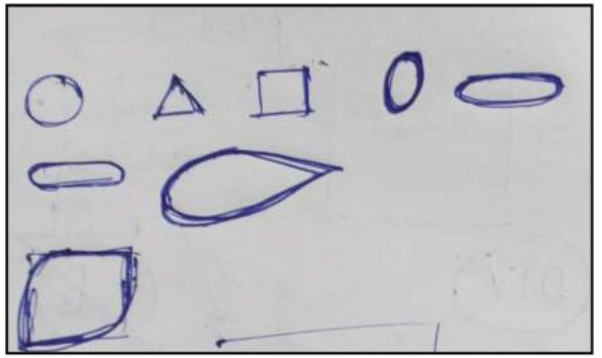


Fig. No: 5.34

Fig. No: 5.35

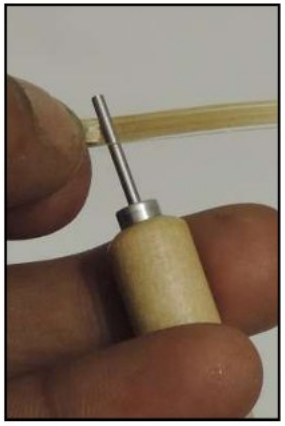


Fig. No: 5.36

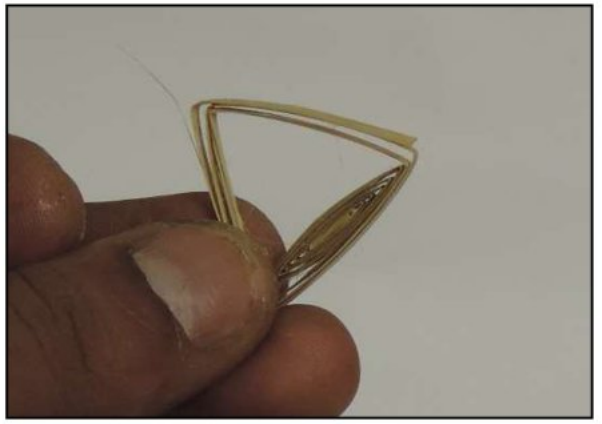


Fig. No: 5.37

Fig. No: 5.38

Fig. No: 5.39

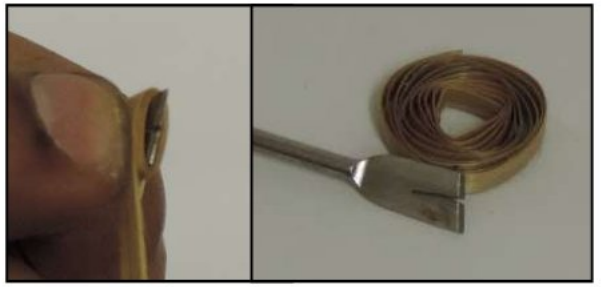


Fig. No: 5.40

Fig. No: 5.41

Fig. No: 5.43

Fig. No: 5.44

Fig. No: 5.42

Fig. No: 5.45

5.7 Quilling Mini Mould

Mini mold tool a three dimensional shaping tool which transforms tight flat coils into perfect domes, is basically a set of hemispheres of various sizes (fig no. 5.45), which are used to create jhumka like shape (fig no. 5.43), spherical beads, cones(fig no. 5.44)(cone are created by successive forming from smaller to larger moulds).

Many other shapes can also be formed by cutting chopping the existing forms.

Another important aspect of this tool was how it can be frugally manufactured (in mass manufacturing unit like uravu, initial idea was to cast PoP (plaster of paris) on the mould (which is the tool itself) which can become more frugal and efficient by using cement instead of PoP).

5.8
Quilling Coach

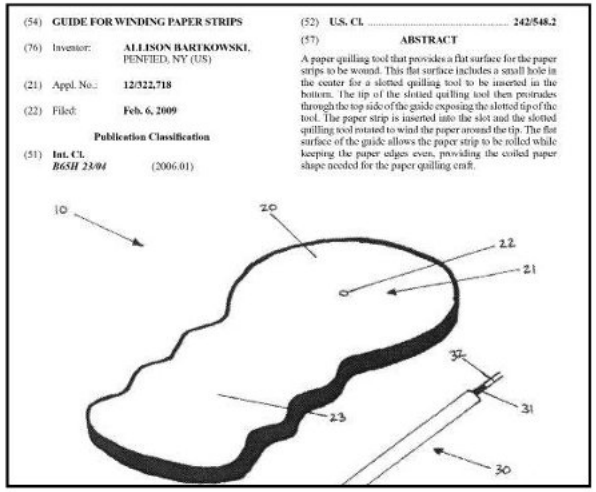
During the use of mini mould, mainly for larger tight coils (fig no. 5.46)are required And for larger tight coils (which are used for making jhumka form), there it a necessity to have a base to stabilize and handle the coil. For this purpose there is quilling coach tool (fig no. 5.49) which acts as a guide by supporting the coil to achieve larger uniform tight coils.

However, the tool is patented for '**paper**' quilling use (fig no. 5.48) and also Its handling and functionality is confusing to user, presence of handle (fig no. 5.49) makes it difficult to understand how it is used during process of coiling.

Hence removing the handle and just leaving the circular part (fig no. 5.50 to 5.52) leaves no confusion to the user on the handling part.

Fig. No: 5.46

Fig. No: 5.47



(54) **GUIDE FOR WINDING PAPER STRIPS**

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(21) Appl. No.: **12/322,718**

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(52) **U.S. Cl.** **242/548.2**

(57) **ABSTRACT**

A paper quilling tool that provides a flat surface for the paper strips to be wound. This flat surface includes a small hole in the center for a slotted quilling tool to be inserted in the bottom. The tip of the slotted quilling tool then protrudes through the top side of the guide exposing the slotted tip of the tool. The paper strip is inserted into the slot and the slotted quilling tool rotated to wind the paper around the tip. The flat surface of the guide allows the paper strip to be rolled while keeping the paper edges even, providing the coiled paper shape needed for the paper quilling craft.

10 20 22 21 37 31 23 30

Fig. No: 5.48

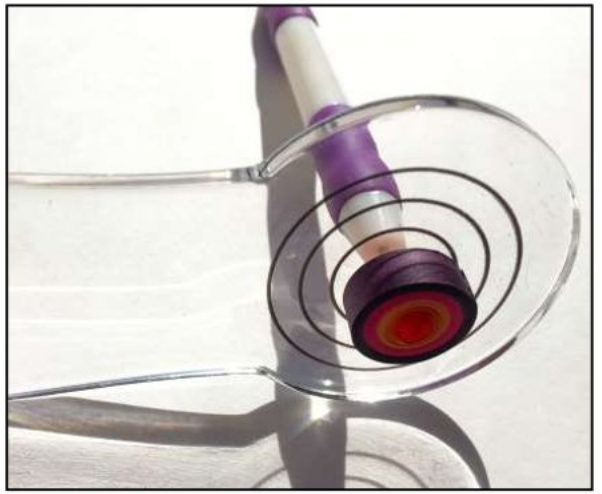


Fig. No: 5.49

Fig. No: 5.50

Fig. No: 5.51

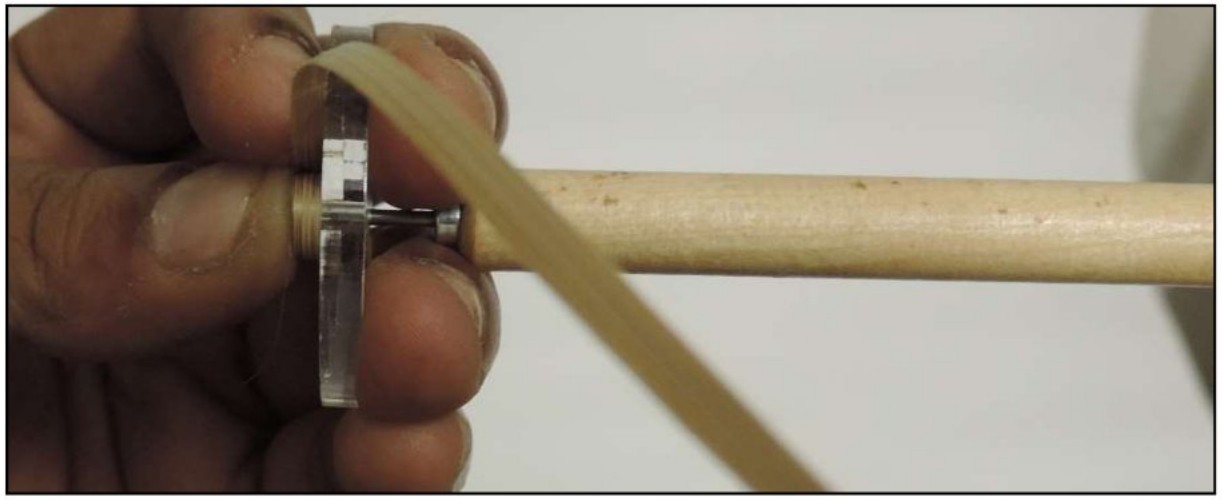


Fig. No: 5.52

During my user study with artisan(Ganga ma), when she was handling the slotted tool with coach tool (fig no. 5.52 showing the positions of finger during the process) t (i also had similar problem)

During the use, **first** the coach tool has to be put on the slotted tool, then the coiling process starts by putting the strip on the slotted tool with the coach tool(in this process the coach tool cannot be removed during the use, it is in between the slotted tool and the coil (fig no. 5.50)).

But, in the process of coiling with bamboo strips, there are many processes involved (sticking, cutting and adding the next strip) and having coach tool which in one hand supports the strips but in other hand hinder in Cutting processes with scissors or

Can get spoiled by the glue.

And an important usability issue is that for small tight coils the coach tool is not required (larger coil needs stabilization) for which the user has to be aware of it before use because the coach tool has to be placed before starting the coiling

The fig no 5.63 and 5.64 shows the prototypes of different shape and marking during the development of the tools.
And trials (fig no 5.50 to 5.52) were done to understand the important factors.

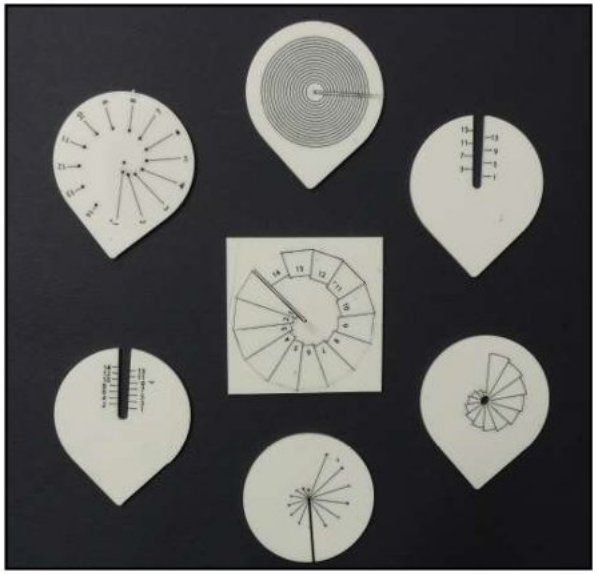


Fig. No: 5.53

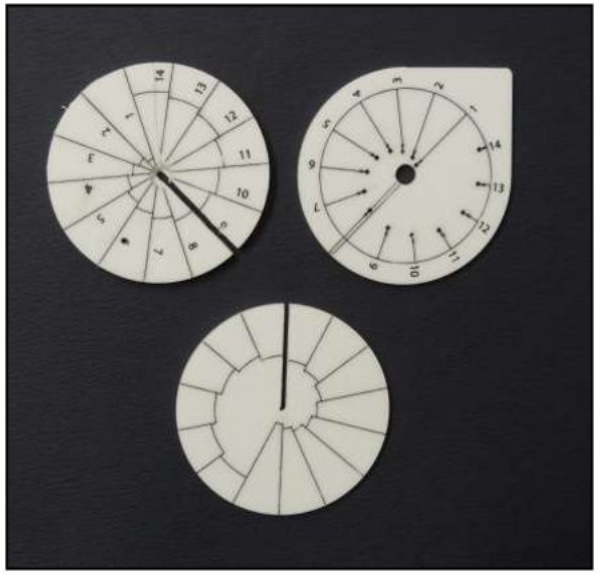


Fig. No: 5.54

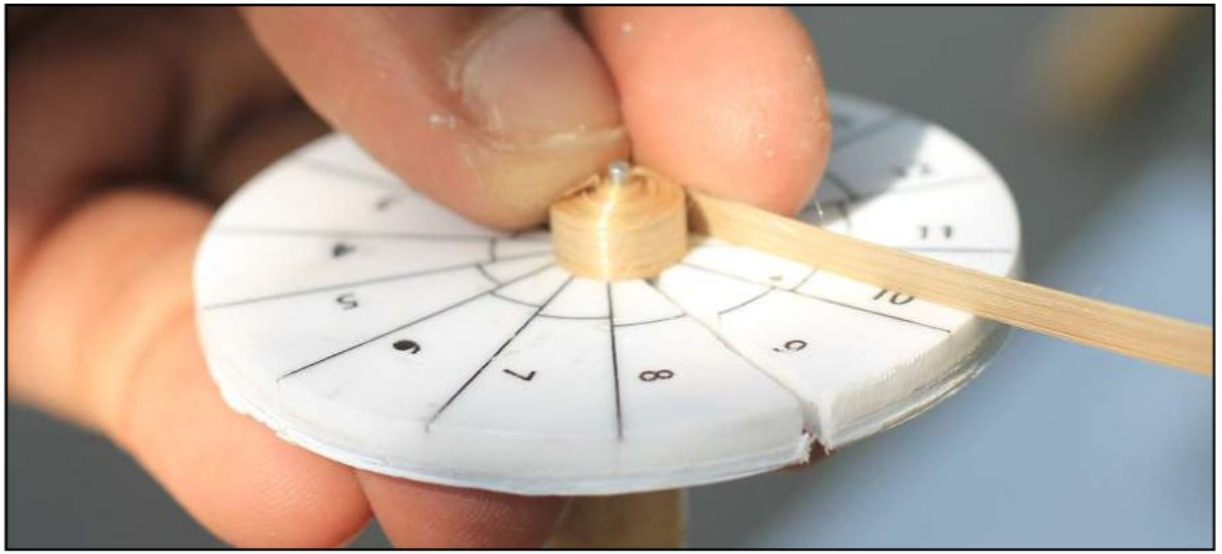


Fig. No: 5.55

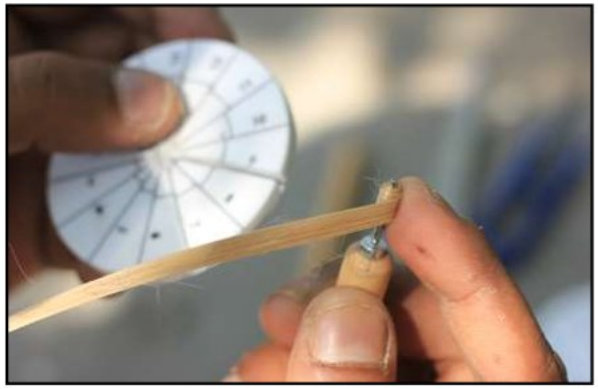


Fig. No: 5.57

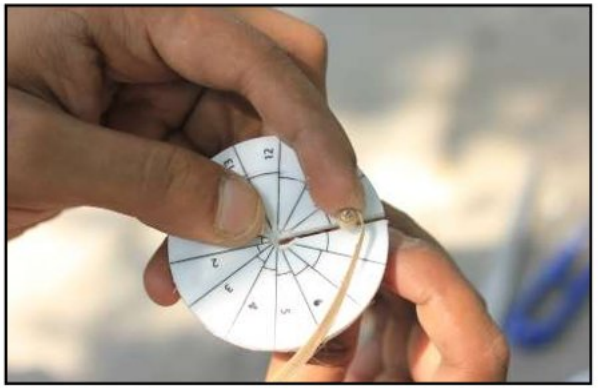


Fig. No: 5.58

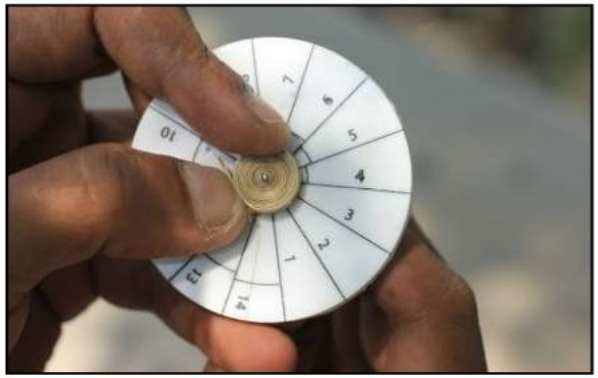


Fig. No: 5.59

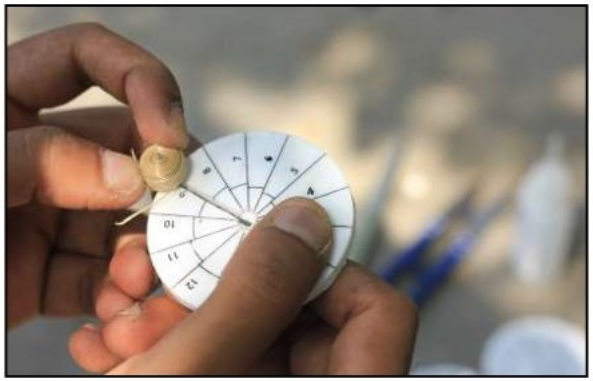


Fig. No: 5.60

Fig. No: 5.61

Fig. No: 5.62

While designing the coach tool, I took into consideration the following.

Introduction of a slot(fig no. 5.57 to 5.60) in the coach tool to facilitate the placing and removal of tool **any** time during the coiling. So now one can put and remove the strip according to need, which is essential in coiling bamboo because when user want to add additional strip then the previous strip has to be cut (fig no. 5.62) and glued first then the next strip is glued (fig no. 5.61) at the edge to start coiling. This was not required during paper quilling because thin papers are used which are easy to overlap without slipping.

I also incorporated the marking of mini mould based on the corresponding radii of tight coil (fig no. 5.59). Also the decision of placing the marking radially came out to be very useful as it can also aid in deter mining the anti clock wise direction of the strip which is important aspect of the tool.

5.9
Comb

Another useful tool is the quilling comb(fig no. 5.63).*'A quilling comb looks exactly like a comb with metal prongs. It is used for making paper coils and paper flowers (fig no. 5.64) and some different shapes(fig no. 5.65). That are popularly used in paper quilling craft.'*

The distance between the prongs can create different sized coils (if the tool is scaled up than it has possibility to be used in lifestyle accessories using larger mats or strips).

The quilling-comb method is a quick and easy way to make evenly shaped loops. Coils made with a quilling comb are generally bigger than those made with a slotted quilling tool.

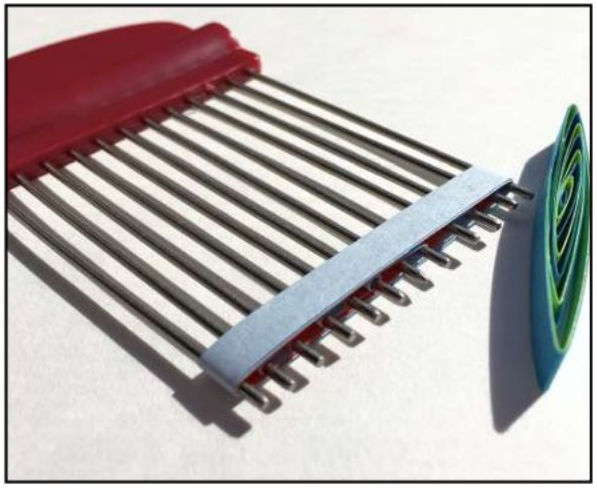


Fig. No: 5.63

Fig. No: 5.64

Fig. No: 5.65

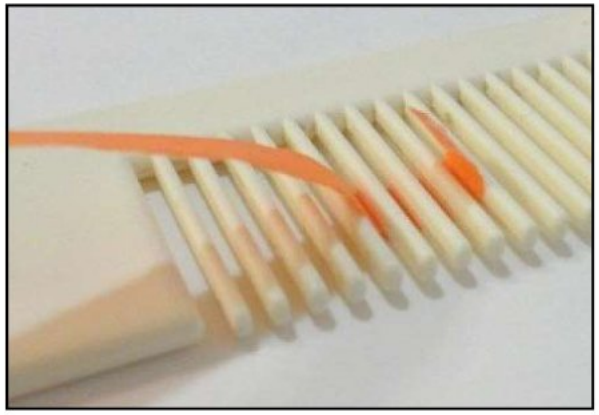


Fig. No: 5.66

Fig. No: 5.67

Fig. No: 5.68

Fig. No: 5.69

Fig. No: 5.70

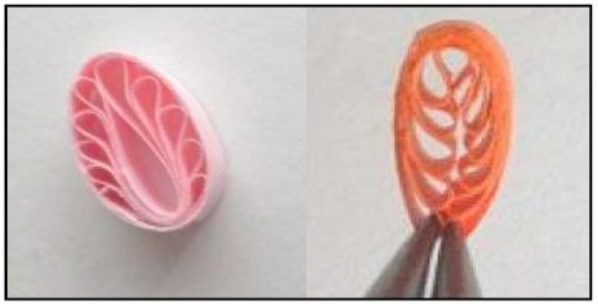


Fig. No: 5.71

The initial starting and securing the coil (fig no. 5.66 and 5.67)
And there are basically three types of coils/ shapes which can be generated with the help of this tools

Basic coil with loops(fig no. 5.68)

Alternative looping method(fig no. 5.69)

Two directional wrapping.
(fig no. 5.70 and 5.71).

The initial starting and securing the coil(fig no. 5.72 to 5.74) with the glue were important aspect of the shape generating process.
Not much problem were faced during the process (fig no. 5.75 to 5.77). But, while replicating shapes again and again I realised that the handle is not appropriate for continuous repetitive use which is an important aspect of mass manufacturing (fig no. 5.78 to 5.79).
Initial prototypes were made using cycle spokes (which is a universal frugal material) and trials were done to under stand the key factors of design
Also hand mapping was done to understand the effect of cross section(fig no. 5.80), and Handle is made by considering the movement of crucial position of fingers during the process(fig no. 5.81)

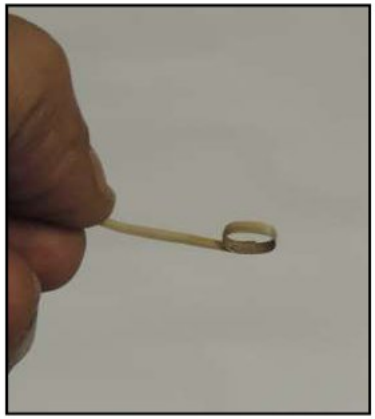


Fig. No: 5.72

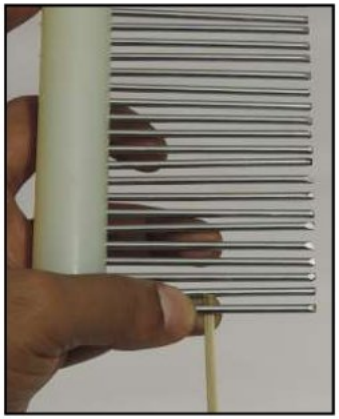
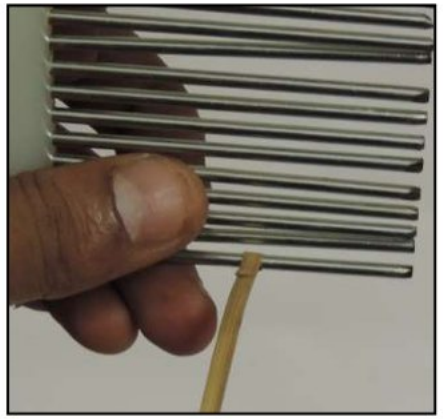


Fig. No: 5.73



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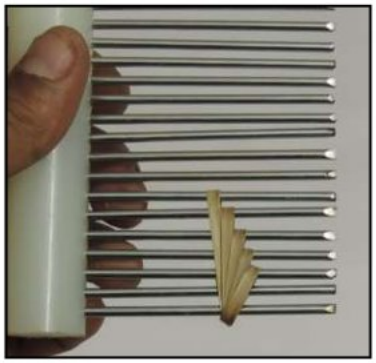

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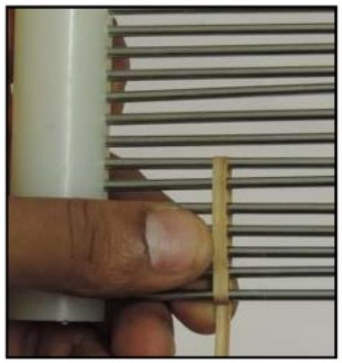

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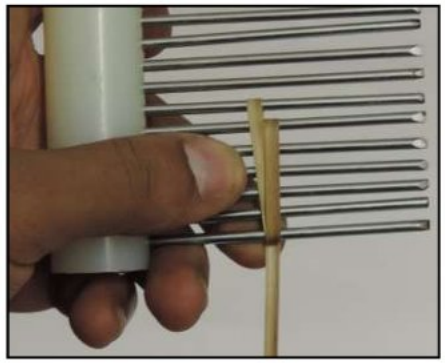

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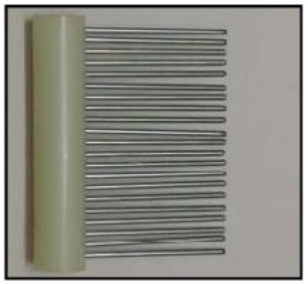

Fig. No: 5.78

Fig. No: 5.79

Fig. No: 5.80

Fig. No: 5.81

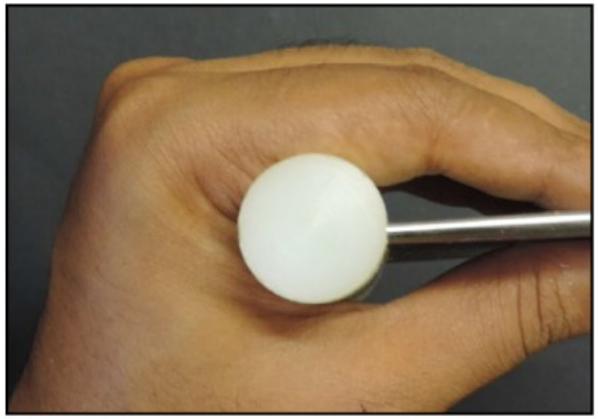

Fig. No: 5.82

Fig. No: 5.83

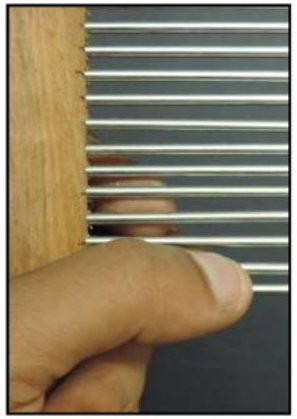

Fig. No: 5.84

Fig. No: 5.85

While designing the comb tool, I took into consideration

Cylindrical Section easy to manufacture and better for hand grip (fig no. 5.82)

Extended Handle which aids in better handling because the lower prongs of the tool so the extra space after handle provide position of other finger for better grip (used for securing the coil and position of **thumb** is crucial for longer and repeated duration), which can also be used to rest on other place for better usability fig no 5.83 to 5.85.

5.10
Positive Mould

Now the important part of the tool exploration
I also extensively used 'quilling buddy' tool(fig no 5.86), which is a positive mold used to create quilled shapes of different sizes and shapes according to the cross section of tool(fig no. 5.87).
Initial problems were with starting because the bamboo strips were slipping and it was difficult to hold(fig no. 5.88) for which I had to introduce a slot(fig no. 5.89) to hold the strips in places. Then I started exploring the possibilities of slots and their probable use for manufacturing.

Fig. No: 5.86

Fig. No: 5.87

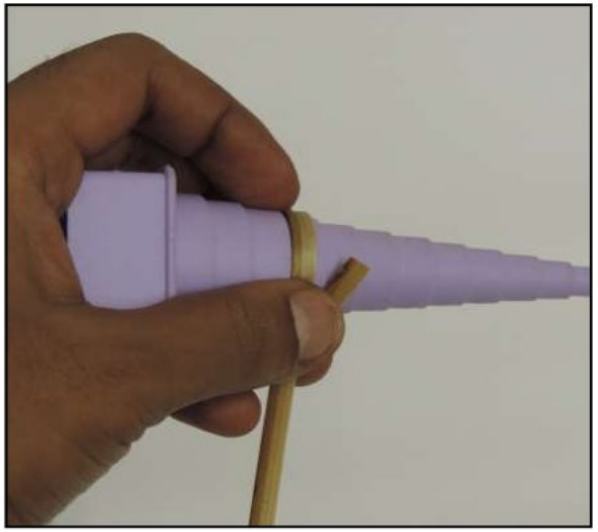

Fig. No: 5.88

Fig. No: 5.89

Fig. No: 5.90

Ideations and prototypes (fig no. 5.90) were done for the tools in three directions - hand-held held tool(fig no. 5.91 and 5.92), handheld jig(fig no. 5.93) and machine held. The exploration in this directions led to creation of link tool.

Fig. No: 5.91

Fig. No: 5.92

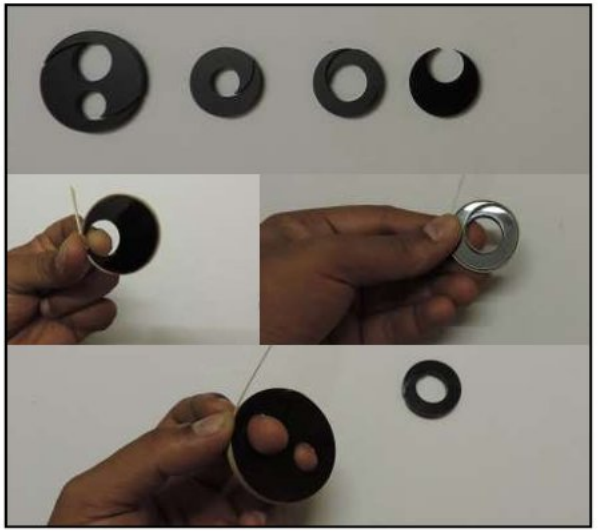

Fig. No: 5.93

Exploration in hand held jig were done.
fig no. 5.94 and 5.95 showing the process and fig no. 5.96 shows how the increase in the slot can help in introducing alternative colours.

Fig. No: 5.94

Fig. No: 5.95

Fig. No: 5.96

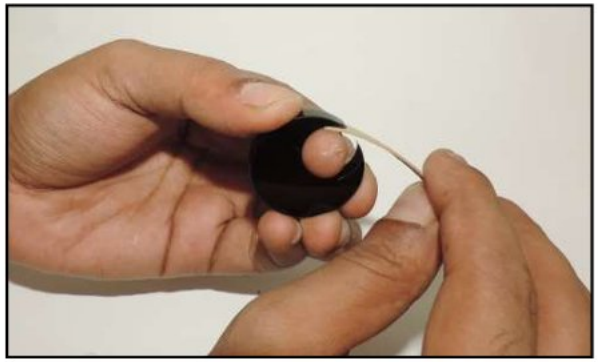

Fig. No: 5.97

Fig. No: 5.98

Fig no 5.97 to 5.102 show the process involved in the link making process

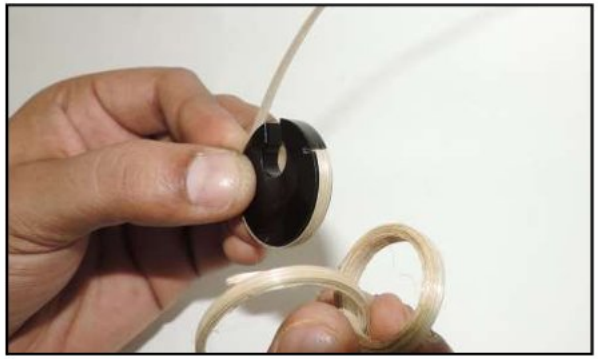

Fig. No: 5.99

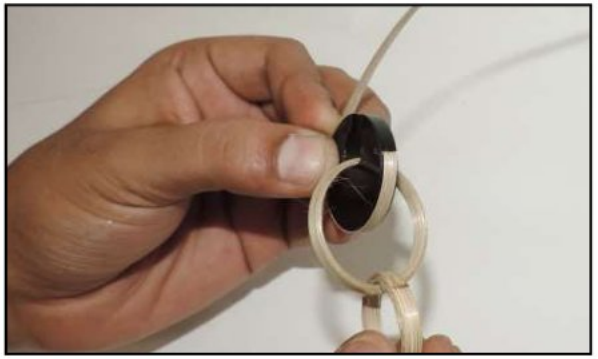

Fig. No: 5.100

Fig. No: 5.101

Fig. No: 5.102

5.11
Negative Mould

Using positive mold hampered the precision in thickness and outer diameter manufacturing as controlling the thickness was difficult. Which led to the exploration of negative moulds

In quilling, negative mold/quilling board (fig no. 5.103) is a useful tool for making and replicating closed coils of standard sizes. Some other tools like tweezers(fig no. 5.104) and needles(fig no. 5.103) are also used in this process. In case of paper quilling, coiled paper is first placed in the negative mold,which is then allowed to fill the gaps by expanding, it either used to make loose coils or the shape of loose coil altered using needles or pins.
Since bamboo strips are not as flexible as paper, this technique could not be applied for bamboo coiling (only circular rings are formed(fig no. 5.104)).
However during trials with strip, I realized that if **perimeter of rings(circle) is matched to perimeter of other shapes(fig no. 5.105)**, we could create bamboo rings first then moulding them into other shapes, hot air applied to retain the shape.

Fig. No: 5.103

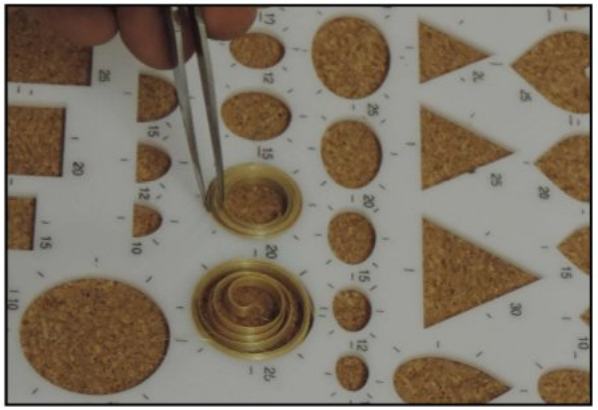

Fig. No: 5.104

Fig. No: 5.105

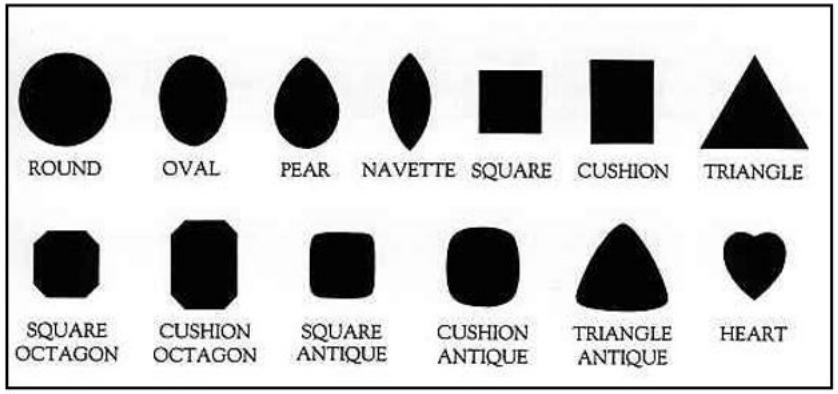

Fig. No: 5.106

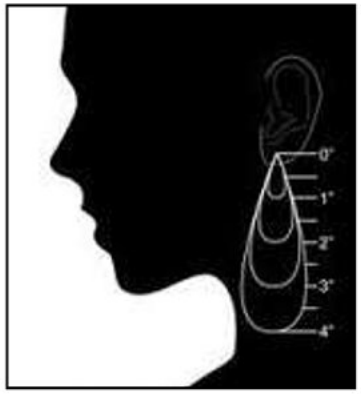

Fig. No: 5.107

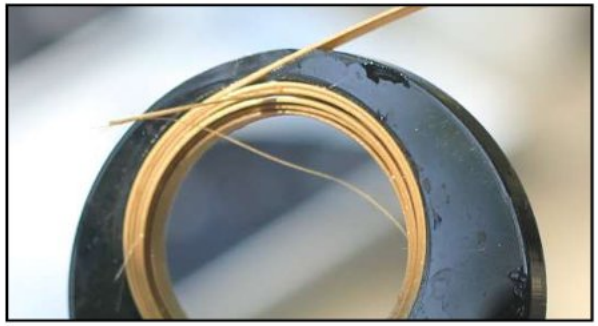

Fig. No: 5.108

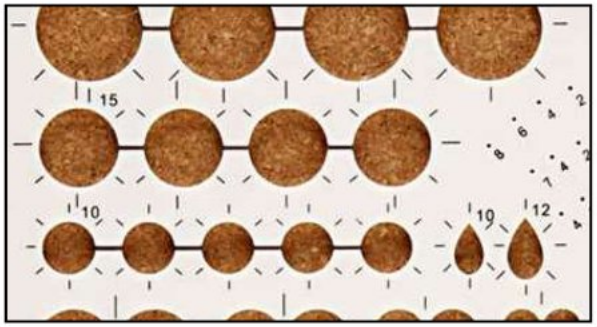

Fig. No: 5.109

Fig. No: 5.110

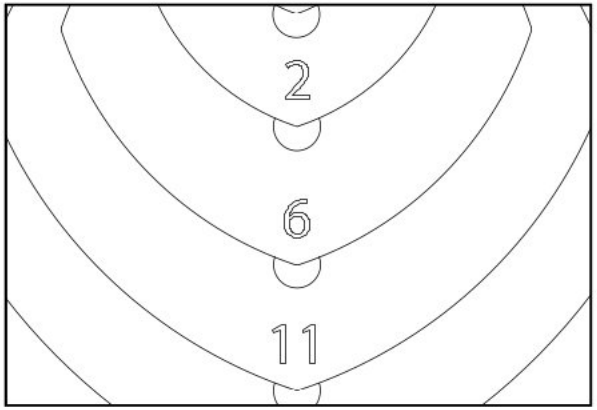

Fig. No: 5.111

While designing the negative moulds, I took into consideration

Size (standard measurement of earring which goes up to 4 inch(fig no. 5.107) ,

Reference of **shapes** were taken from standard stone sizes used in jewellery sizes(fig no. 5.106).

Slot for controlling ring thickness(fig no 5.108).

Markings at different angles similar to quilling board (so, that precision open shapes can be created by cutting, chopping the formed shape)(fig no. 5.109).

Numerals for mapping rings to shapes were given for ease in instruction and reference during the use(fig no. 5.111).

Space for tweezer, for ease in handling(fig no. 5.110),

Small increment in the perimeter of the shapes having sharp edges to have ease in shape forming and avoid sharp bends or we can use lower numeral ring perimeter

As well as design for manufacture(USP).laser cutting to create moulds which can be effectively used for creating multiple shapes and sizes.

The process involves first selecting the shape required along with the corresponding ring tools (fig no. 5.112),
Making coils by hand or the idc coiling tool.
Then coil is allowed expand in desired ring tool (fig no. 5.113)
And thickness is controlled by adjusting the strips through the slot and cutting the excess length (fig no. 5.114)
After that the coil is taken out with the help of tweezer (fig no. 5.116 and 5.118)
Then formed and glued in to corresponding to the numeral of the desired shape and a hot air could be used to retain the shape before putting it out. (fig no. 5.117)

Fig. No: 5.112


Fig. No: 5.113

Fig. No: 5.114


Fig. No: 5.115

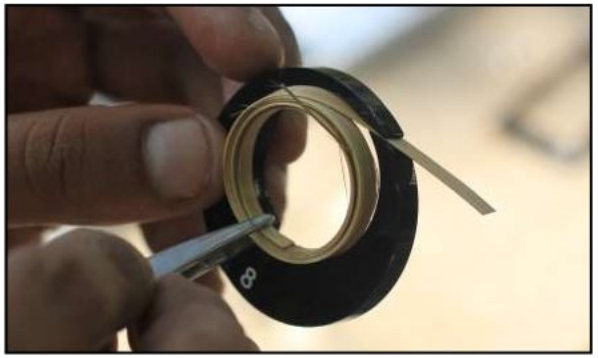

Fig. No: 5.116

Fig. No: 5.117

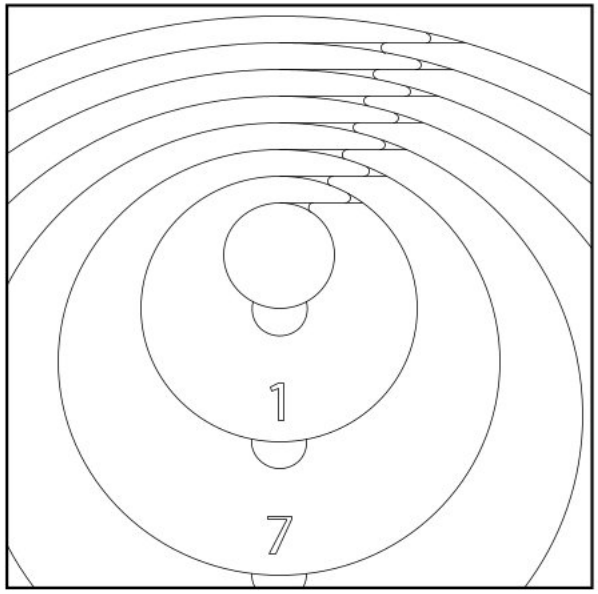

Fig. No: 5.118

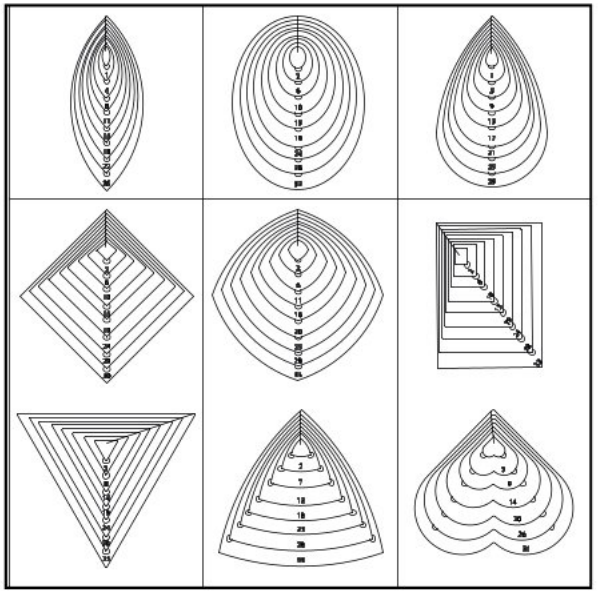

Fig. No: 5.119

Fig. No: 5.120

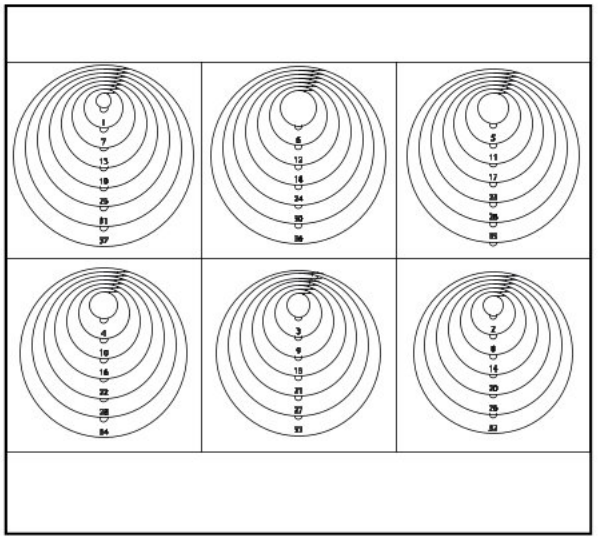

Fig. No: 5.121

The form of the jigs came out purely out of function (DFM), when I was trying to arrange the shapes asymmetrically
(fig no. 5.116) (to accommodate the numerals for ease in use and instruct),earlier the shape were concentrically arranged for the ease in manufacturing.
Also the ring moulds have a special feature which enable it to arrange in progressive(fig no.) chronological order which is similar to ring gauge tool(fig no. 5.120) in the jewellery making tools
Fig no. 5.119 and 5.121 showing the set of shape along with the ring set.
Another interesting feature which can be added in order to use the tool as +ve mould (I have not added it to avoid confusion).

5.12
Grid tool

The Quilter's Grid Guide (fig no. 5.122), is yet another creative tool which allows the user to have freedom to make new designs.
1st prototype (fig no. 5.123) was made to under stand the factors effecting the tool after which I looked into other grid tools used in jewellery making and I came across grid tool used for wire bending tool(fig no. 5.124 to 5.127), bangle making tool(fig no. 5.126).

Fig. No: 5.122

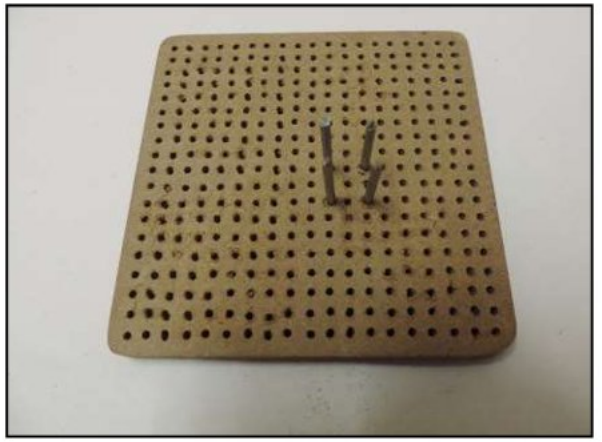

Fig. No: 5.123

Fig. No: 5.124

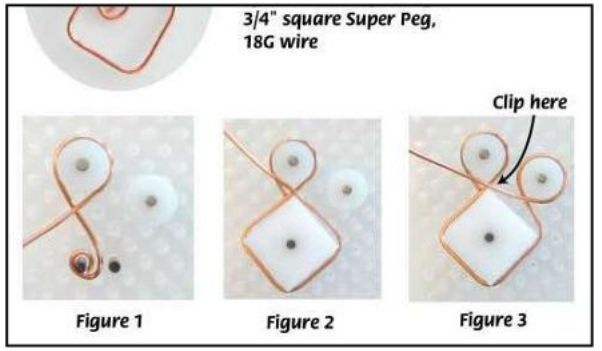

Fig. No: 5.125

Fig. No: 5.126

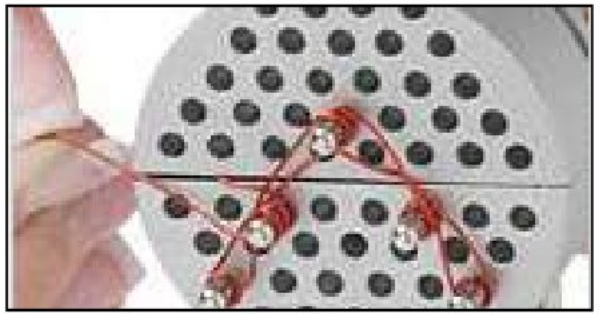

Fig. No: 5.127

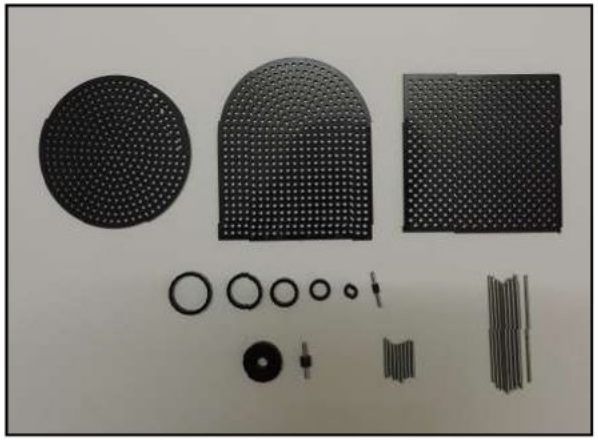

Fig. No: 5.129

Fig. No: 5.130

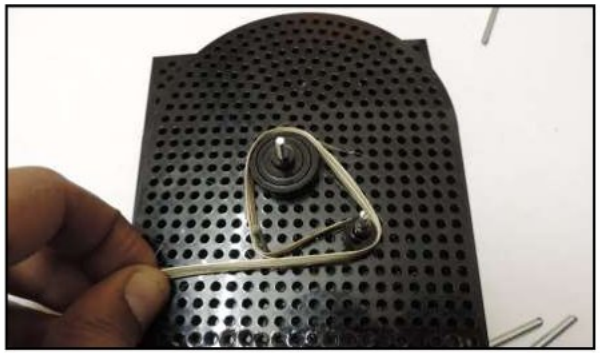

Fig. No: 5.131

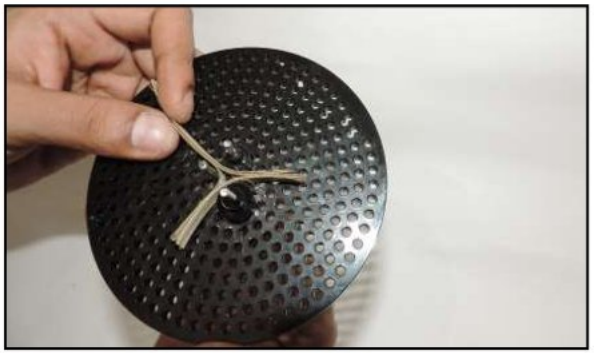

Fig. No: 5.132

Fig. No: 5.133

Fig. No: 5.134

Redesign was required in grid tool to allow usage of bamboo strips which only requires radius (sharp bends cannot be formed) to form. But this tool was an additional yet creative. (The major advantages this tool is that it can lead to new designs and new product specific tools can be developed)
(fig no. 5.129 to 5.134)

5.13 Development of Idc coiling tool

Then I decided to incorporate the grid tool in the existing IDC coiling tool (fig no. 5.137) and furthermore developing it to increase in functionality and usability while retaining the existing functions and use of the tool(fig no. 5.137).

Earlier the Idc coiling tool was used to make coasters(fig no. 5.135) and bangle rings. Now because of the grid tool it has feature which allows it used to create multiple **closed shapes** and **open shapes** also new bangle designs similar to how wire is used **bangle making** (weaved designed)

Fig. No: 5.135

Fig. No: 5.136

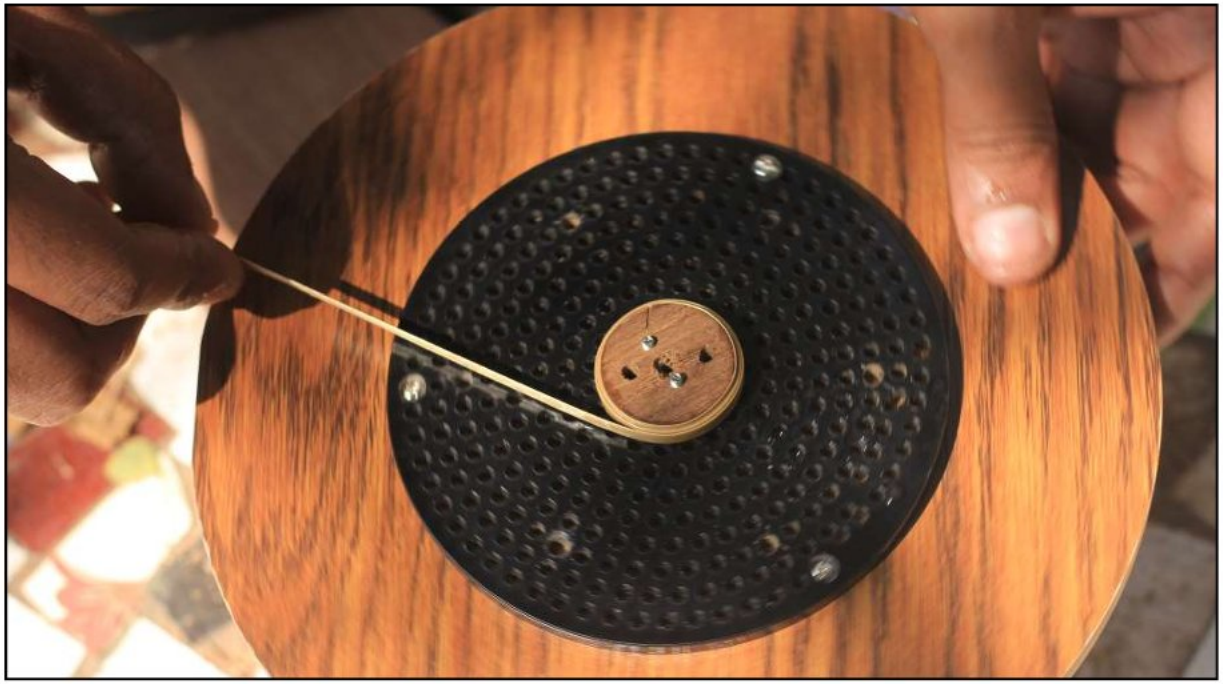

Fig. No: 5.137

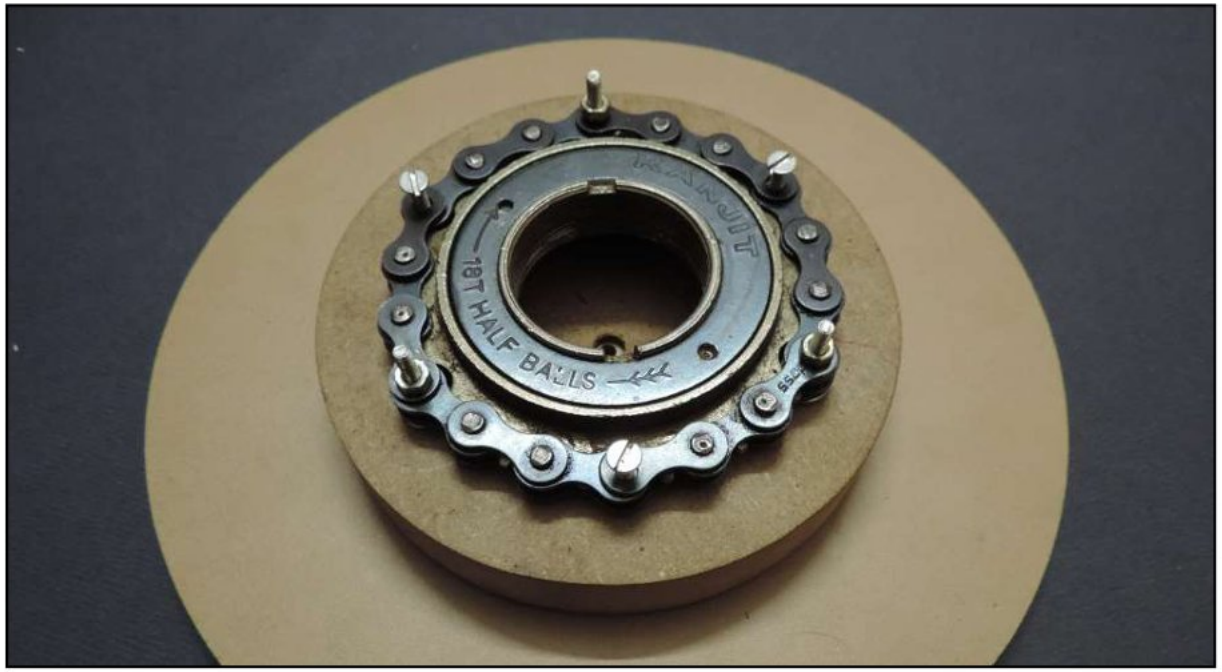

Fig. No: 5.138

Fig. No: 5.139

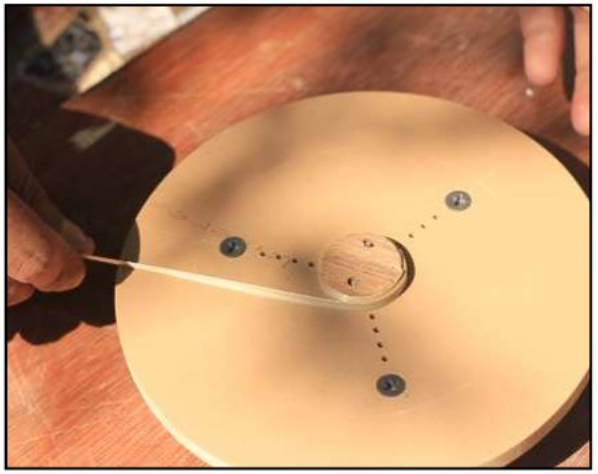

Fig. No: 5.140

Unique features of this tool is that it can be frugally manufactured in any place of india because the material which is used for making is a cycle part - ratchet and chains(fig no. 5.139), the joinery was further developed with chain link to make it easy to assemble (fig no. 5.138) the special feature of adding the ratchet is that it provides only one directional movement which is favourable for the coiling process (existing coiling tool was difficult for one person to manage and hold the tool so that the coil doesn't unwind fig no. 5.135) because of one directional restriction by the ratchet now one person now can easy handle (fig no. 5.140)the complete process and having better comfort in usability.

5.14 Some Process Tools

The exploration of the existing process and tools also highlighted some basic needs of tools for important supporting operations (I.e. cutting(fig no. 5.144), drilling(fig no. 5.143), sanding etc.),
Along with a gluing tool specifically for bamboo strips,shown in fig no. 5.147
Which was added to the tool set along with existing tools of cutting.,drilling and sanding, idc sewing tool.

Fig. No: 5.141

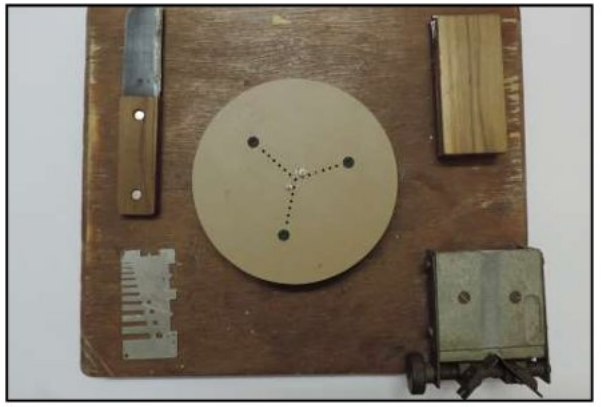

Fig. No: 5.142

Fig. No: 5.143

Fig. No: 5.144

Fig. No: 5.145

Fig. No: 5.146

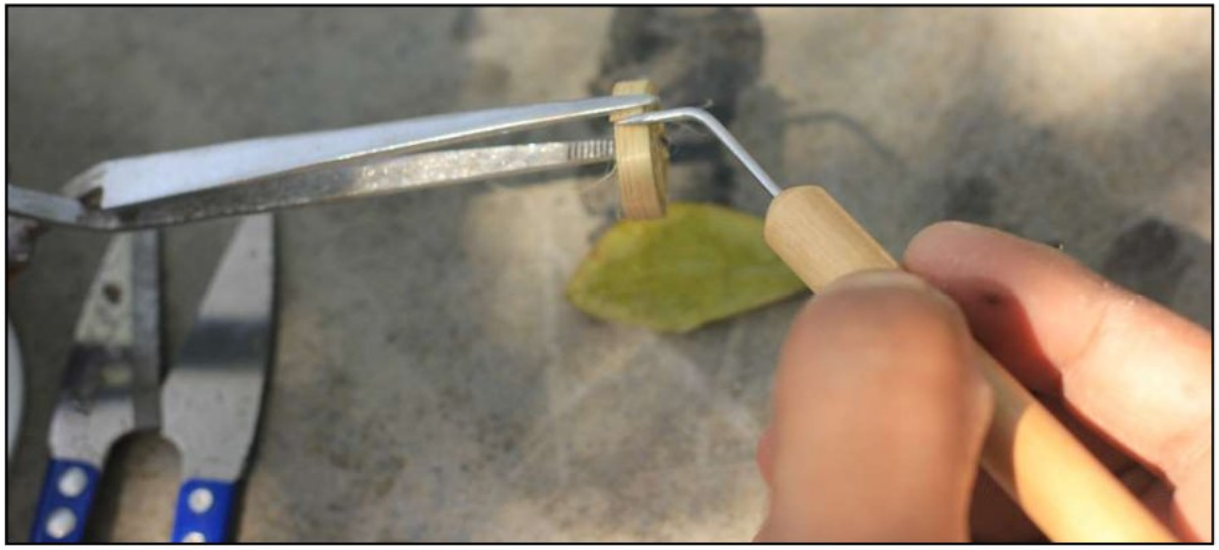

Fig. No: 5.147

Apart from gluing the loops (fig no. 5.147), the tool is used in other process like adjusting the loops (fig no. 5.148) and making flexible loops (fig no. 5.149)

Fig. No: 5.148

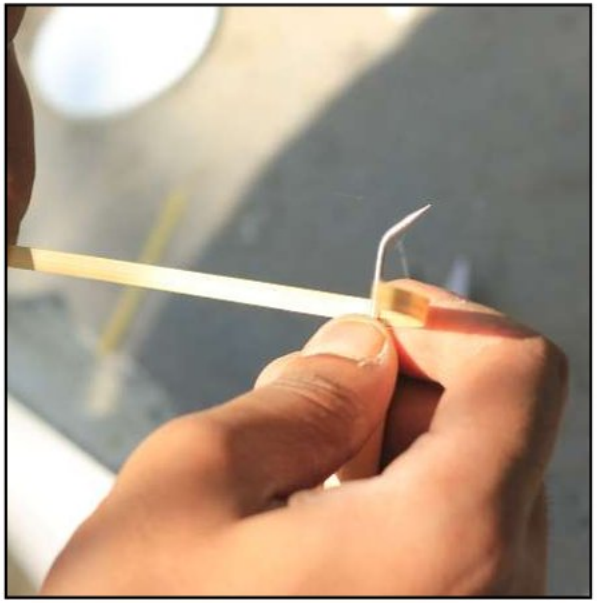

Fig. No: 5.149

Chapter 6

User Profile

Shape generation tools are designed by keeping in mind that artisan or a craftsman is going to use them and during my user study I came across two types -

self employed

NGO employed.

Both the system have different requirements a self employed artisan like Ganga ma needs jewellery tools along with the shape generation tools and the tools can be multifunctional at the same time

However for a jewellery unit which mass manufactures bamboo jewelries like Uravu need only shape generation tools. This Is because they already have the general jewellery tools(cutting,bending pliers) for making the joineries and other additional parts of jewellery assembling, also if the tools are multi functional then it can reduce the mass manufacturing of jewelries.

Since the shape generation tools will be new to the system so further development of the tools cannot be done until tool evaluation (at a mass scale for further understanding), which will take time .

I further categorised the tool kit into three categories which are as follows.

Democratic kit (for single user) which will be low cost and as frugal as possible. so that it reaches to mass population of india

Mass Manufacture kit the tools will be made so that they are easy to mass manufacture within the system

Premium kit (Evolve) these tools are for a higher class craftsman (or artisan)for whom the tools would be one time investment.
I decided to go with the premium category because it could be test kit for a mass manufacturing unit (like Uravu) as well.

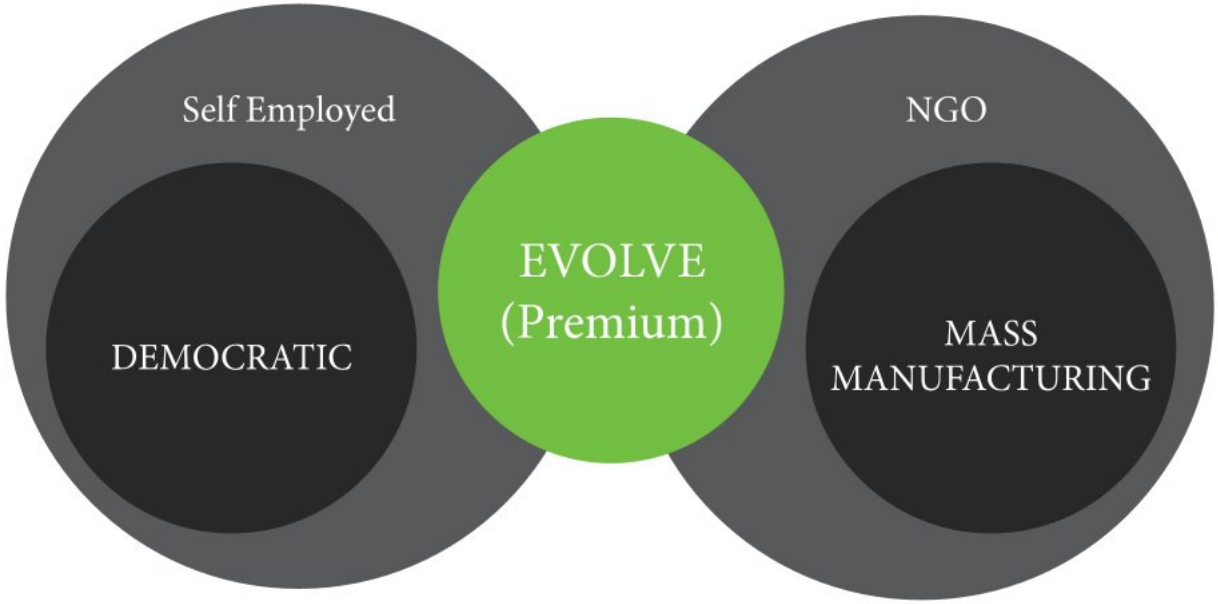

Fig. No: 6.1 Showing the possibility of the tool kit

Chapter 7

Final Concept

Premium Toolkit (Evolve) was chosen because it is suitable for both the scenarios mentioned in my user profile

Further discussions with A G Rao sir and V Bapat sir lead to understanding another important aspect of the tool kit, it is critical to have a training manual (introduction of new tools to the system requires correct information and knowledge about the tools along with product possibilities which needs to be imparted properly). So the tool kit along with the manual were decided to be the part of the final concept(fig no. 7.1 and 7.2 in the next page).

Fig. No: 7.1 - Showing the kit of hand held tool

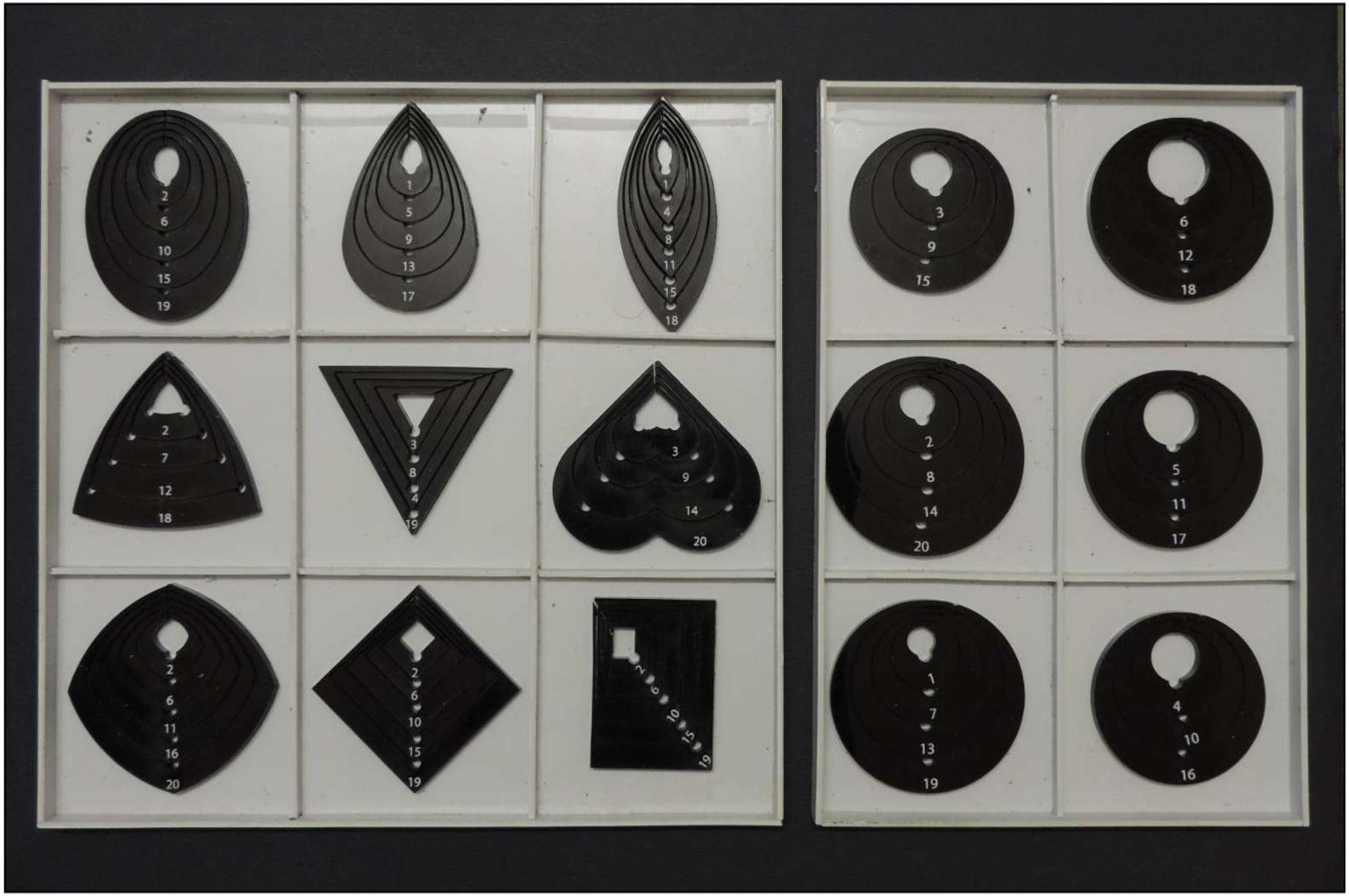

Fig. No: 7.2 - showing the kit of fixtures and jig of shapes

7.1
Tools associated with the shapes

The following are the major shape generation tools associated with the project.

Slotted tool with thicker slot (fig no. 7.3) which can accommodate multiple coloured strips, along with the coach tool (fig no. 7.4) used for achieving precise diameter of the coil. Which is used to create

Tight coils of various colours (fig no. 7.5), also multiple strips can be added to get different designs (fig no. 7.6).

Fig. No: 7.3

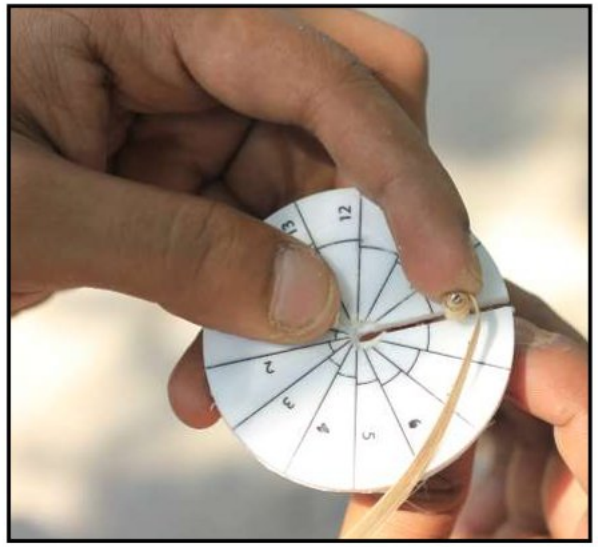

Fig. No: 7.4

Fig. No: 7.5

Fig. No: 7.6

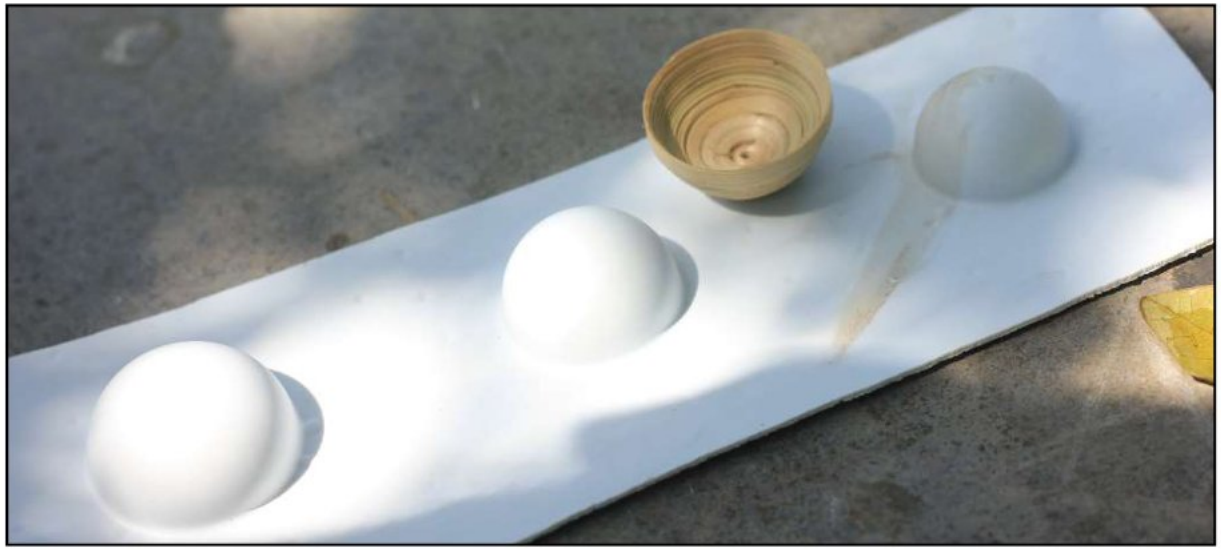

Fig. No: 7.7

The tight coils can also be formed to create different 3D shapes with the help of mini mould tool (fig no. 7.7) to form hemispherical domes of different colour combination.

Hemispherical domes which can be used for jhumka (fig no. 7.8), also two domes can be added to get beads of different sizes (fig no. 7.9).

Fig. No: 7.8

Fig. No: 7.9

Fig no. 7.10 showing two flatted slotted tool of different sizes to which is used in making vortex coils (fig no. 7.11) of different colours

Fig. No: 7.10

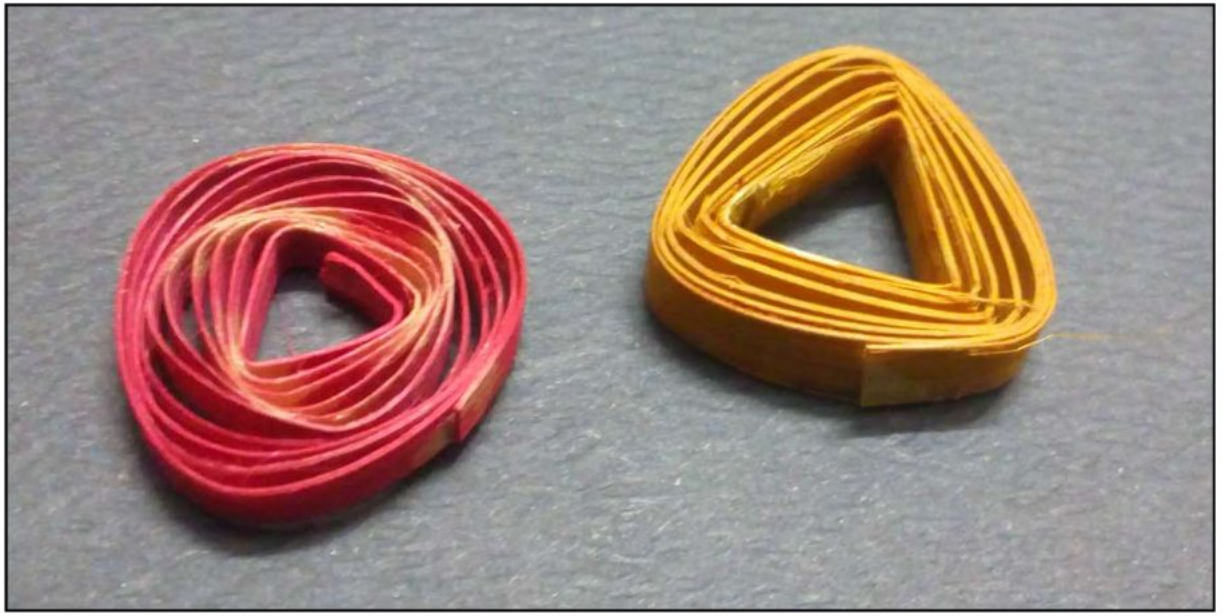

Fig. No: 7.11

Fig. No: 7.12

Fig. No: 7.13

Fig. No: 7.14

Fig. No: 7.15

Fig no. 7.12 showing Comb tool which is used to create evenly shaped loops. It is used to create the following shapes.

Basic coils with loops(fig no. 7.14 - top two coils)

Alternative looping coils(fig no. 7.14 and 7.15)

Two directional wrapping coils.
(fig no. 7.13).

Fig no. 7.2 which shows the kit of fixtures for generating multiple shape and of different sizes.

Different sizes and colour of circular coils (Fig no. 7.18) which can be made using ring fixtures (Fig no. 7.16)

the circular rings produced can be formed to different shaped (according to the perimeter which is corresponding to the shapes perimeter identification numerals are given) (Fig no. 7.19)

the outer profile also can be used in the generation of shapes (Fig no. 7.17)

Fig. No: 7.16

Fig. No: 7.17

Fig. No: 7.18

Fig. No: 7.19

Fig. No: 7.20

Fig no. 7.20 shows different permutation and combination of shapes which is achieved by cutting,chopping and use of shapes created by tool kit.

Fig. No: 7.21 showing the Branding

Chapter 8

SWOT Analysis and Value Proposition

Strength
Frugal manufacturing
Easy to maintain
Gradual learning curve
Minimal design
Cost effective

Weakness
Introduction of tools and traning is required
Understanding of tools and their limitations-as it is a new area.

Opportunities
Unexplored market space

Threat
Tools are easy to replicate and copy
v

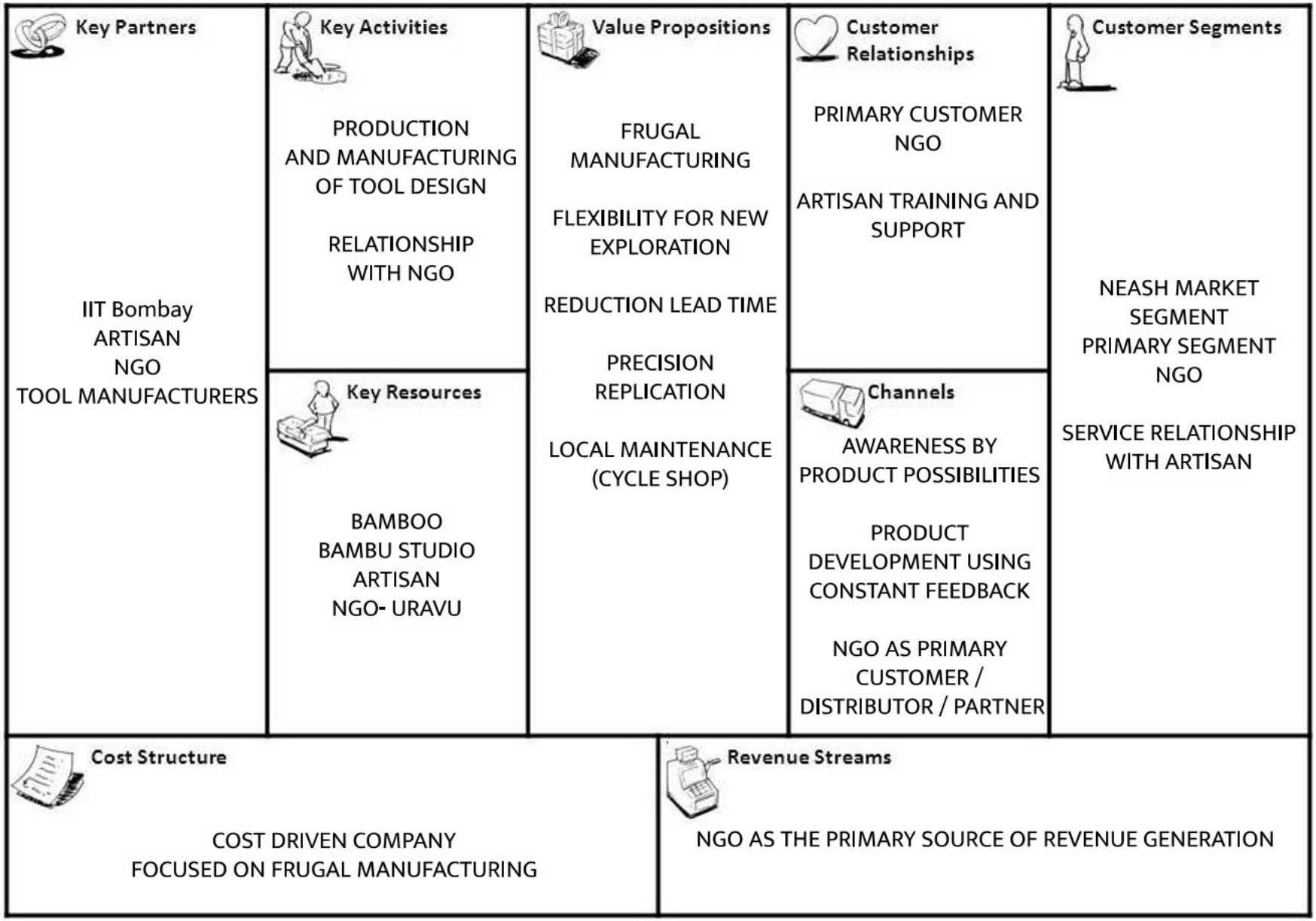

Fig. No: 8.1 Showing the Value proposition chat

Chapter 9

Future Scope

Implementation

Different **test kit** for deployment
Development of **catalogue** for training
Training of the artisan for **validation and evaluation** of tools
Manual for Frugal manufacturing of the tools in the system

Development of the toolkit

Identifying, studying and incorporating **other techniques** like wire bending jewellery ,Origami paper folding which is similar to north-eastern cane folding jewellery designs
Exploration and Catalogue generation for **colouring and gluing techniques** for jewellery and strips
Additional material available - **jewellery parts** which could be useful for jewellery designs
Manual for possible shapes and there form manipulation (cutting, chopping, SCAMPER methods)& exploration is needed for showing the product possibilities from the tools

Tool exploration possibility

The developed tools can be suitable for other lifestyle accessories which can be identified during the user testing of the tools in different scenario
The grid tool which was incorporated in the coiling tool which can be further developed for many possibilities like it can eliminate or incorporate all the other shape generation tools (a modular set eg. fig no. 9.2), also the exploration with the tool can lead to many product specific tools similar to goggles mould.

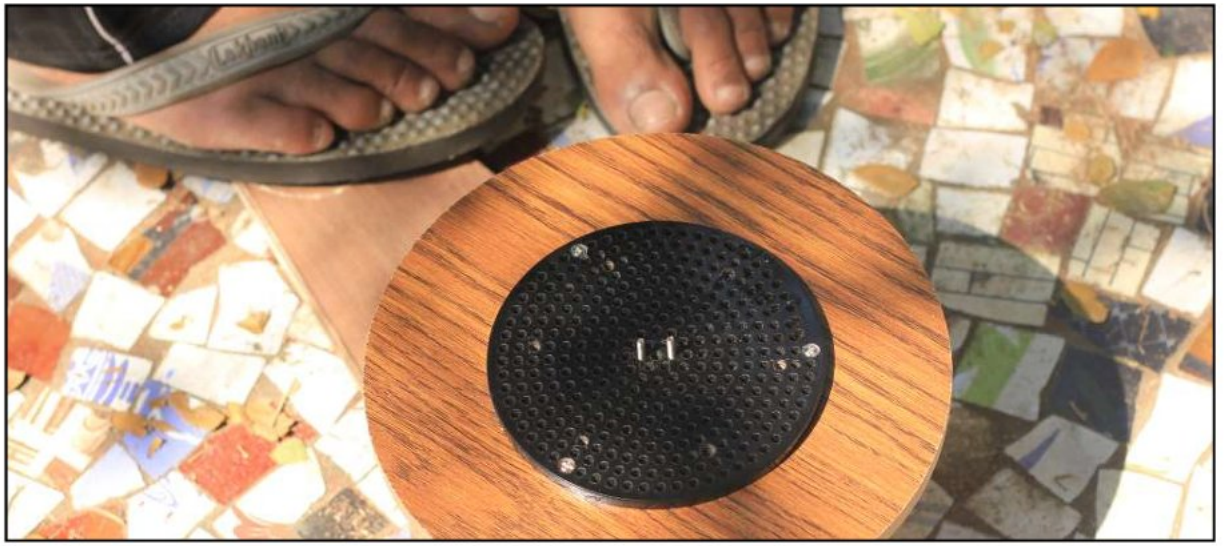

Fig. No: 9.1

Fig. No: 9.2

Chapter 10

Reference

Text
1 and 3 - Paper quilling - Wikipedia the free encyclopedia [Online]Available at: https://en.wikipedia.org/wiki/Quilling
2 - Ebook Titled 'Bamboo: Structure and Culture' Content - 3 modernization of bamboo in industrial context
4 - www.shop.gaath.com

Image Sources

Fig no 1.1 and 1.12 -Ebook Titled 'Bamboo: Structure and Culture' fig no 4-2 the triangle of material utilisation system

Fig no 1.13- Project1 Report pdf (Student name- Shashank Gautam IDC PD 2014-16)

Fig no 1.2 to 1.11, 3.13 - Uravu

Fig no 2.1 -http://makezine.com/2013/06/24/gorgeous-quilled-map-of-the-world/(on 23.12.2016)

Fig no 2.2 - https://s-media-cache-ak0.pinimg.com/originals/c8/1d/7c/c81d7ccf168a2198b478979f45eadfd5.jpg (on 23.12.2016)

Fig no 2.3 and 5.74 - https://i.ytimg.com/vi/fGKqHxKW5O8/0.jpg (on 23.12.2016)

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