

# **Transformable Furniture**

Industrial Design Project-II

## **Submitted by :**

Roshan Lawrence Valder  
08613007

## **Guide :**

Prof. B K Chakravarthy  
Industrial Design Centre  
Indian Institute of Technology Bombay  
Mumbai- 400076

## Approval Sheet

The Industrial design project 2 entitled "Transformable furniture" by Roshan Lawrence Valder (08613007) is approved in partial fulfillment of the requirements for Master of Design degree in Industrial design.

Guide :

Chairman :

Internal Examiner :

External Examiner :

## Declaration

I declare that this written submission represents my ideas in my own words and where others' ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/ source in my submission. I understand that any violation of the above will be cause for disciplinary action by the institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

Signature:

Name of the Student:

Roll No.:

Date:

## **Acknowledgement**

I would like to express my sincere thanks to my guide Prof. B.K. Chakravarthy for his valuable guidance and support.

I would like to thank the IDC Faculty for their feedback and constructive criticism.

Finally, I would like to thank all my friends for everything they did.

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## Abstract

With growing population and the influx of people into the cities, urban India has had a constraint on living space. In a city like Mumbai, even entire families live in single roomed apartments. So there is a lot of emphasis on space in such homes.

All basic activities happen in the living room which also doubles up as a dining area, TV viewing, study room for kids and bedroom. An ideal piece of furniture would be one that elegantly addresses all these activities.

Transforming furniture is not a new concept. The standard Sofa Bed is an example of a piece of transforming furniture. Recently, however, different variants have been popularized with the emphasis on style. Sofas that transform into bunk beds, or a bed which transforms into a cabinet are modern examples of transformable furniture.

Throughout this report, transformer and transformable furniture would be used interchangeably to mean the same.



## 1. Data collection

Basic furniture consists of the types shown beside. Any transformable furniture would have a mode that would take up one of these types.

Furniture has evolved from just elevating man off the ground to help provide him comfort and aesthetic appeal.

In smaller homes, the opulence of intricate curved and ornate furniture is reduced to its bare minimum without losing out on its aesthetic appeal in a bid to save space.

A study was conducted to see what furniture was being used in small urban homes.

The aim of this study was however not just that. It also sought to find out the problems of existing furniture in these small homes and problems of the residents in their daily life

## 1.1 Diachronic Analysis

Though not mainstream, transformable furniture were in existence for a long time.

Some transformers have two or three modes of transformation

for example:

first mode would be studying, reading, writing,  
second mode would be comfortable sitting for relaxation and contemplation  
third mode ; informal conferencing ...

The secondary modes seemed to be derived out of a need of a particular situation.

Because of the contrasting modes, transformable furniture face an array of issues that demand operating efficiency. To the user this change in mode would have to be effortless and simple.

The main categories of transformable furniture are

- transformers you can use in two (or more) different ways without changing mode;
- transformers that change modes
- accessories are attached to the chair (linked);
- accessories in use only for one mode, can be taken apart (not linked).





Drawer chair  
1760 English



desk chair with  
drawer, 18th  
century, USA



18th century comb-  
back Windsor writing  
armchair USA



table=chest  
by  
tomoko azumi, 1995



storage chair  
by  
eduardo luigi  
paolozzi, 1986

## Storage Chairs

These chairs incorporate some storage facility usually beneath the seat itself since this area is traditionally vacant and hence can add a good amount of storage.



louis XVI easy chair ca. 1780



napoleon III steel camp day-bed  
france, circa 1850



foldable recliner by eileen gray  
france, 1938A



thonet foldable chaise-longue, austria, ca. 1890



'Wink' by toshiyuki kita  
manufacturer cassina,  
italy, 1980



stretcher chaise by mies van der rohe,  
germany, 1928

## Recliner Chairs

Recliner chairs are classic examples of transformable chairs that change from a sitting position to a more relaxing reclining position. Shown beside are few examples of recliners throughout the ages.



rectangular chair table, 1750 ca., england



Chair folds into a table, design by shin & tomoko azumi



Chair folds into a table, design by kathleen stone



round chair table, 18th century, USA



'unit', a small breakfast / working place, design by j. philström and g. moer

## Table Chairs

Table chairs are transformer chairs that mix two distinct functions. However, when the table is used, the chair function cannot be used.

## 1.2 Synchronic Analysis

Although many examples of transformable furniture exist, the focus was on furniture that could be used by the family and in the living room. Furniture that could cater to the primary function of eating, sleeping, sitting, storage, storability and ease of use.

Some examples (from the net) were taken that provided to some or all of those needs and an analysis was done.

This was done to see what kinds of products are available in this realm and identify any gaps that could be filled or issues that could be solved.



Godrej brussels sofa chair

## Advantages

- Smoother transition than traditional sofa beds
- No mounds created
- Better aesthetics and easy to clean

## Disadvantages

- Expensive and large
- Bed doesn't stay in position
- No option of Storage



Murphy bed

## Advantages

- Takes the least amount of space when not used
- Looks completely hidden

## Disadvantages

- Tedious to put back
- Immovable
- Installation is tedious
- No utility in upright position



Wardrobe workstation

## Advantages

- Workstation out of a cupboard
- Includes a stool
- Has options for all kinds of storage
- Hides the storage completely and elegantly

## Disadvantages

- Large footprint upon opening
- No utility when the doors are closed
- Writing area is insufficient



Kapsule chair

## Advantages

- Easy manufacturing
- Fully plastic and durable

## Disadvantages

- Tedious to open and close
- Person sitting will have to vacate for any storage activity.

## 1.3 User studies

User studies were conducted in apartments in Khandivili and Borivili . The area of these apartments ranged from 350 sq ft to 500 sq ft.

The 350 sq ft apartments had only one room which doubled as a bed room. Some converted their kitchens into bedrooms.

Middle Class families of at least four live in these apartments.

## Sofa Beds



Looking into these small homes, you would come across many variants of the sofa cum bed. A typical sofa bed would consist of a wooden base 6 ft in length over which a rollable mattress would be laid for seating and sleeping. The hollow base would also be used for storage. Some are extendable, expanding the bed up to three times its width.

It happens to be the most used furniture in the house as it caters to the basic functions of sitting and sleeping. Most activities like watching TV or children studying are done on these sofa cum beds. It can hold up to four people in the sofa position and can accommodate up to three people while sleeping.





## Folding Tables

Folding tables are another common feature of small homes. They can be folded and stowed away when not in use but their operation seems to be a deterring factor for frequent use. However, the users do look out for furniture with such ability to save space.

They are quite often stored at hard to reach areas (under the bed). The users also can't keep anything heavy in front of the fixed tables since they would have to move them when the table has to be used.

The type of folding table on the top left seems to be used for different purposes in different households. One household used it as a computer table with the flap resting the keyboard. Another used it traditionally as a dining table on demand. Yet another used it in the kitchen.





## Vertical Storage

Vertical storage is a consequence of living in a small home. Due to inadequate floor space and the need for the floor space for activities, expansion of storage would mean expanding vertically.

Frequently used items are housed in lower cupboards and rarely used items are stored on top, in cupboards that are directly below the ceiling.

Access to these high cupboards is done by means of a high stool.





## The showcase

The showcase is a very integral part of any Indian household used mainly as storage, display and often a TV unit.

It is the heaviest piece of furniture in the house and moving it is difficult, requiring disassembly.

Most showcases in small homes are of knock down type and are made by a local carpenter. They typically cover an entire wall or fit alongside it. Some however, are readymade, sourced from a local furniture shop



## Shoe rack

The shoe rack is usually an independent unit . One shoe rack had a provision for seating ( cushions) and drawers which held the shoe shine equipment.

One household had integrated the shoe rack within the showcase. Another had a shoe rack mounted on stone slabs.



## Ladder-Table

As an improvement to the high stool, the ladder cum table was used. Each of its sections were bendable allowing for the ladder to be transformed into a table structure and a seating structure along with a table top.

The product however was difficult and cumbersome to use involving turning of a screw as shown. As a result, The changing between modes took a long time

## 1.4 What users say?

Furniture should be easy to move and handle

Easy stow away ability and non obstructive furniture is needed so that it can be stored under the bed or away from view.

With more furniture, Passage and movement of the inhabitants through the house is an issue

They need to coordinate new furniture with the old while buying

They need a dining table but there is no space to keep one

Users need extra seating when guests come over. Need for serving and placing food/drink for them. Folding and plastic chairs are used but storage for them becomes an issue. And they take up space.

The showcase is the worst piece of furniture to move since it is bulky and heavy. However, a way around this issue has been devised by making it knock-down.



## 1.5 User Perceptions

They customize their furniture wherever possible

Their buying patterns involves collapsible or folding furniture. However, they prefer plastic chairs as they are lighter to move around and less prone to people tripping on them when compared to folding metal chairs.

Even if chairs are not available for the guests, any flat raised location is fine. Even stools will do. However, users will give the better chairs to the guests and use the stools

They have and are willing to adjust to current conditions.

Top left is a seating created by remodeling the structure near the window. The user has also created three storage spaces for his children's books and study material by using the wall itself.



## 1.6 Observations

Storage is done usually on a top shelf/ cantilever; access is by a high stool; This means vertical access solutions maybe required. However such access is infrequent.



Single mould Plastic chairs/stools are used because they last longer.

Folding chairs are heavier and have to be kept against a wall so they are prone to make people trip and fall



Stools can be used as tables, they are easy to stack and better than folding chairs in terms of durability. Hence in small homes they make good solutions





Furniture is usually pushed to the walls

Corners are used; This is a good space saving tactic.



Storage issues of recently/frequently used items e.g.. School bags

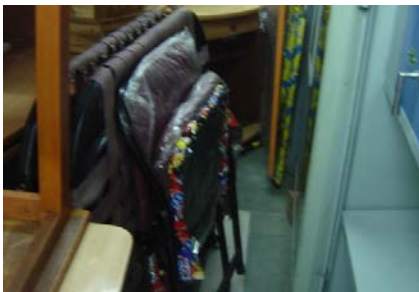


Inaccessibility between rooms through inadequate space and clutter

Guests sometimes sleep in relatives houses/ neighbors for lack of space



Furniture is reused in different situations. An old computer table is used in the kitchen to store kitchen items .



## 1.7 Local Furniture markets

A survey of local furniture markets that cater to the segment of people from small homes reveals that every product in their catalog sells as much as the other. However, Teapoy's are not in demand.

Sofa cum beds start from Rs 7000. Their basic frame is made of wood, steel and wrought iron. The frames made with steel are popular among most communities. Wrought iron painted in black is not accepted by some communities.

Folding chairs are not popular because of lesser guarantee they carry. Plastic chairs are popular and durable, have a brand name and carry a lifetime guarantee.

There was no product that added extra seating functionality to the existing product or even an integrated table.

## 1.8 Inferences

There is a need to create surfaces in the household primarily to place food items and frequently used items.

Although the households do need dining tables, they do not have the space to keep them. Moreover since the houses use the same sofa bed for even eating from, an integrated dining experience would solve the issue of space and clutter of furniture itself.

The existence of a separate dining table takes up space without the option of storage. The divan takes care of seating and storage but no surface to dine from.

Hence with an integrated dining, seating and storage experience, it is possible to save on space and remove the need for redundant furniture.

From the synchronic and diachronic analysis, . Traditional transformer designs took up more space due to their opulent curves and had cumbersome transitions. A modular approach to transformable furniture was not seen. Modularity could help in saving space and open up new possibilities for space saving.

Since most of the users have only one room at their disposal, the living room doubled up as a bedroom, so they needed furniture that could do both functions. Hence the popularity of the sofa cum bed.

As an offshoot of this, A dual seating and serving surface could help to save space but this was not available in the market

Moreover Elderly people eat while keeping a stool in front of them which is unergonomic and potentially hazardous to their health. Dinning table at the right height with easy access to it could help in this regard.

Traditional folding tables are hard to access as they are stored at hard to reach areas ( under the bed) or they have a cumbersome mechanism of opening ( spring based is quite tedious). The most popular folding table is fixed and immovable and hardly used but nevertheless people are interested in installing them!

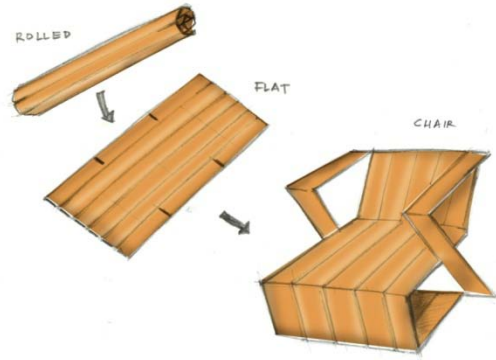
## 2. Product brief

To design transformable furniture that provides for additional seating and surfaces in small homes

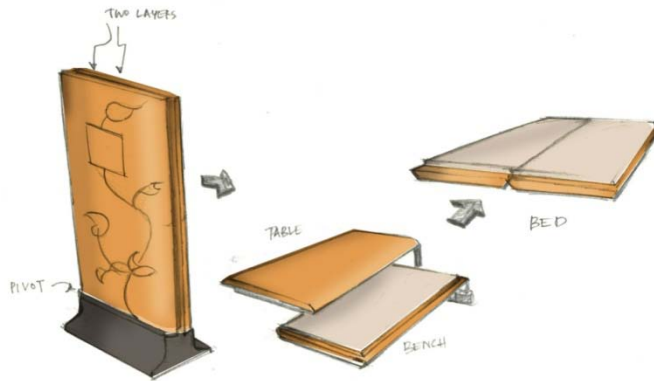
The furniture should transform to cater to at least two functionalities in the living room cum dining room

The furniture should be able to be produced by a mid range manufacturer capable of batch to small scale production along with customization abilities

### 3. Ideation



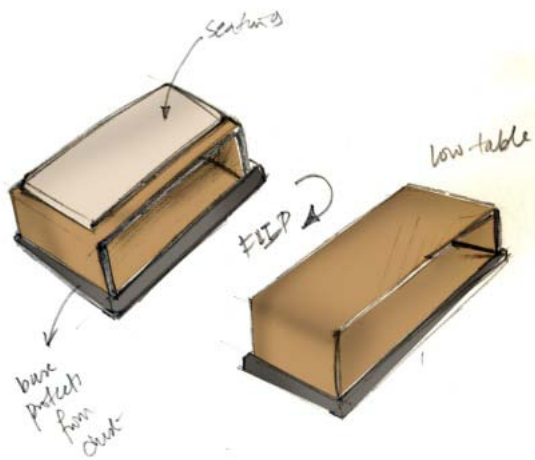
Roll able strips of wood are unfolded to produce the chair assembled by plopping on the ground



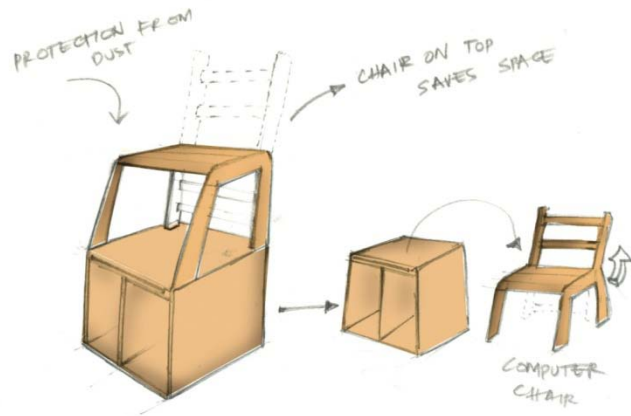
A seeming monolith consisting of two layers opens up to form a bed and desk/bench combo



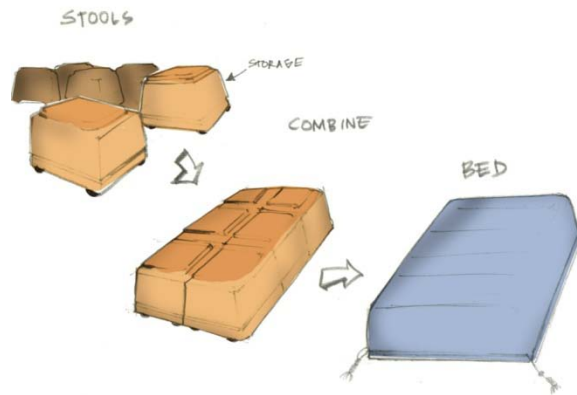
This shows a stool within a table which when removed can be combined to form a chair with a back rest



Inspired from a soap dish, a seating and coffee table can be obtained from this idea



The addition on top of the computer table is detached to form a chair for the table

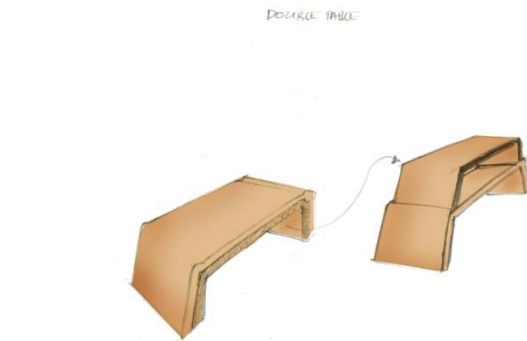


Individual stools with storage are combined to form a bed with a tight removable fabric covering

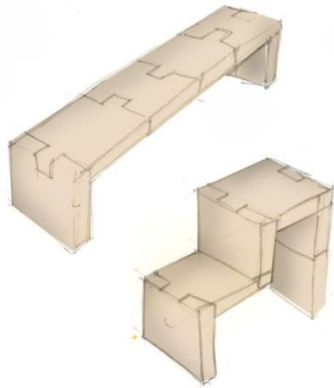




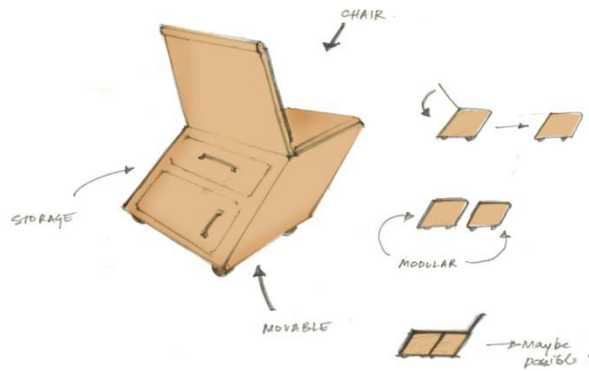
Two additional seating surfaces are available in this analogy of a curling spiders legs



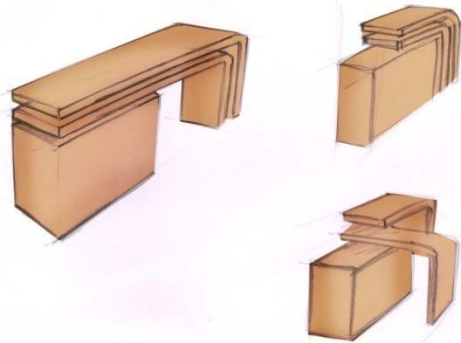
Height of the table is increased by this simple method of placing the nesting table underneath a table over it



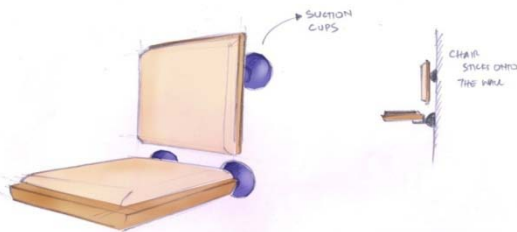
Configurable jigsaw like modules can be arranged to form the shapes shown besides other possibilities



Individual chairs with storage that can be moved and are a part of a modular system



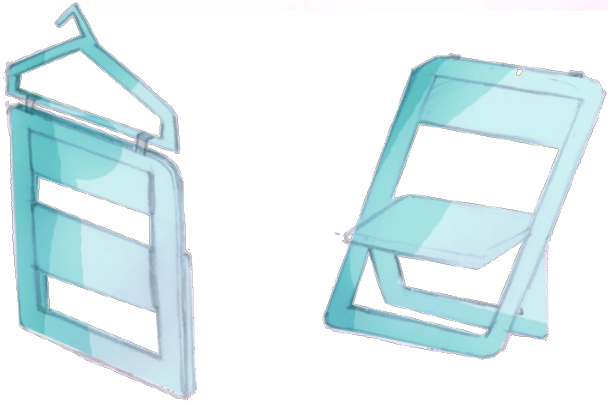
Swiveling system that provides for multiple tables at varying heights



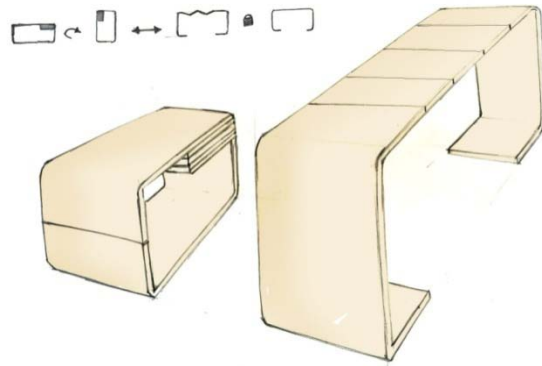
Chair with suction for fixing and removing off the wall



Stools with a smaller and bigger end. The smaller end when up becomes a seat and the bigger end when up becomes a small table.



Folding chair that can be hung from a clothes hangar



A coffee table that unfurls to form a higher table



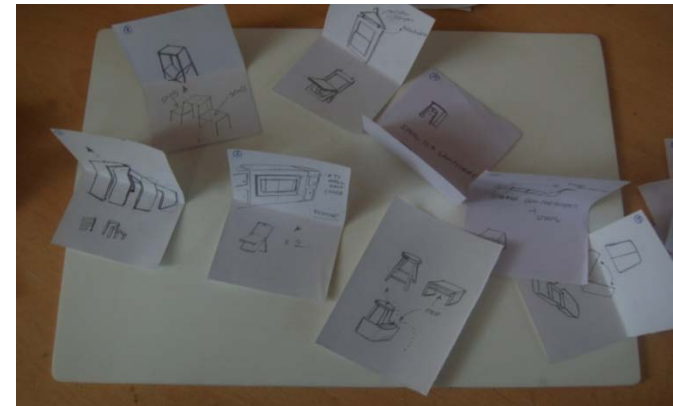
A coffee table that unfolds to form a higher table

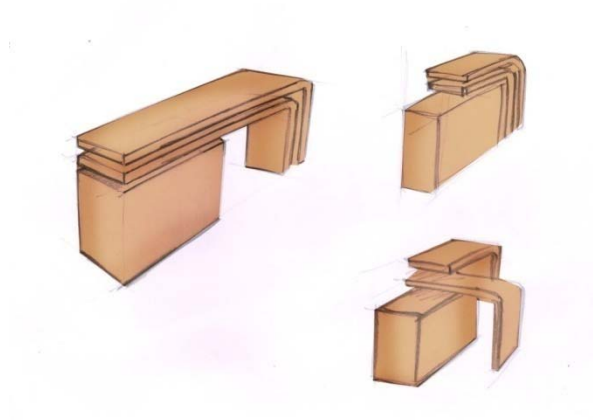


## 4. Concept generation

### 4.1 Clustering Group 1

All the ideas were taken and grouped according their primary mode of operation. Group 1 was made with ideas having a strong swiveling approach.



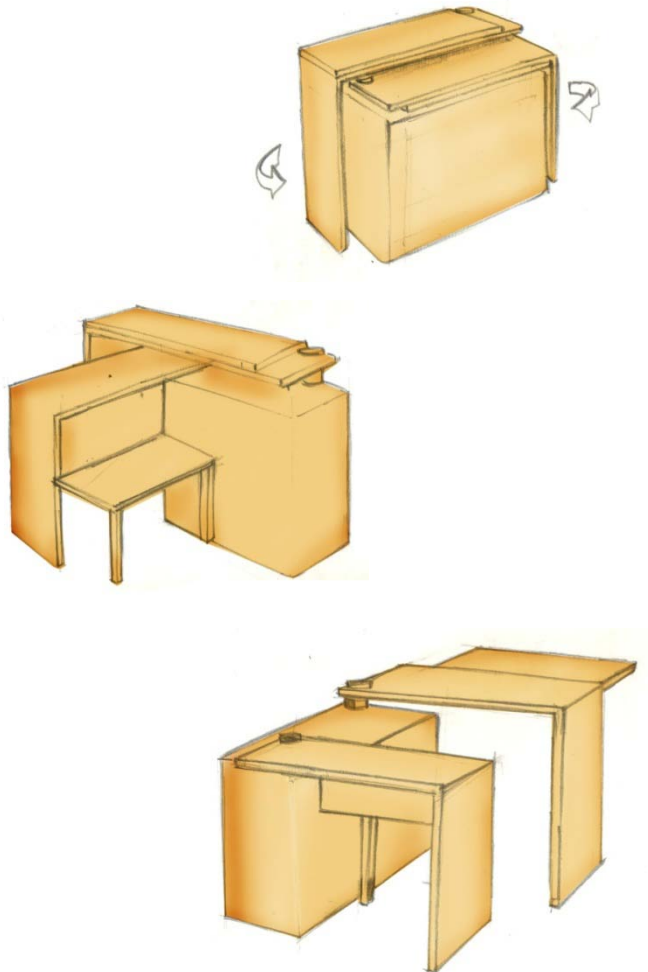


The figure shown beside is the principal idea taken for group 1

As shown it has a strong swiveling approach

Other ideas in the cluster were used to build over this. To obtain the following versions

## Cluster group 1 Version 0



### Advantages

- On demand features; collapsible when not in use
- Provides seating and surfaces at the same time

### Disadvantages

- Fixed distance between table and seat
- Big foot print during transformation
- No real use when collapsed apart from small space for keeping items





## Cluster group 1 Version 1

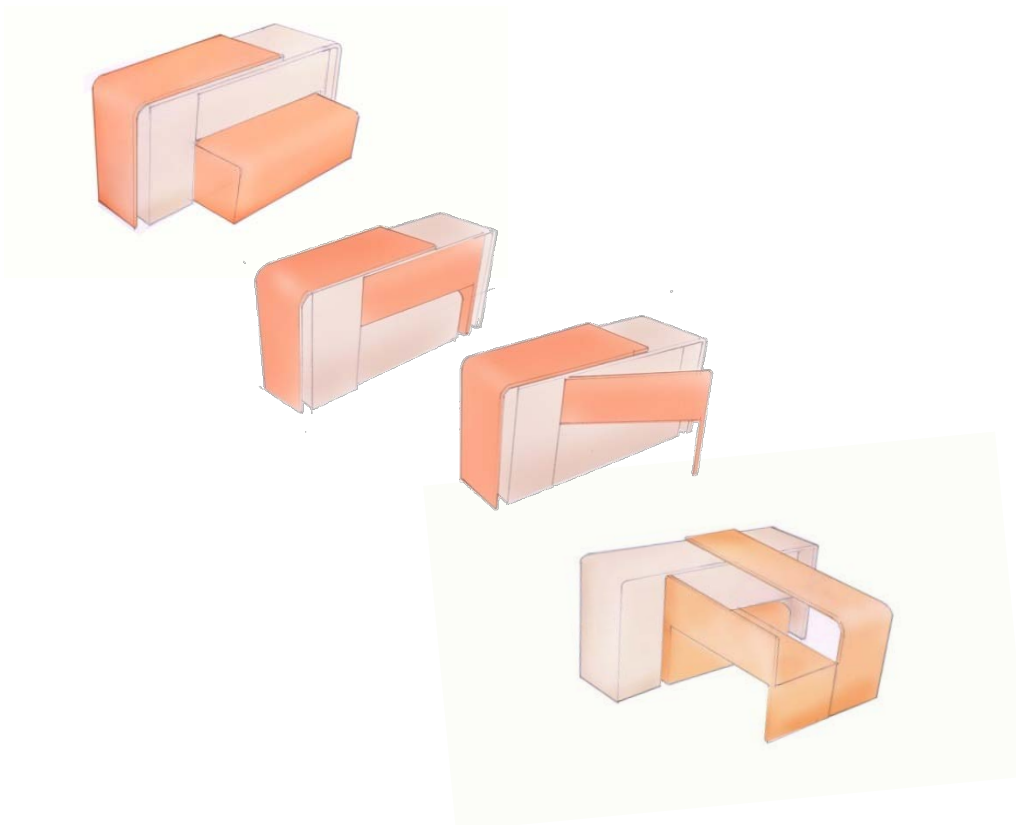
Attempt at completely concealing the storage part . The exterior façade would also be a seating point

Advantages

- Conceals the storage fully

Disadvantages

- Doesn't really fit in the homes
- Only seating provided
- Can it really work? Too many cascades



## Cluster group 1 Version 2

Advantages

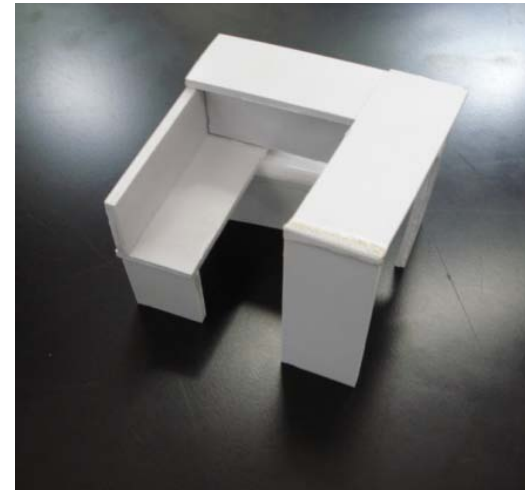
- Provides to bench or table or both
- Additional seating when not in use

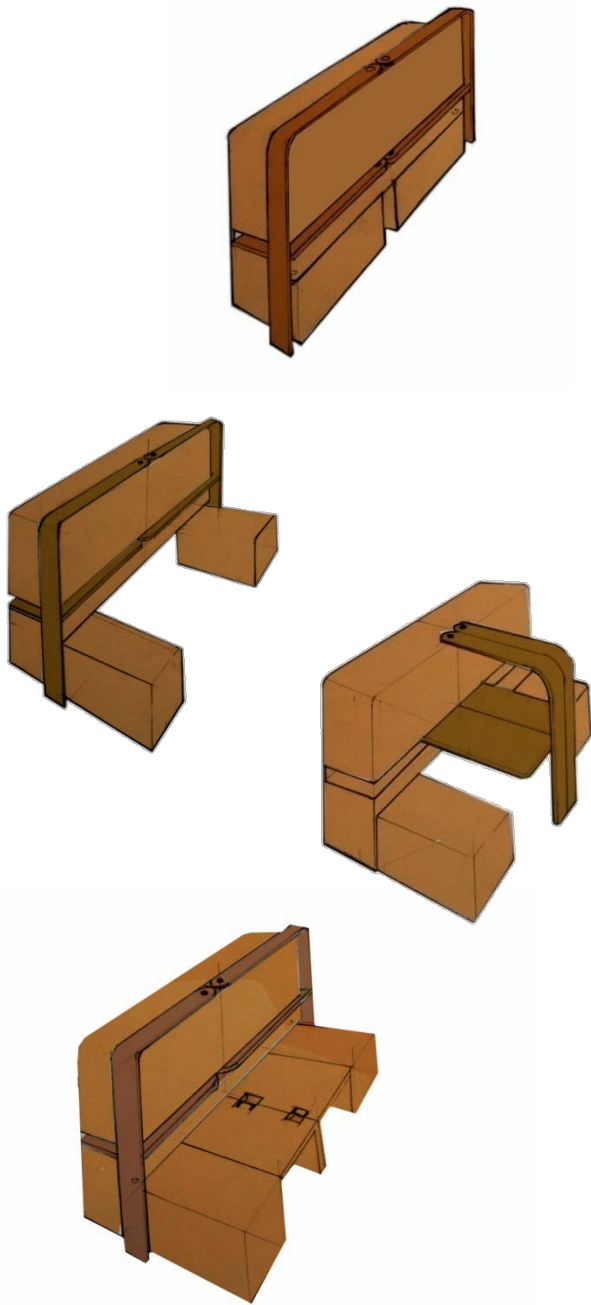
Disadvantages

- Large footprint



Exploratory model of version 2





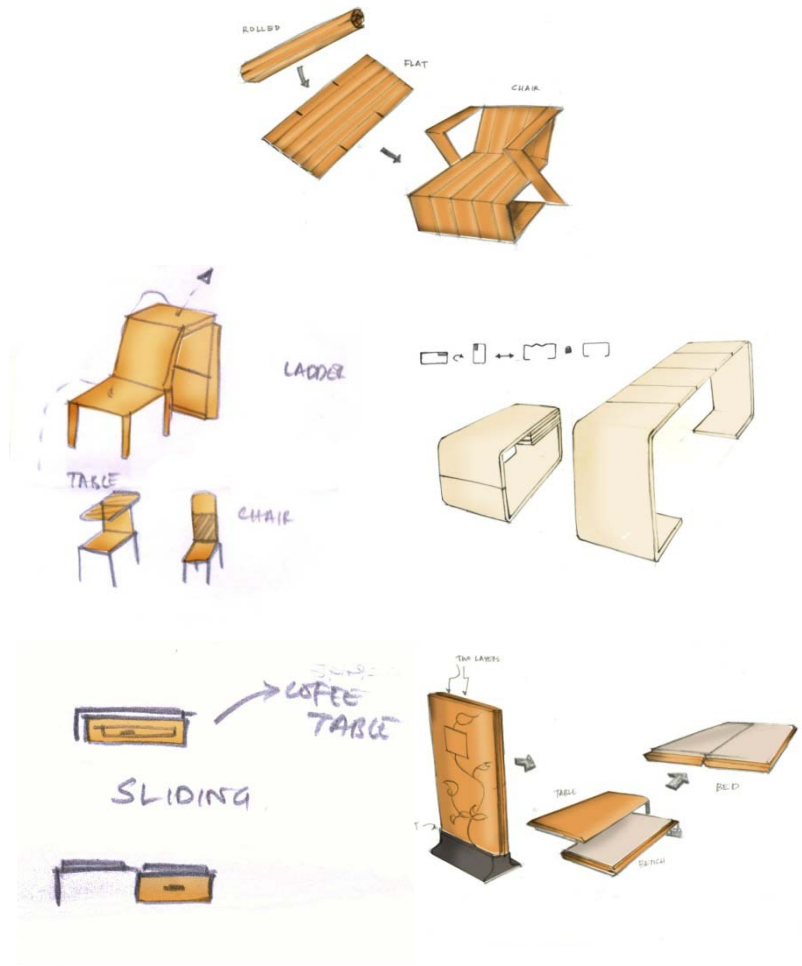
## Cluster group 1 Version 3

### Advantages

- Provides for seating, sleeping and dining with integrated table and seats for four people and even storage
- The seats can also be used to reach high storage areas within the same unit

### Disadvantages

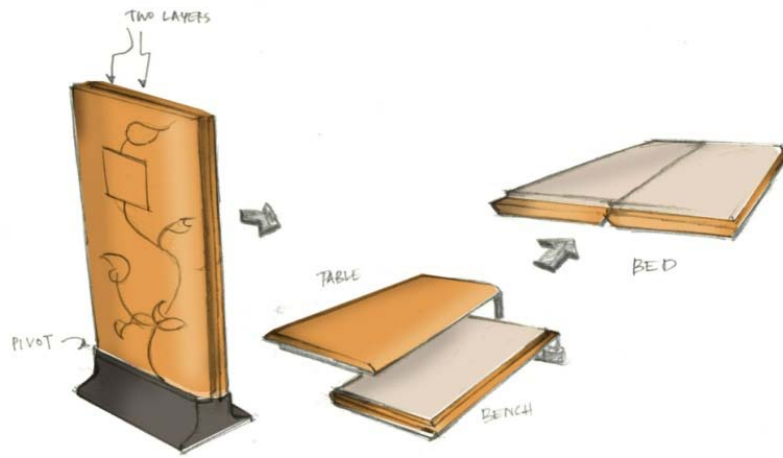
- Dining mode doesn't provide back rests
- Large footprint



## 4.2 Clustering Group 2

Group 2 was made with ideas having a strong sliding approach. Some ideas that fit in with the sliding concept were also taken into consideration





The figure shown beside is the principal idea taken for group 2

As shown it has a strong sliding approach

Other ideas in the cluster were used to build over this to obtain the following versions



## Cluster group 2 Version 0

### Advantages

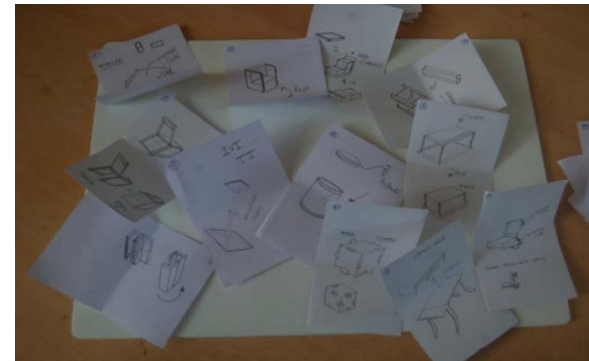
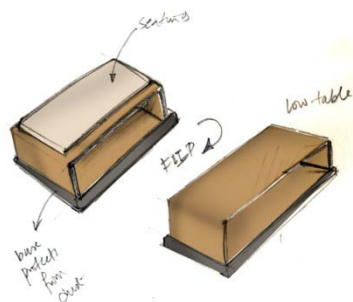
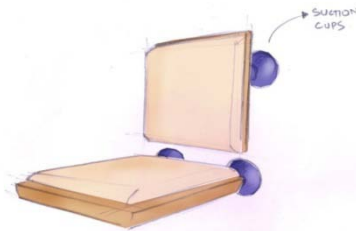
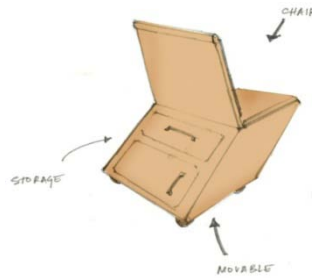
- Extendible two levels of surfaces
- Lower surface can be used for seating and sleeping

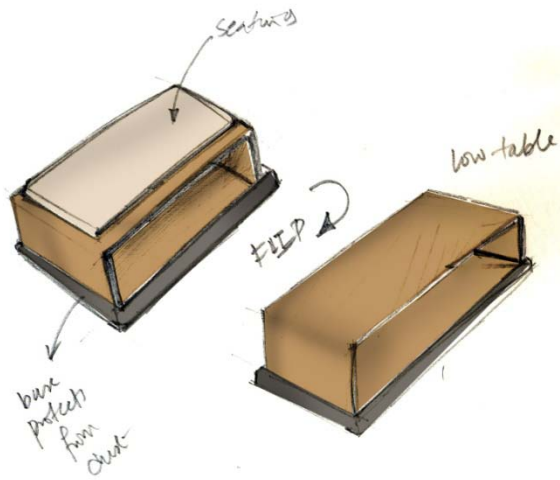
### Disadvantages

- Even if folded, has a large footprint
- No storage of cushions/mattress

### 4.3 Clustering Group 3

Group 3 was made with ideas having a strong flipping approach. Some ideas that fit in with the flipping concept were also taken into consideration





The figure shown beside is the principal idea taken for group 3

As shown it has a strong flipping approach

Other ideas in the cluster were used to build over this. To obtain the following version





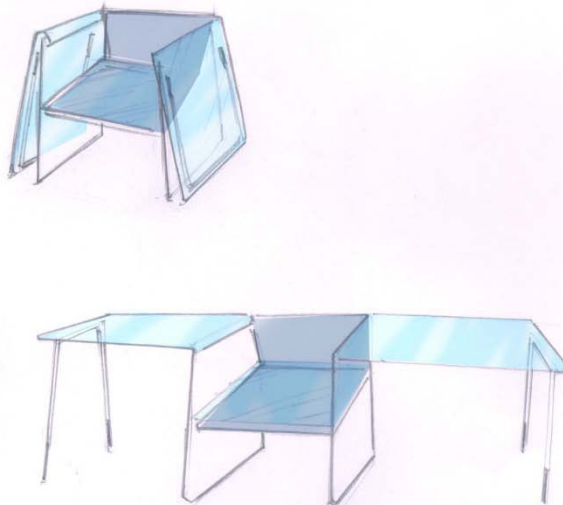
### Cluster group 3 Version 0

#### Advantages

- Easy operation
- Large area
- Option for storage

#### Disadvantages

- Table and chair cannot be used at the same time



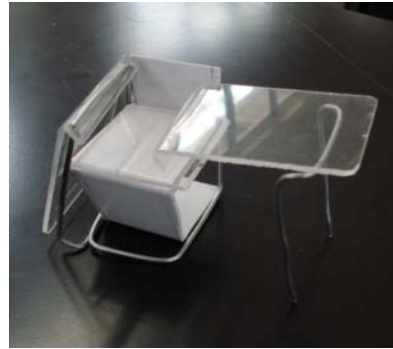
### Cluster group 3 Version 1

#### Advantages

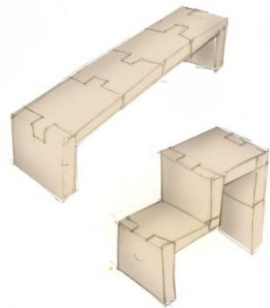
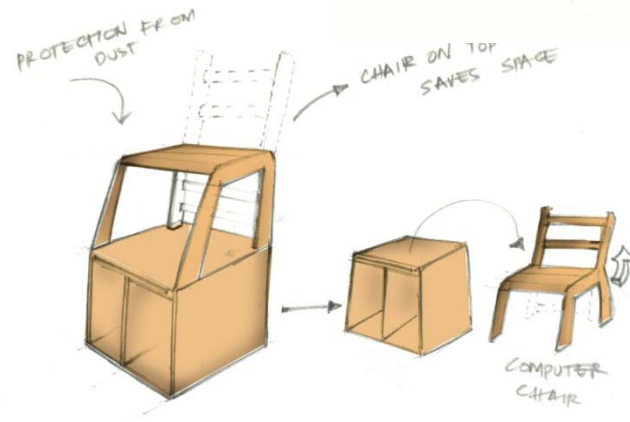
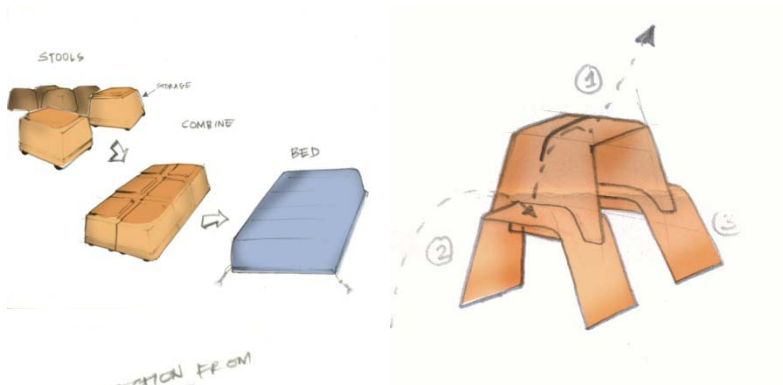
- Chair can be used along with the side table
- Option for either chair or table exclusively

#### Disadvantages

- Bulky
- inadequate backrest

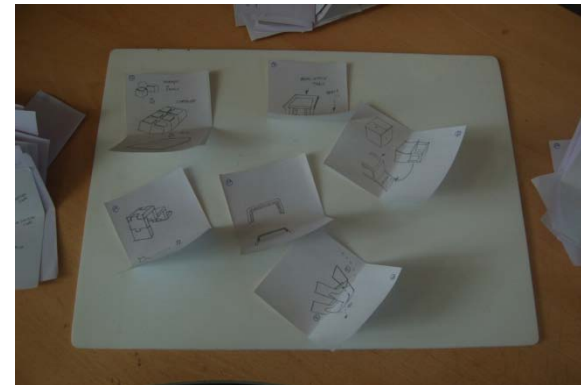


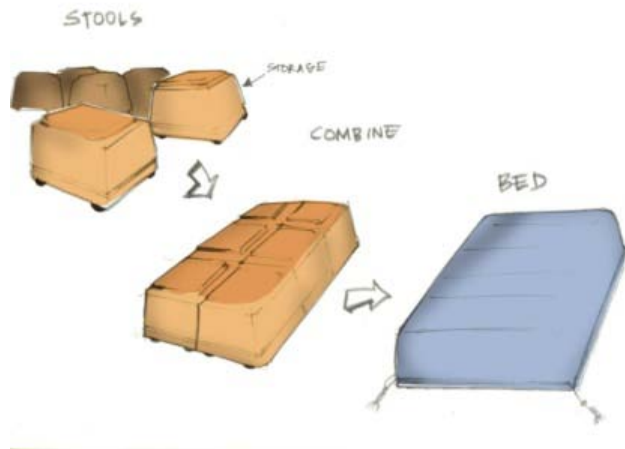
An Exploratory model of cluster group 3  
Version 1



## 4.4 Clustering Group 4

Group 4 was made with ideas having a strong modular approach. Some ideas that fit in with modularity were also taken into consideration





The figure shown beside is the principal idea taken for group 4

As shown it has a strong modular approach

Other ideas in the cluster were used to build over this. To obtain the following version



## Cluster group 4 Version 0

### Advantages

- Modularity
- Able to add units to create larger surfaces and seating

### Disadvantages

- More units have to be bought
- Grooves are not very pleasing upon use

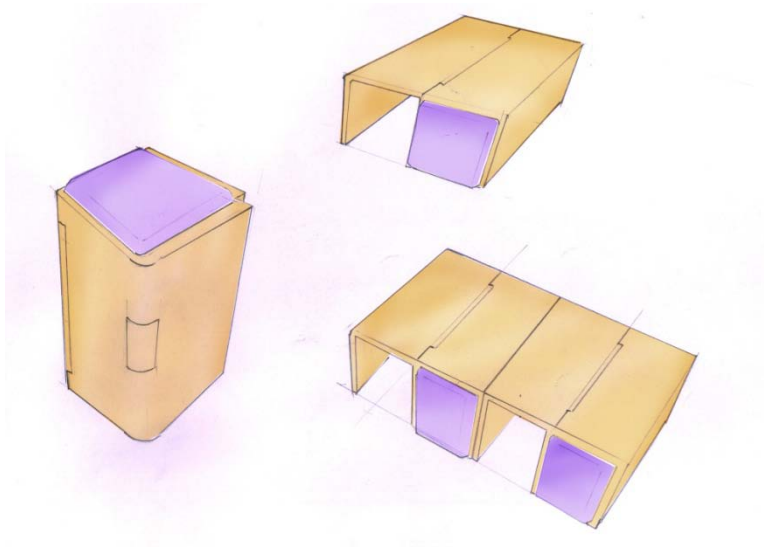
## Cluster group 4 Version 1

### Advantages

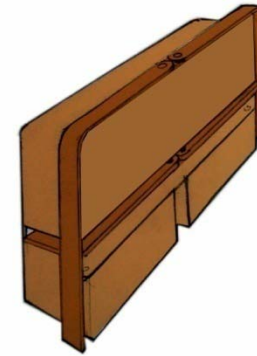
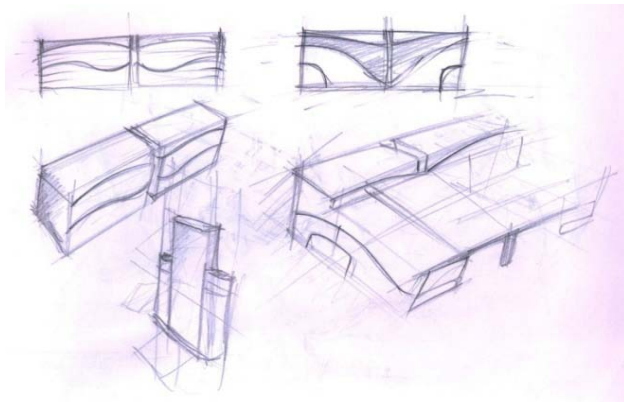
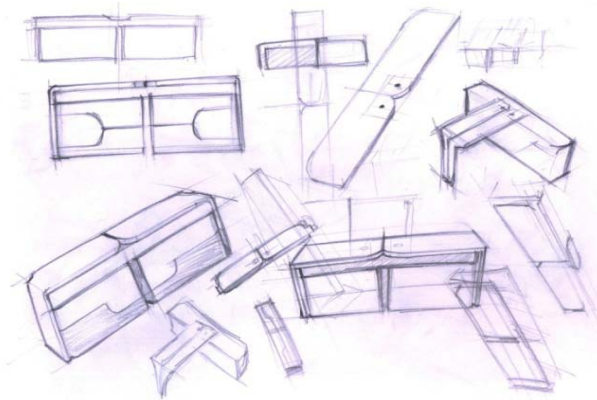
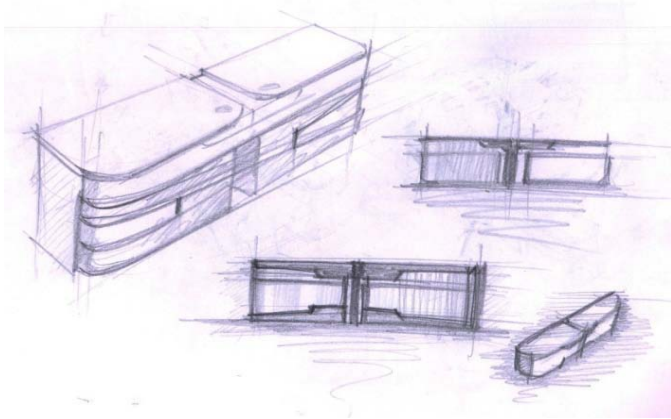
- Modular
- Two stools can make a surface for sleeping
- One stool can make a low table

### Disadvantages

- Blocky; looks temporary



## 5. Concept Evolution

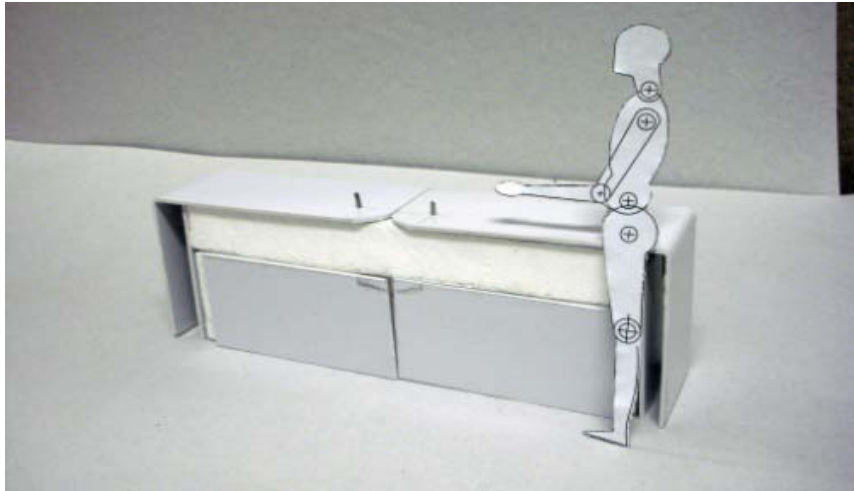


Version 4 of group 1 was taken forward because it was evaluated to be closer to the product brief than the others. Another factor was its operational feasibility ( feasibility of mechanism and ease of use ).

The top storage portion was however separated to keep the unit light and movable as per the user interactions. So now the focus was on creating a better dining, seating and sleeping experience using the unit.

The dimensions were taken keeping in mind the anthropometric data of Indians. The following data is based on the 50 percentile Indian male.

The height was kept at 450 mm and the table height was kept at 730 mm. The other dimensions were government by dimensional constraints



Basic closed state



Seating for four, two opposite two

## 5.1 Physical model

A rough physical model was made to test out the feasibility of the operation. From the physical model it was found that although the unit expanded to provide a bed of size 6x 3 ft, there were numerous other drawbacks in the design

Opening the flaps that formed the bed as per figure no. was quite cumbersome and the mechanism had to be changed or improved.

The overall area of the unit was quite large as it occupied 7 x 4.5 ft

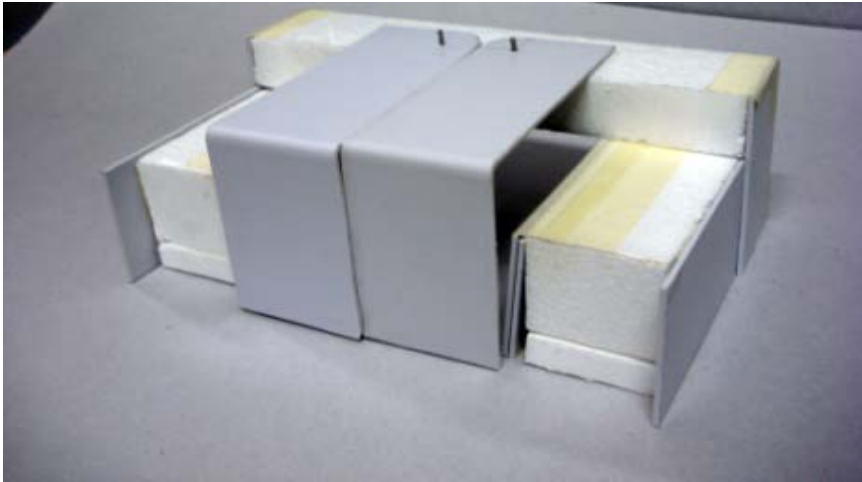


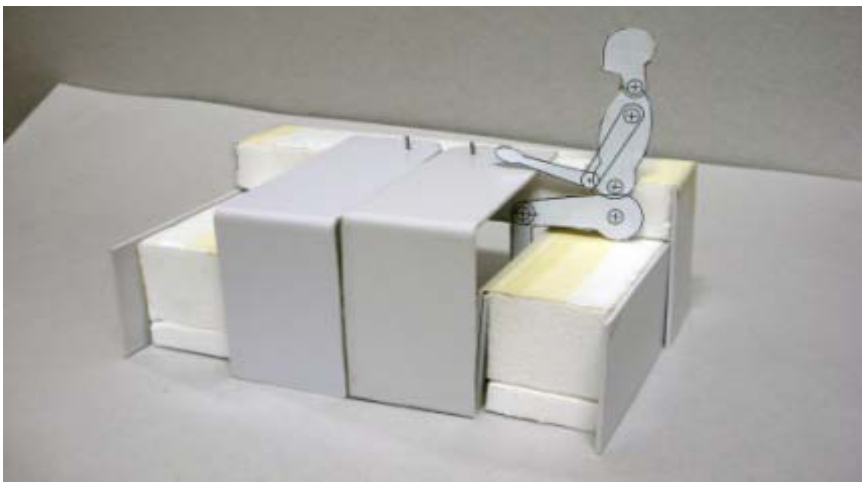
Table and seats for four

A long handle would be needed for the lower boxes to help access when the tables were folded in.

A cut out was also required on the table ends to help the person get in.

Overall it was also found that the operation to bring out the dining table was cumbersome and took a lot of time. The user would not be inclined to undergo such series of operations.

Moreover in a passive state ( completely folded) the concept did not have much use



A comparison with a scaled mannequin



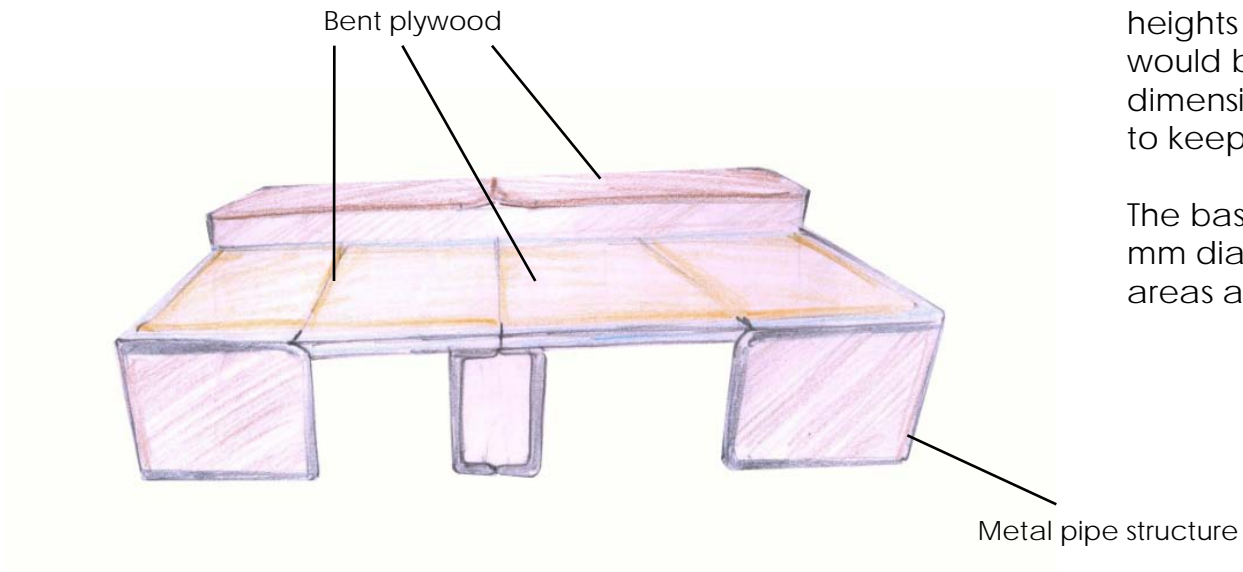
Bedding state; 6x3 ft bedding is available



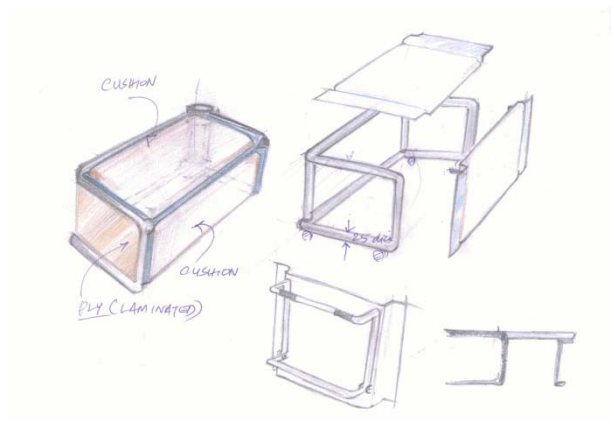
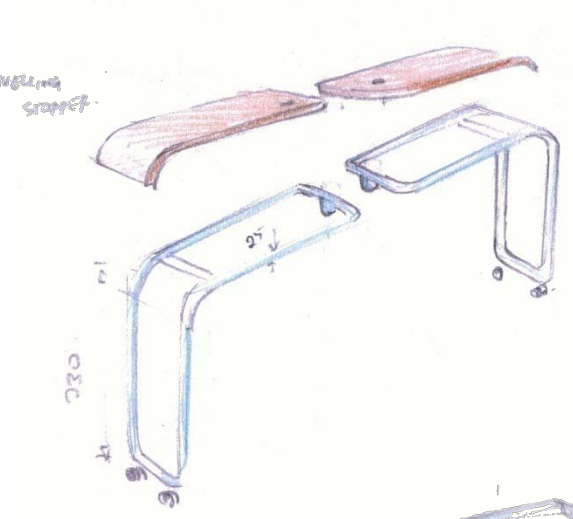
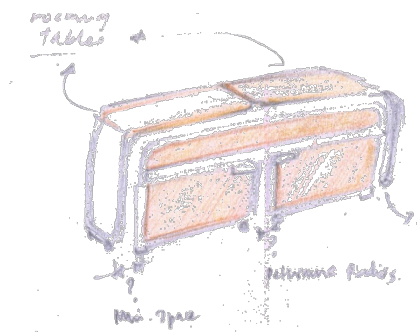
## 5.2 Exploration in metal

An exploration was done in pipe and sheet metal. It was found that the difference in heights between the boxes and the flaps would be minimum hence no special dimensional considerations would be needed to keep the surface more or less flush

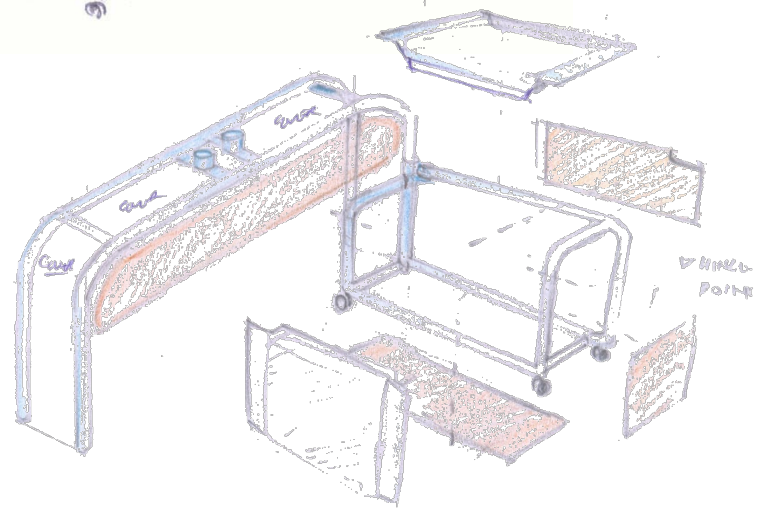
The basic structure would be made out of 30 mm dia pipe with bent plywood cladding on areas as shown.



A view of the unit done in metal



The exploded view shows various parts of the unit



A rough detailing of the unit in sheet metal and tubular pipes. The facades in brown denote plywood (either bent or straight form)

### 5.3 Material and aesthetic Exploration

Considering a basic wooden frame, material considerations were done for the parts of the unit.

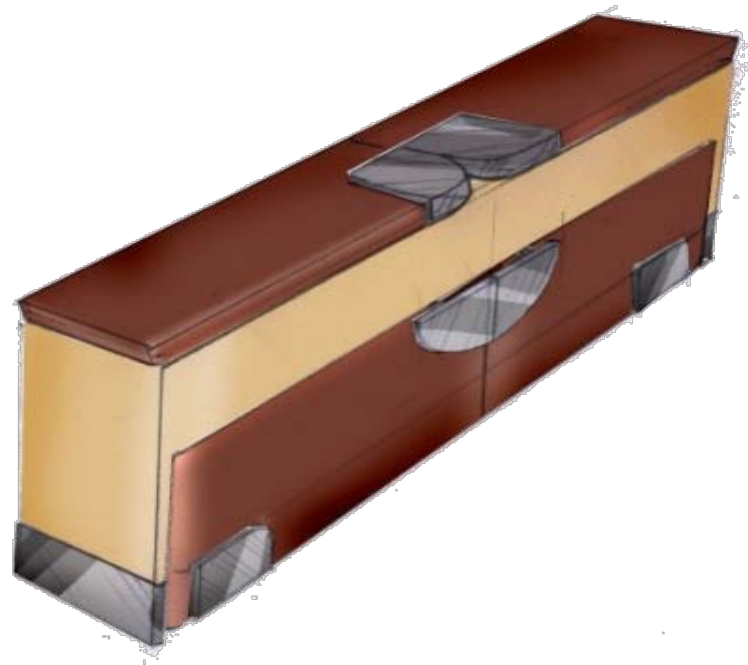


Figure 1 is a wooden laminate and brushed aluminum concept

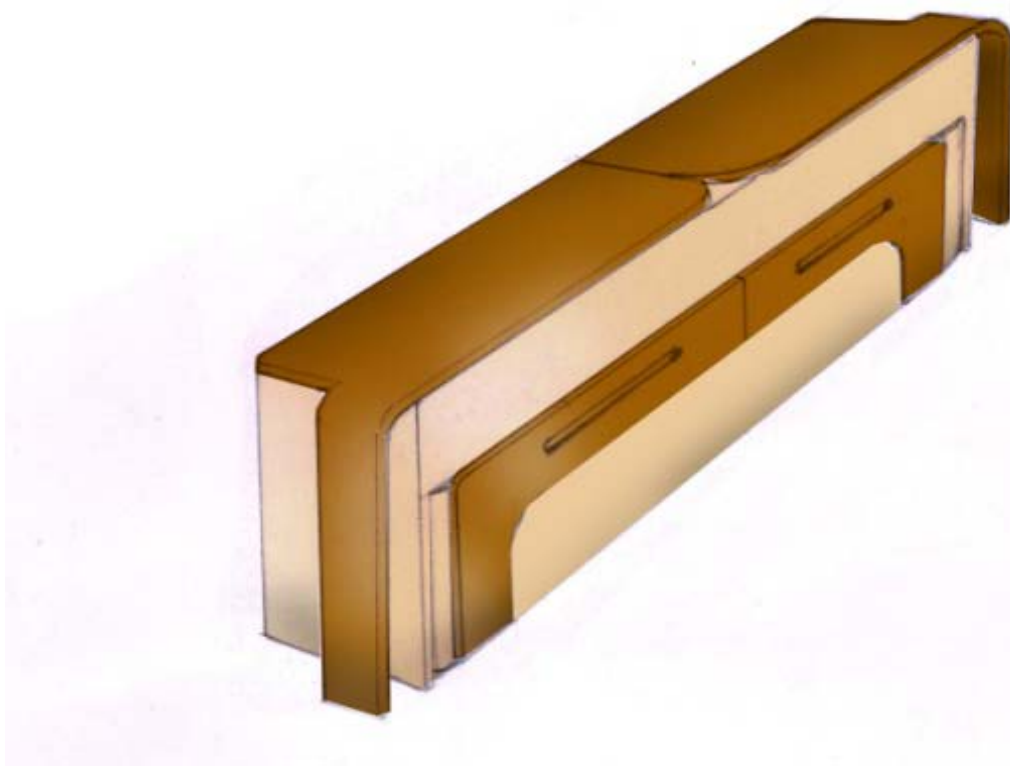


Figure 2 is an all wooden concept with wooden ply and laminate.



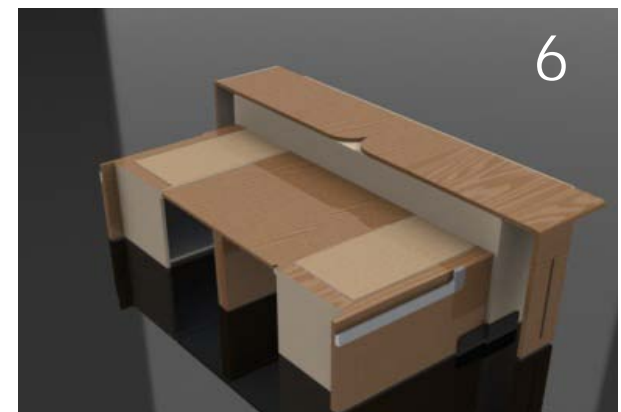
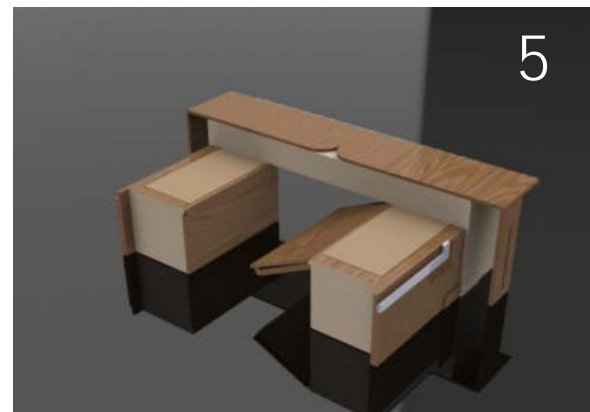
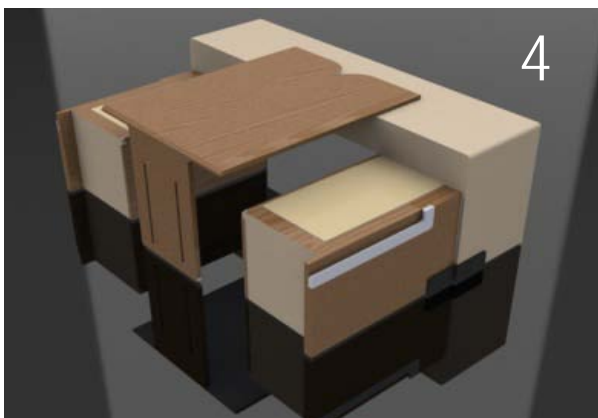
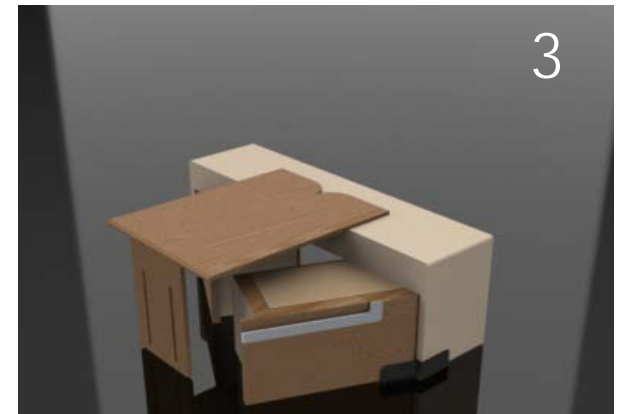
Figure 3 is a wooden and steel concept. With the steel parts powder coated



Figure 4 is a wooden laminate with an aluminum profile for the handle and nylon stoppers at the bottom in black

## 5.4 Final renders

Renders were done to visualize the concept as close to real as possible. The figures beside show various modes of operation and the sequence of actions to be unfurled fully.

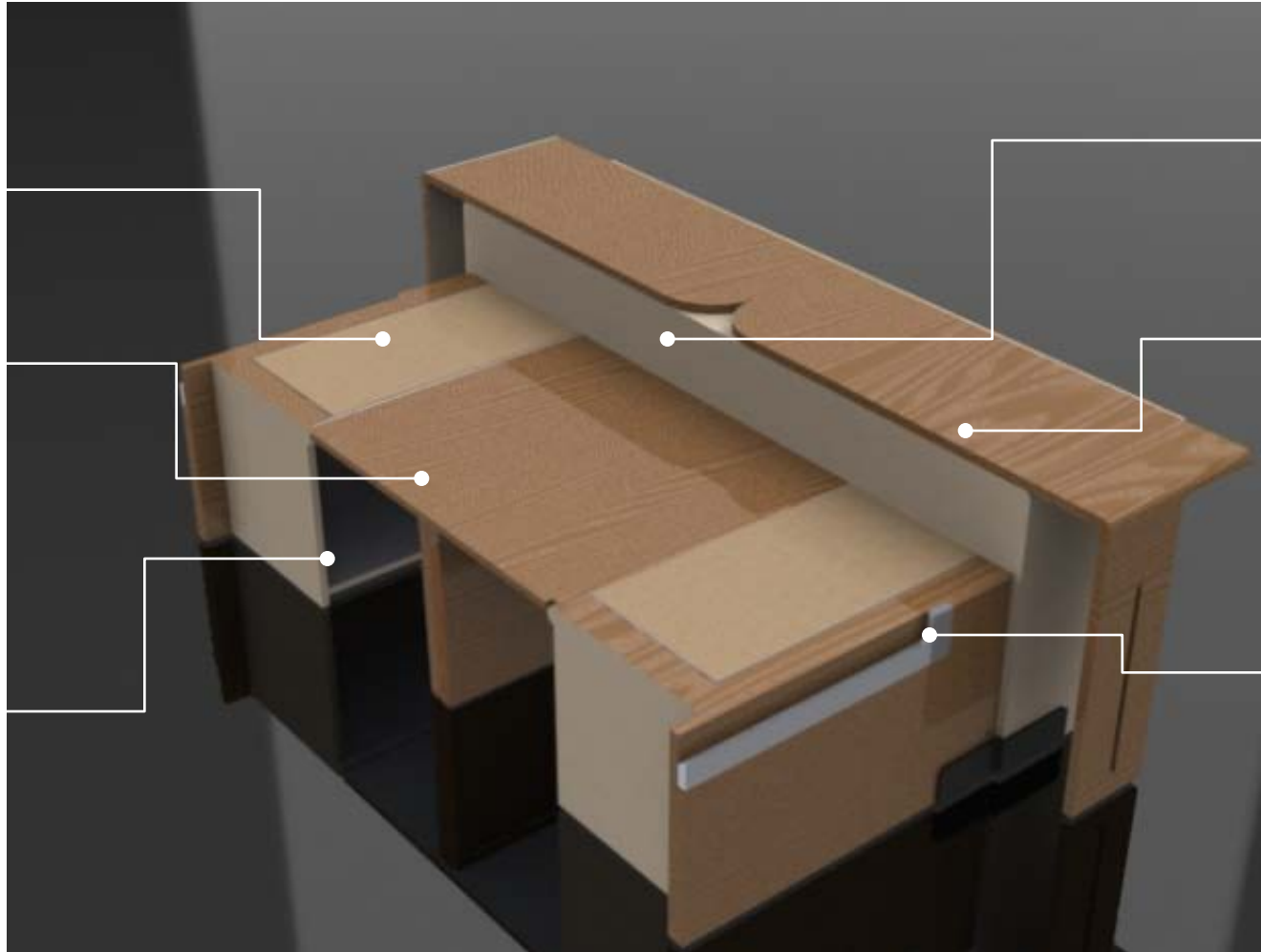


Note: The table is kept back to original position

Cushioning (thin layer of foam)

Extended flaps

Storage Area for roll able mattress



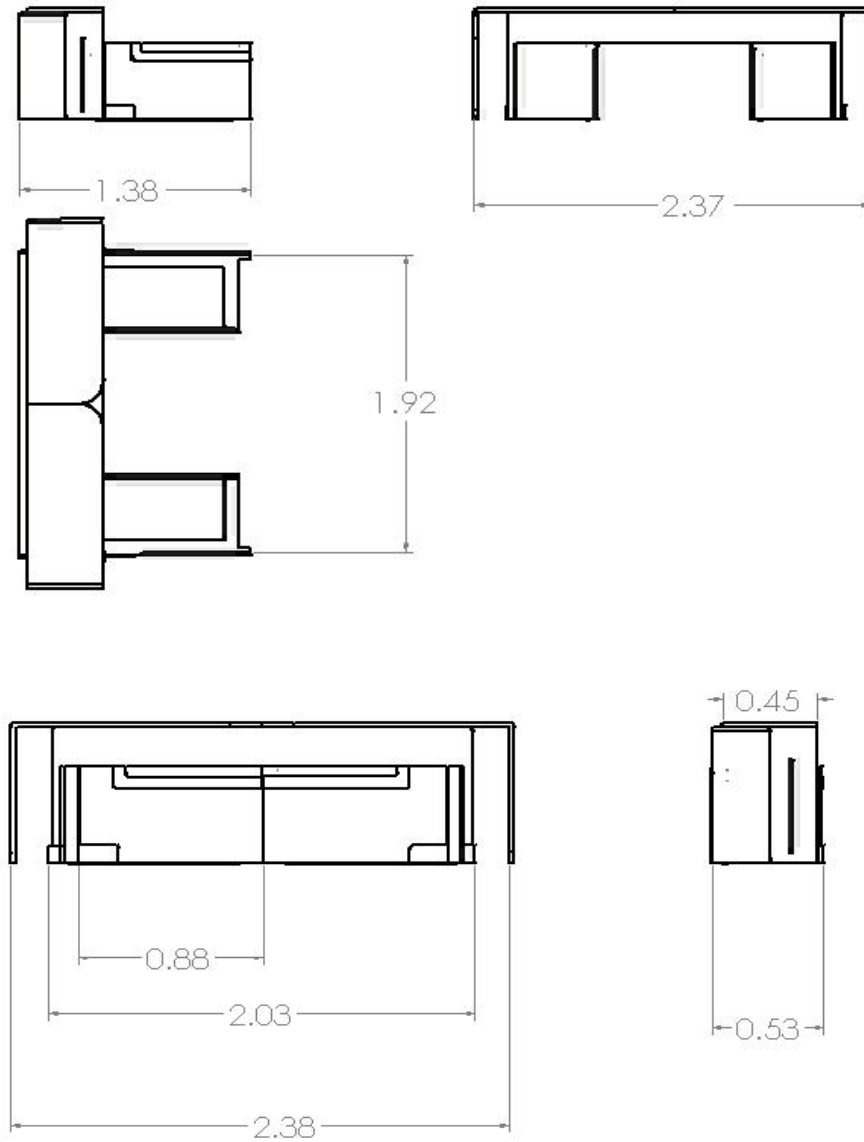
Option for drawers

Swiveling table

Polished aluminum profile



## 5.5 Concept dimensions (m ts)



## 6. Final Concept

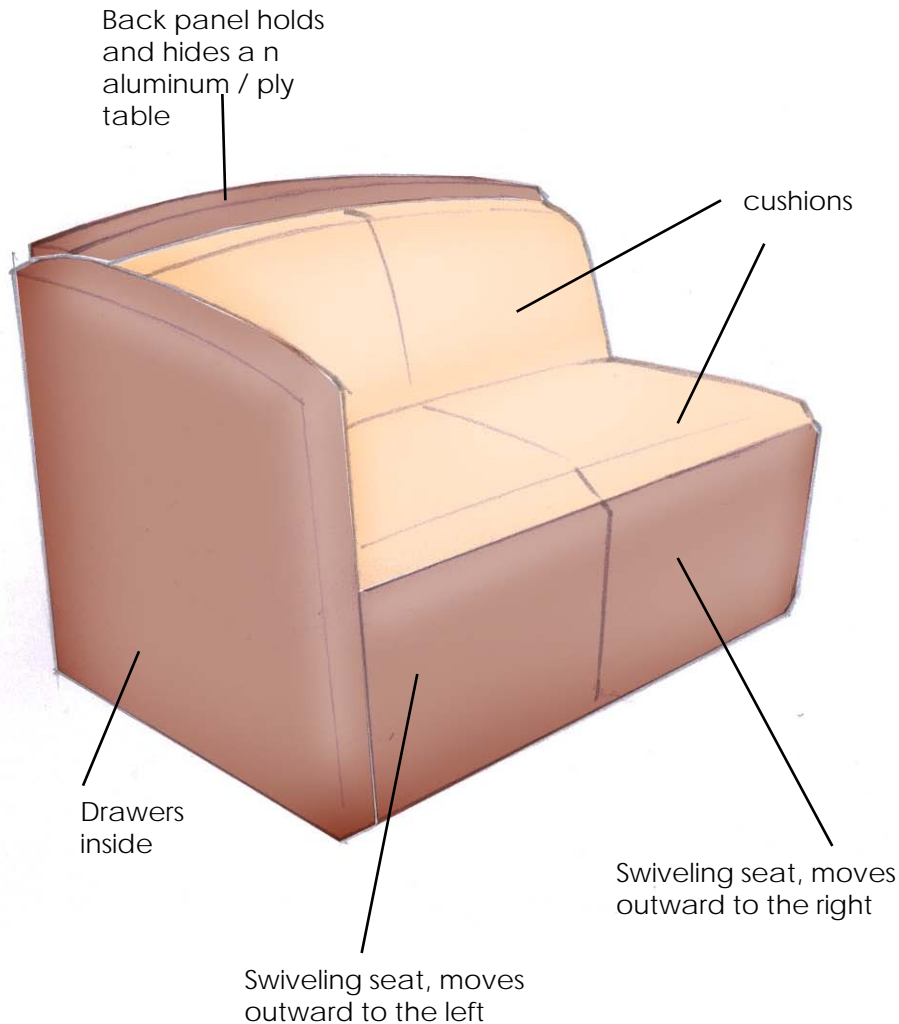
The concept further evolved after taking feedback and criticism of the previous iteration.

The earlier concept had no use when collapsed so it was decided to make the product use the most dominant activity in the passive state. Sitting was to be the most performed activity and hence it would take up that task

Unfolding to form a dining table was quite a bit of a task previously so it was simplified by a simple pull out of flap from the centre that formed the table.

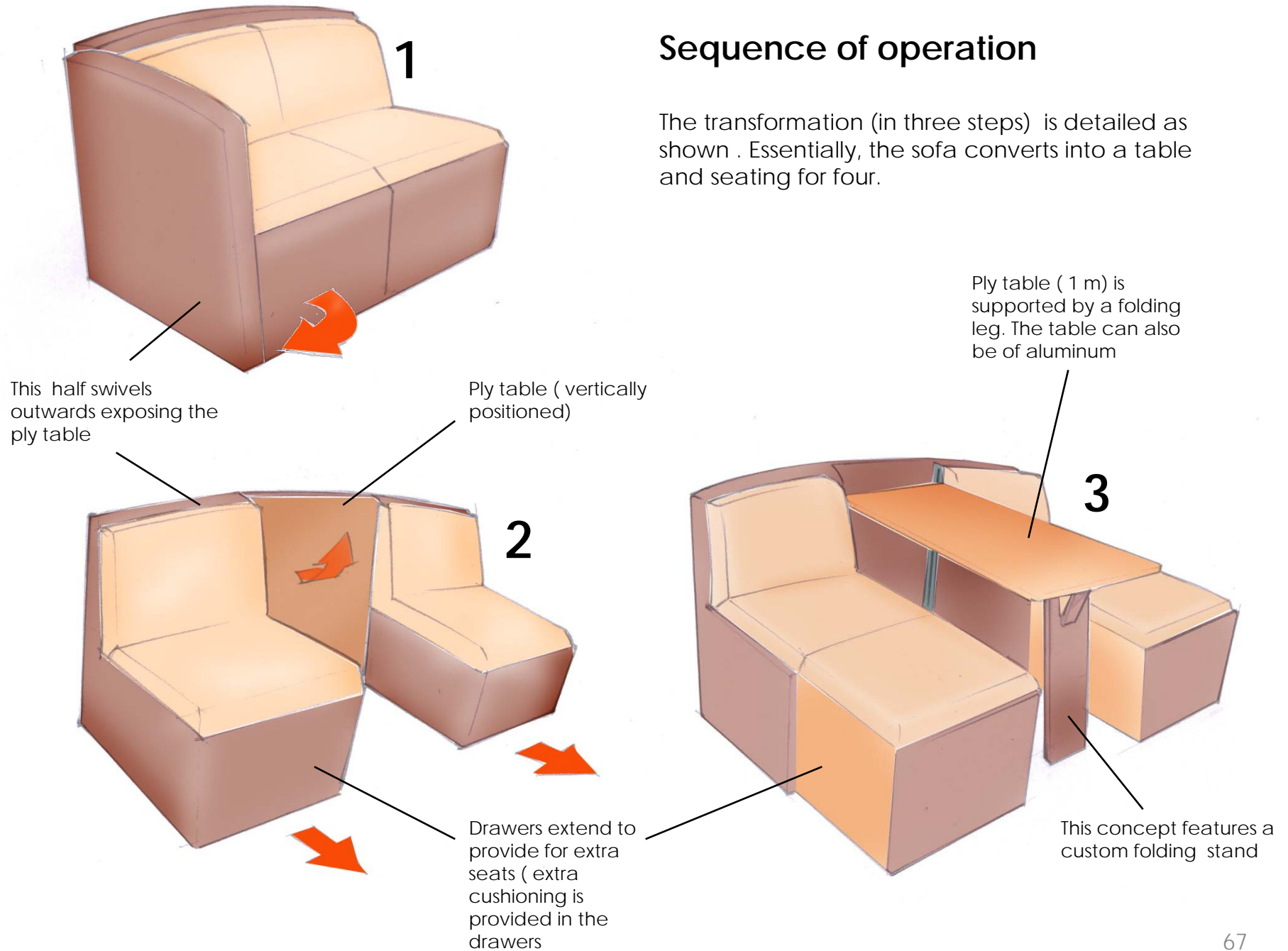
This concept could even be used in the corners of the room as it swivels out sideways.

In its passive state, this concept unit does not show that it's a multifunction unit, hence keeping the aesthetics consistent with the rest of the house

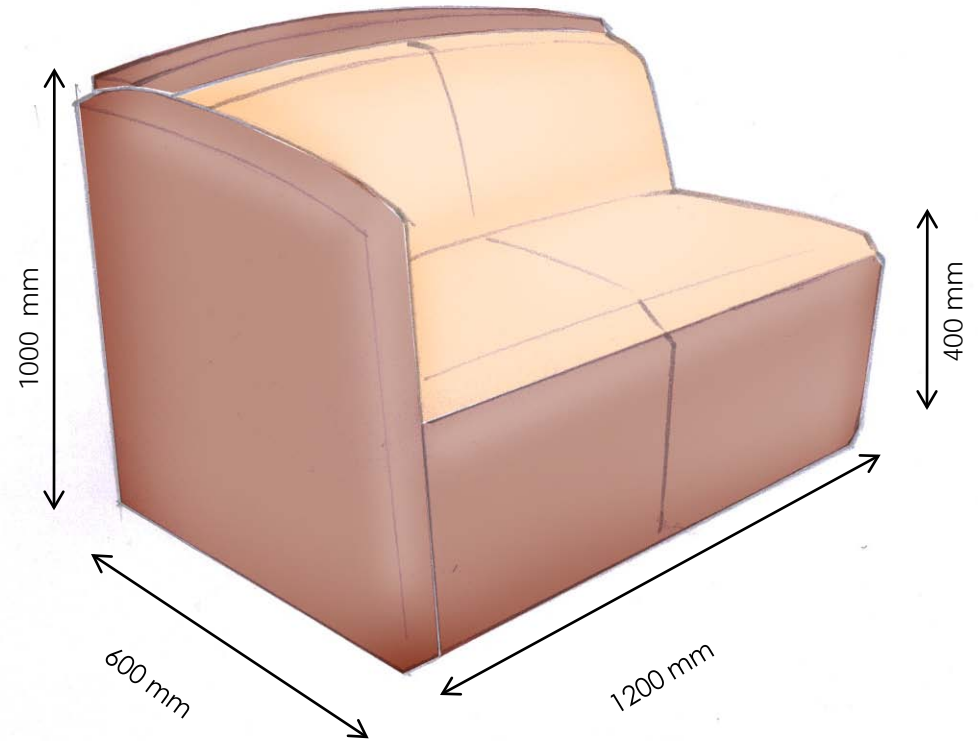


## Sequence of operation

The transformation (in three steps) is detailed as shown. Essentially, the sofa converts into a table and seating for four.



## Dimensions (mm)





The pedestal type leg with drop lock is constructed with 1" diameter heavy gauge steel tubing with a positive locking device that falls in place when the leg is opened.



Butt hinges are used to create the swiveling action



Castor wheels are used to allow for motion of the unit and its seats

## 6.2 Hardware involved

Parts of the concept involved ready to use hardware available in the market today, sourced from reliable manufacturers.

Butt hinges are standard hinges used to fold the seating inwards

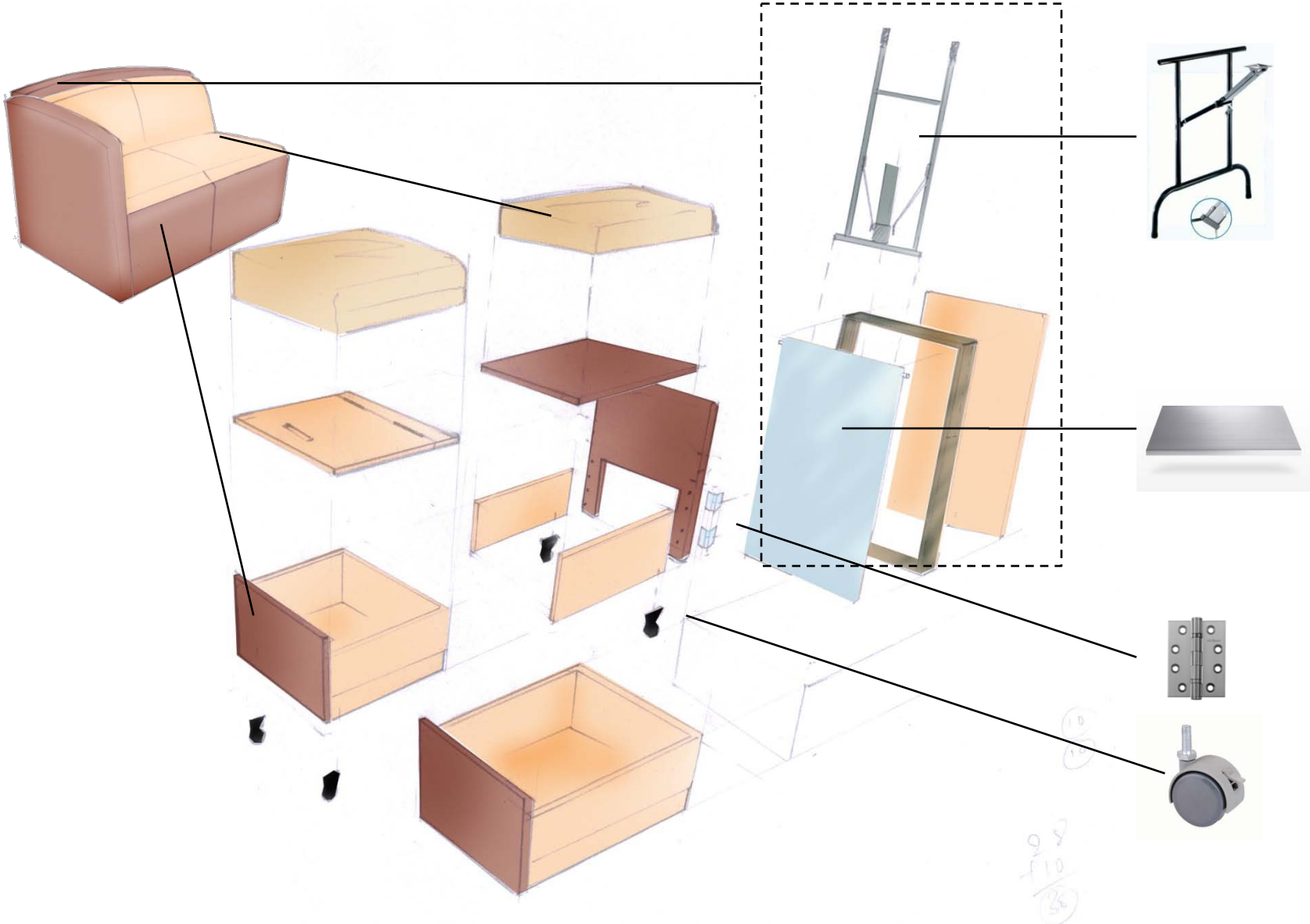
Pedestal folding table leg is widely available and is used to support the table that unfolds in the dining mode

Castor wheels are used to provide motion to the seats .

## 6.3 Material Selection

The current unit is proposed in plywood and a wooden core. Since the table had to be lightweight for access, it can also be proposed in aluminum. Ply is however considered for now to keep a homogenous aesthetic

# 6.4 Assembly Details



## 7. Rig

Following are the pictures from the rig that was made. It shows the feasibility of the concept and also provided dimensional inputs for the final model.



## 8. Final Product

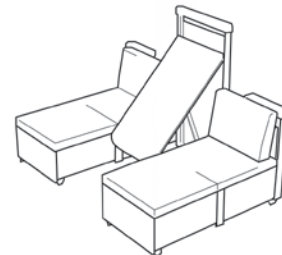
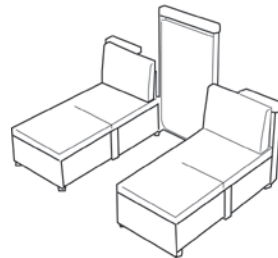
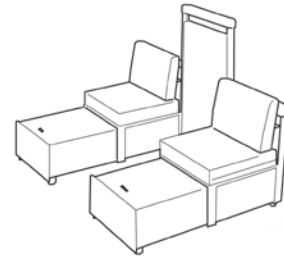
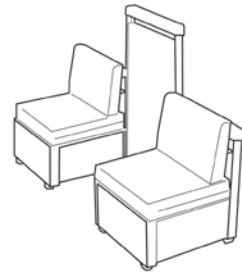
**SOFTA**  
FURNITURE FOR SMALL HOMES



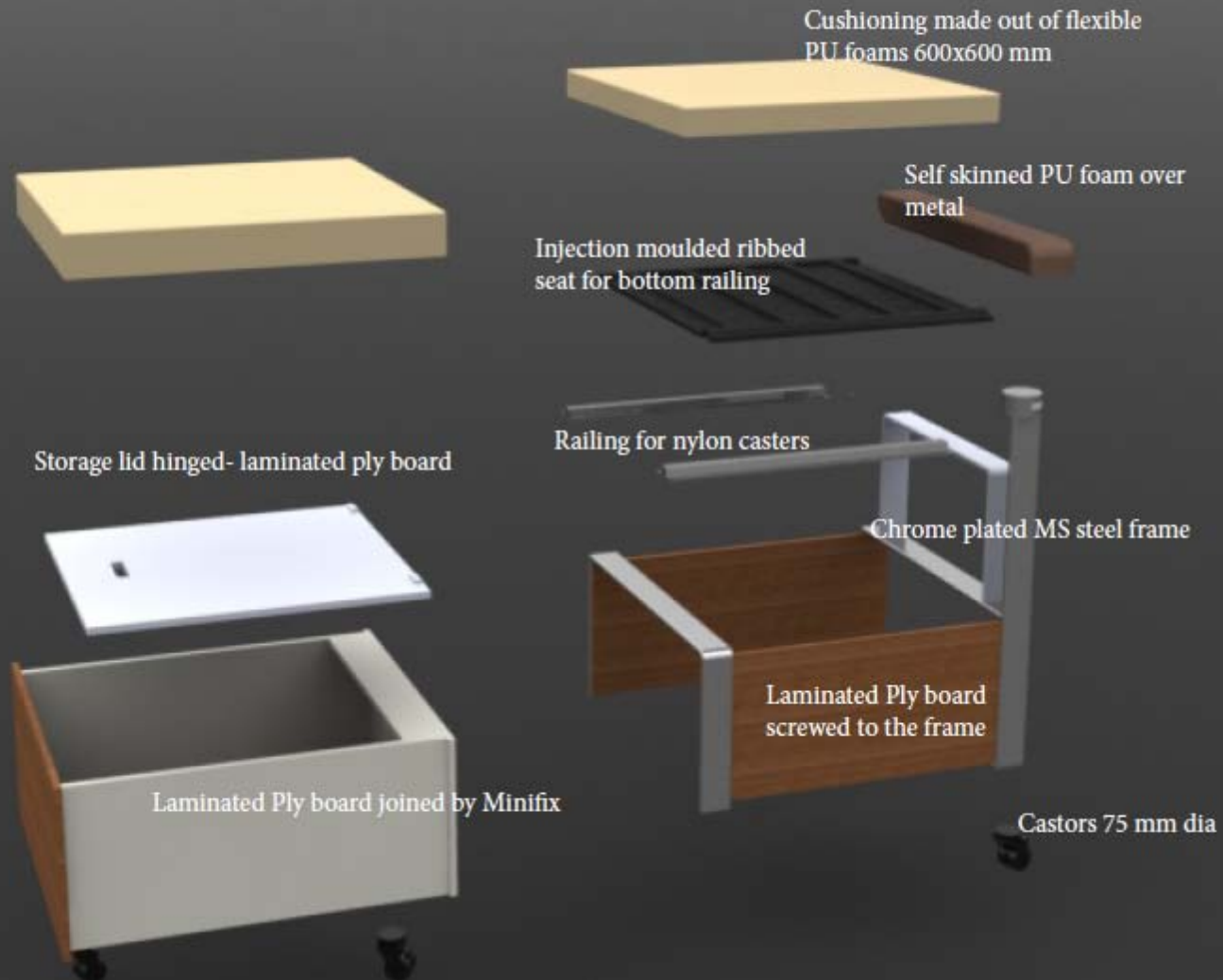


## 9. Transformation detail

The following images denote the transformation of the two seater into a dining arrangement



# CONSTRUCTION DETAILS



## 11. Product Features



A scaled down model ( 1: 5 )

Features of the final product

- Two seater sofa converts into a dining table and 4 seater
- Has facility for storage under the seat
- Easily movable due to castors.
- Can be placed in any side or corner of the room thereby maximizing the utilization of the space
- The users can sit face to face with each other hence it promotes interaction between users
- Provides dining arrangement and two seater sofa within the size of a two seater sofa footprint

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