In-Flight Catering Delight:

Re-Imagining an Airline Service Trolley

Gautham Varma | 136130005

Guide: Prof. Kumaresan

IDC | IIT Bombay

The Inception

My own Experience

Many ways of solving the issue

Chose one way - Re-design the airline trolley

30+ years, Trolley has not changed

Passion for aircraft and aviation

Preface

Flying as a ‘commodity’

No room for flight experience

Aircraft nearing perfection; Components not

Many issues left unseen

...A good cause to re-imagine!

Project Focus/ Keywords:

Re-imagining

Enhancement

Efficient

Effective use of volume

Experience

Modularity

Useability

Technology

Problems to be Addressed:

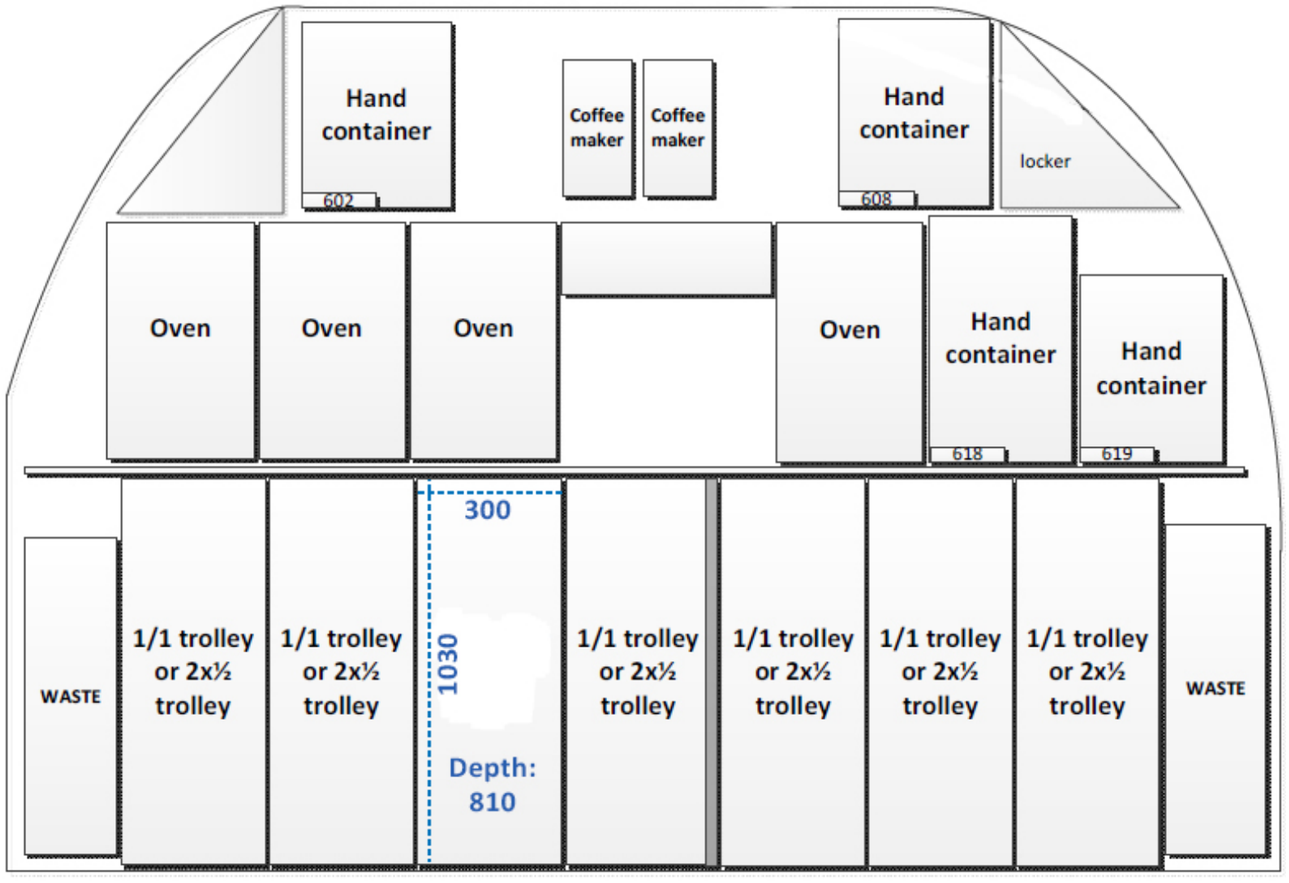
Physical Comfort

Efficiency

Passenger discomfort

Safety

Project Assumptions:



All Dimensions in mm

Source: LSG Sky Chefs Galley Layout ES-SAL; 31.01.2015

Some modifications in galley is permitted

Stick to the galley dimensions as much as possible

An Airline Service Trolley

A Typical Economy Class Trolley

What is an Airline Service Trolley?

Transport of beverages, food and other items during flight.

Even entertainment devices such as iPads.

Used by Cabin crew

Supplied by the airline

Source: www.amazon.co.uk; as seen on 04.05.2015

An Airline Service Trolley

Why a trolley?

Introduced when wide-body aircraft were launched

Large number of passengers- Serving by hand inefficient

At seat- service, similar to long distant rails.

An Airline Service Trolley

ATLAS-

KSSU-

ACE-

FAA

EASA

CAAC

Source: FAA Logo: http://www.uavlegalmatters.com/; accessed on 01 Feb 2015
EASA Logo: http://upload.wikimedia.org/; accessed on 01 Feb 2015
CAAC Logo: http://www.icao.int/; accessed on 01 Feb 2015

Current Airline Service Trolleys

Galleys- ATLAS and KSSU Standard, ACE

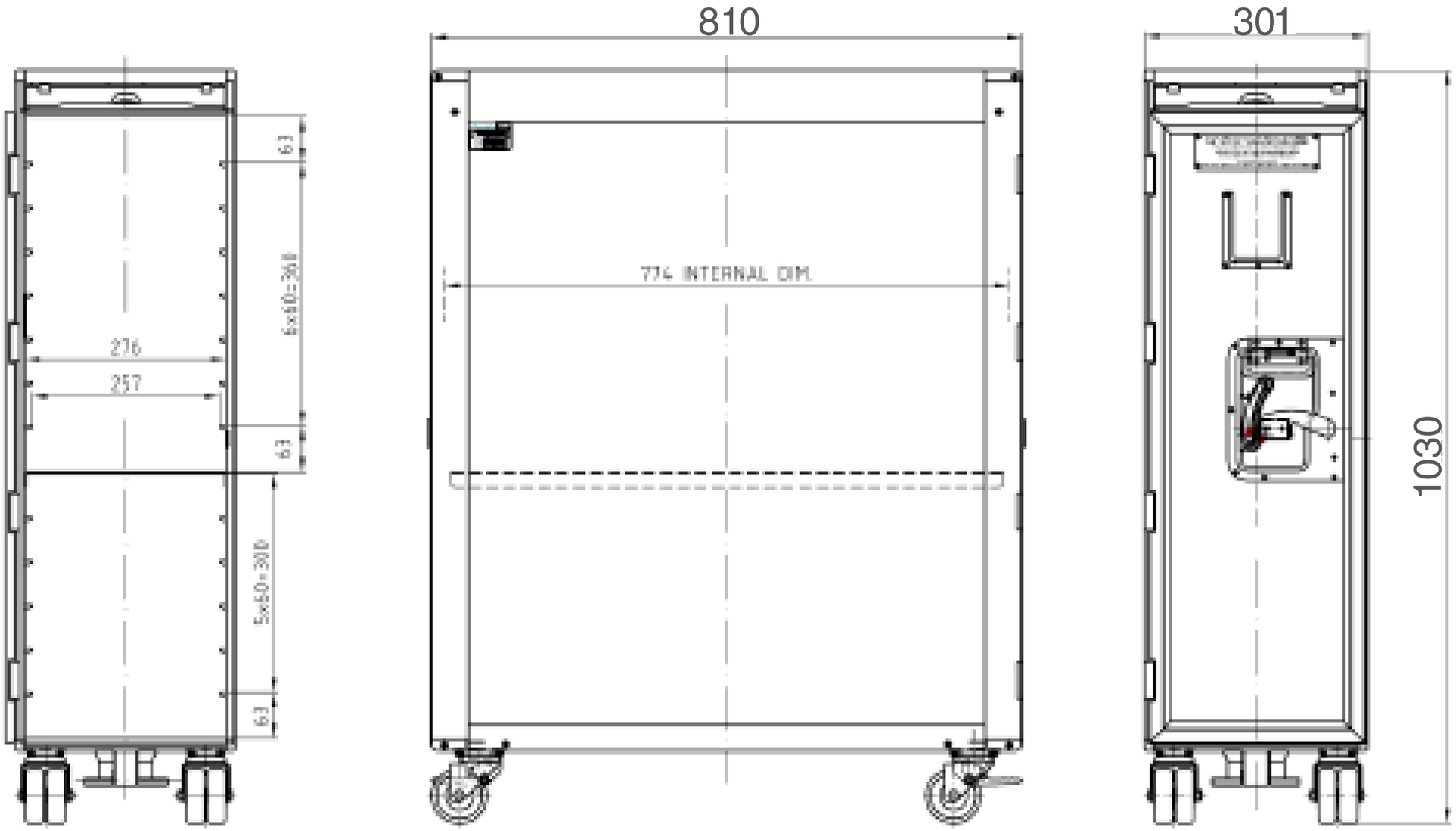
Compliance to FAA TSO, EASA: ETSO- C175; SAE AS-8056

ATLAS most widely used

Half and Full trolley

Full Size and Half Size Trolleys

Source: http://www.worldtravelcateringexpo.com/; accessed on 01 Feb 2015



All Dimensions in mm

Source: ATLAS Full Size Light Weight Trolley; as seen on 06.01.2015

 Source: http://www.boeing.com/; accessed on 01 Feb 2015

Waste Carts

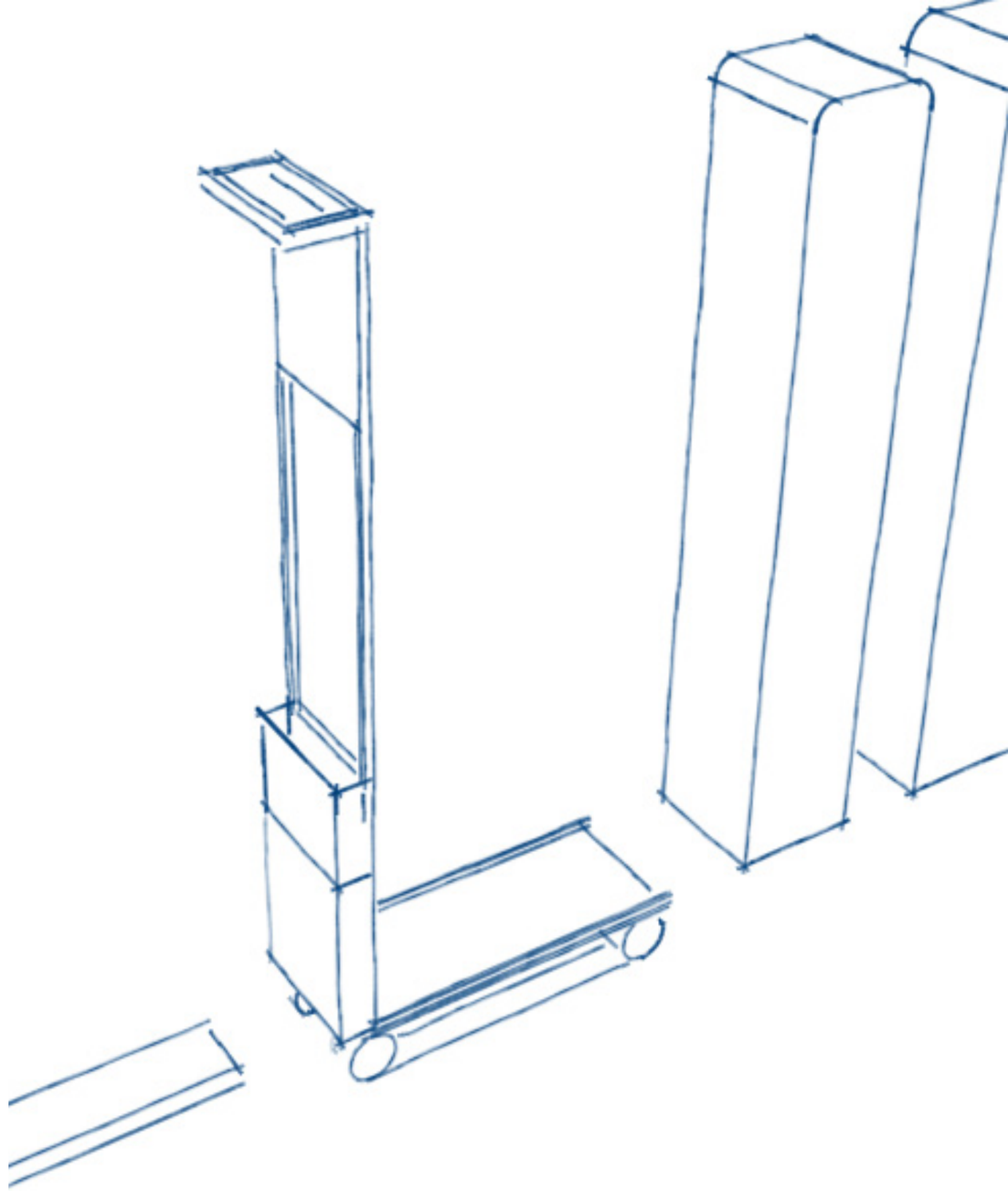
Diethlem Keller Aviation

Meal/Beverage Carts

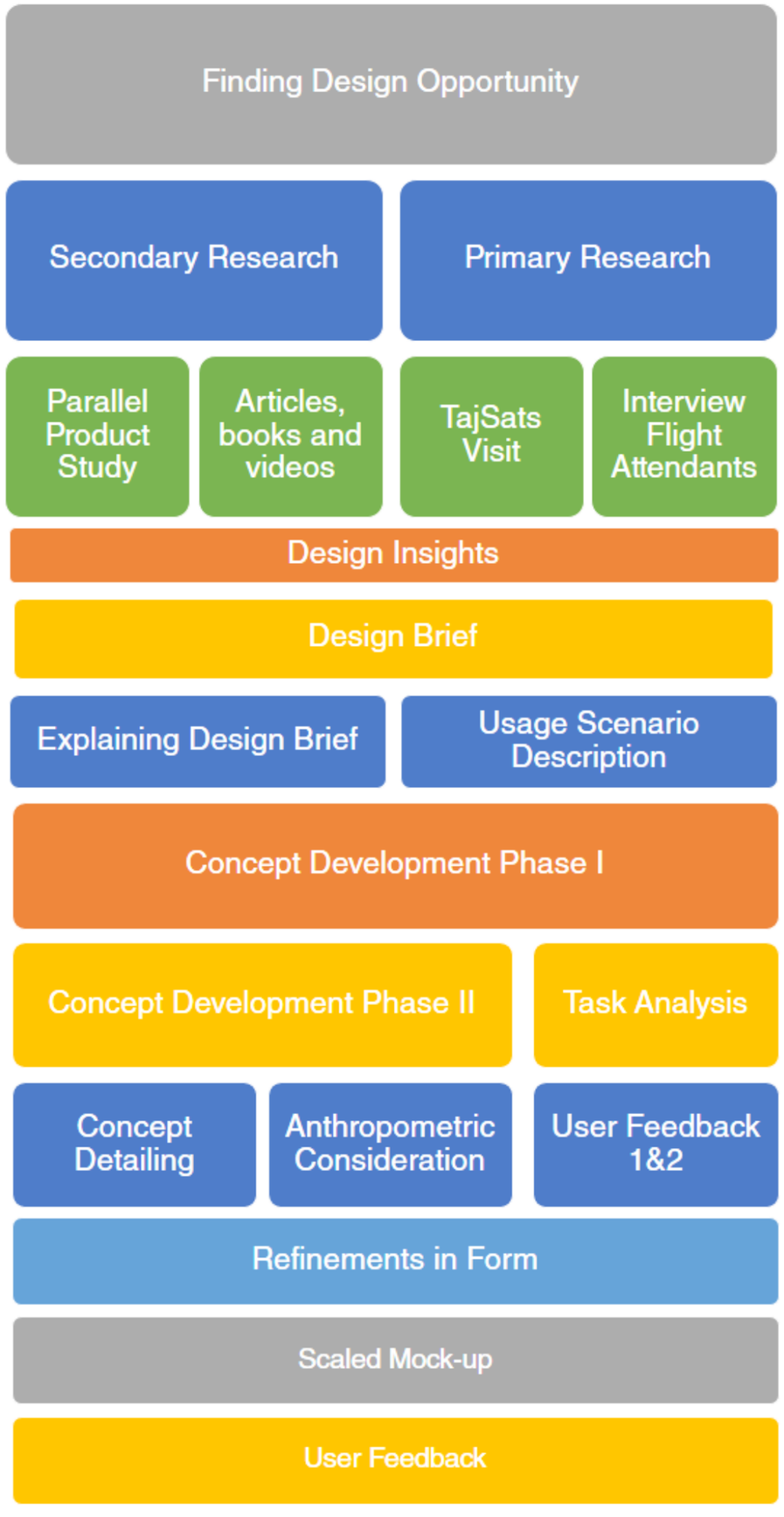
Diethlem Keller Aviation

42

Source: http://www.boeing.com/; accessed on 01 Feb 2015



Design Approach



Source: Varma, 2015

Research:

Parallel Product Study

Industry Visit
- TajSats Air Catering Pvt. Ltd

Interviews of Users
- Caterers
- Cabin Crew (Air India and Indigo Airlines)
- Passengers

Standards, Articles and Videos
- SAE-AS8056, Trolley report- On a roll
- Direct Airflow- Full size ATLAS trolley

Journeys
- Mumbai- Hyderabad (To and Fro)
- Personal Experience, Activity Study, Interior Form Study and Feedback

Parallel Product Study

Quantum trolley -by Norduyn

Source: http://www.2456.com/; accessed on 02 Feb 2015

SYNC- Smart airline trolley
-by Patrick Loh

Source: http://www.pilotfish.eu/; accessed on 31 Jan 2015

Skytender -by SkyMax, Air Eltec

Source: http://www.pilotfish.eu/; accessed on 31 Jan 2015

SPICE foldable trolley -by Airbus

Source: http://www.aircraftinteriorsexpo.com/; accessed on 31 Jan 2015

Flying trolley
-by Seongjoo Joh & Lee Min

Source: http://www.yankodesign.com/; accessed on 31 Jan 2015

Orbit trolley -by Heather Dunne

Source: http://www.smartplanet.com/; accessed on 22 Dec 2014

Industrial Visit: TajSats Pvt. Ltd.

First hand experience; Close observation

Different kinds of trolleys from various airlines

Various kinds of trays, drawers and dishes

Interview of catering supervisor

Source: http://www.tajsats.com/; accessed on 02 Feb 2015

Studies and Observations

An Oven Cage

Crates/ Drawers for Glasswares

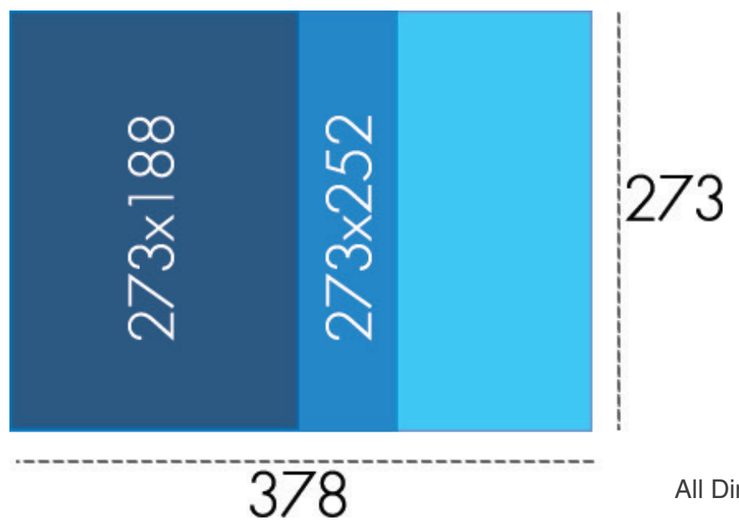
Water Bottles Kept in Tray

A Chinaware

1/1 Tray- More Space

2/3 Tray- Inefficiency in Space

Studies and Observations



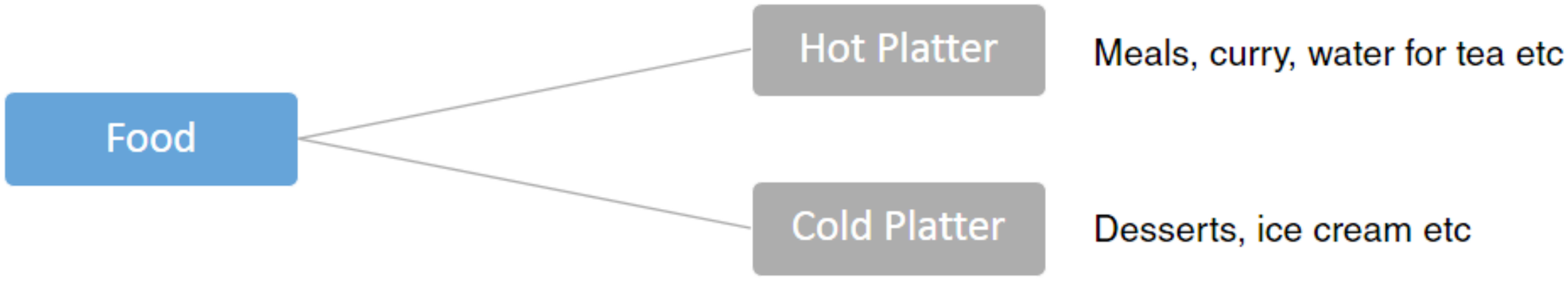
All Dimensions in mm

1/4 Tray- 134g 2/3 Tray- 180g 1/1 Tray- 300g

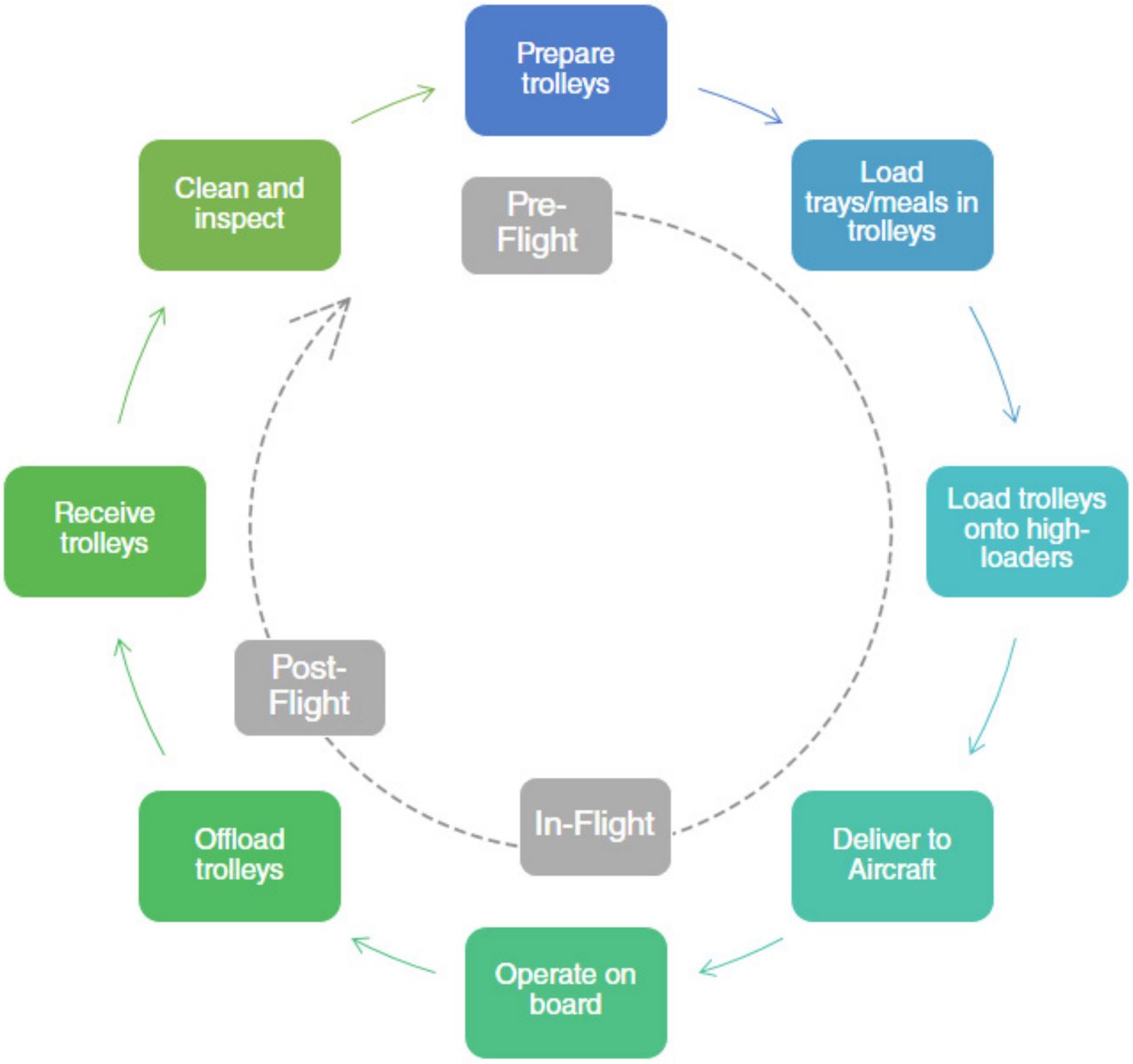
Trays mostly made of ABS Plastic

Odourless, Heat Resistant and Non Toxic

Kinds of Meals



Process of Catering



Studies and Observations

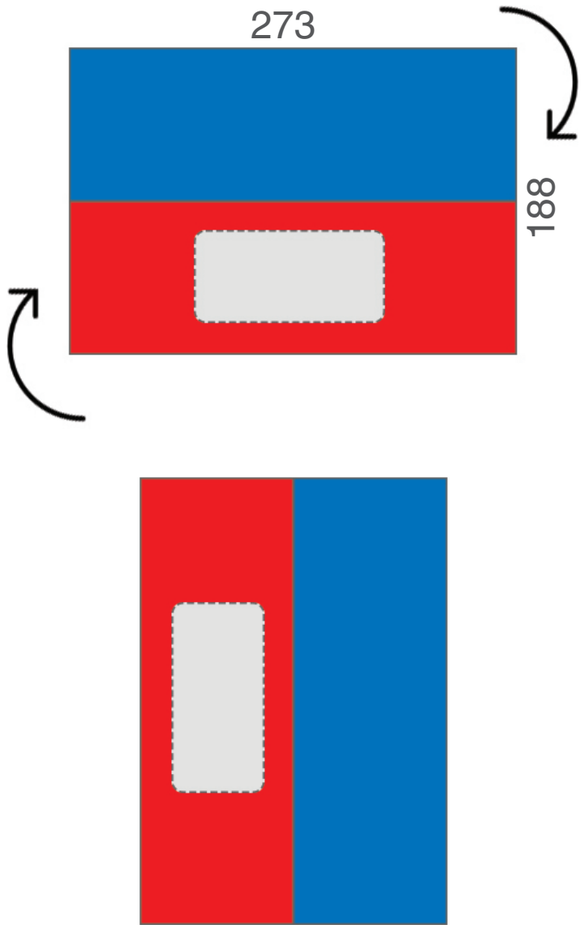
Source: http://www.vishal1mehra.com/; accessed on 19 Jan 2015

A Meal Box

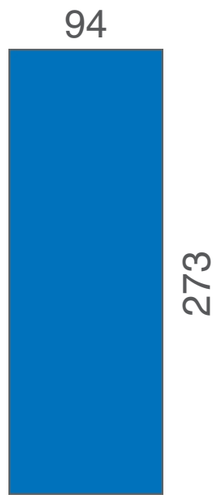
No trays required

Space provided to keep hot food

Post-flight activities are reduced



Rotation of Meal box



Only cold platter

Interviews

Ms. Aparna

Air India

Experience: 20 years

“We have to frequently bend to take things in and out from the trolley. That’s the most difficult part”

“The workers have to manually load the trolley one after another, by sitting down and bending”

Mr. Dinesh Saxena

Asst. Manager- Training and quality assurance, TajSats Air Catering Pvt. Ltd.

Ms. Pratima

Indigo Airlines

Experience: 4 years

“I will be held responsible if there is any error in tallying”

“Once I had to go to the lavatory but I couldn’t since they were serving the meals and I had to wait till they collected the wastes”

Mr. Gautam Chaitanya

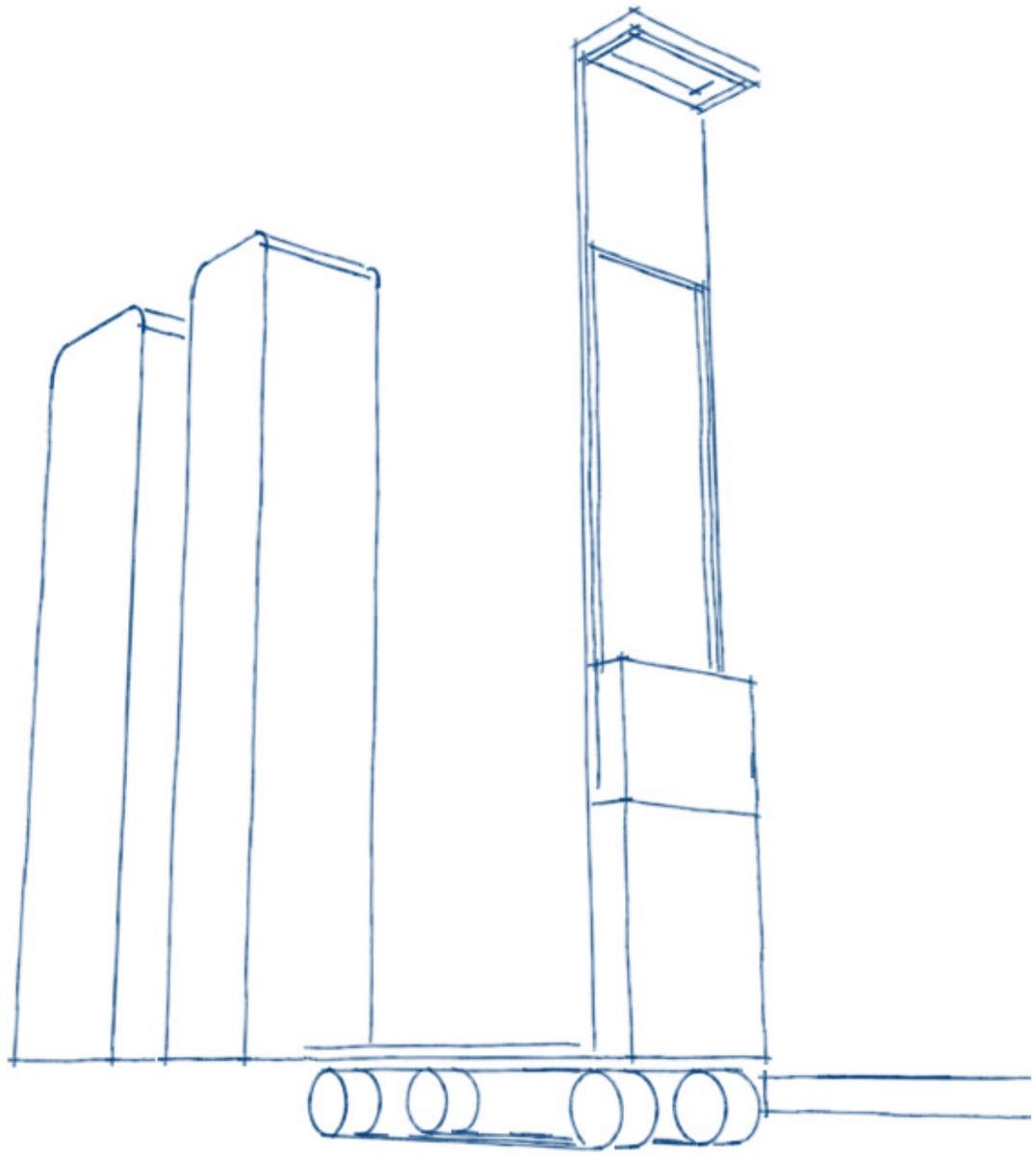
Inferences from Interviews

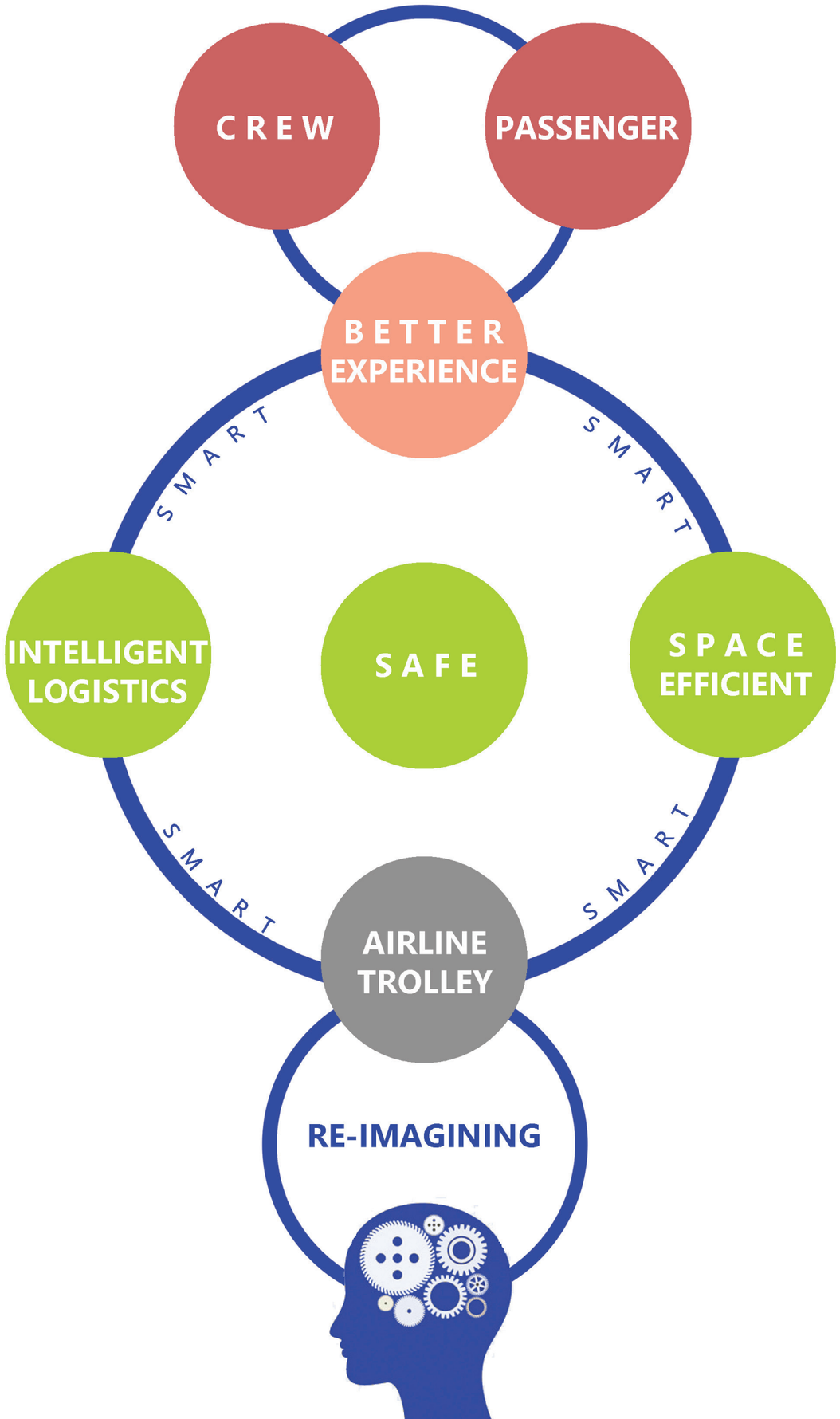
Challenges	Needs
Frequent Bending	Better method to take out food
Cart is Heavy	If the cart could be lighter...
Turbulence	The cart shouldn't topple or roll-on
Uterine Prolapse	Reducing push/pull efforts

Hot Food Separate	Tracking systems
Manual Arranging	Method to load in bulk/ Automatic
Hand-written Notes	Digital entries

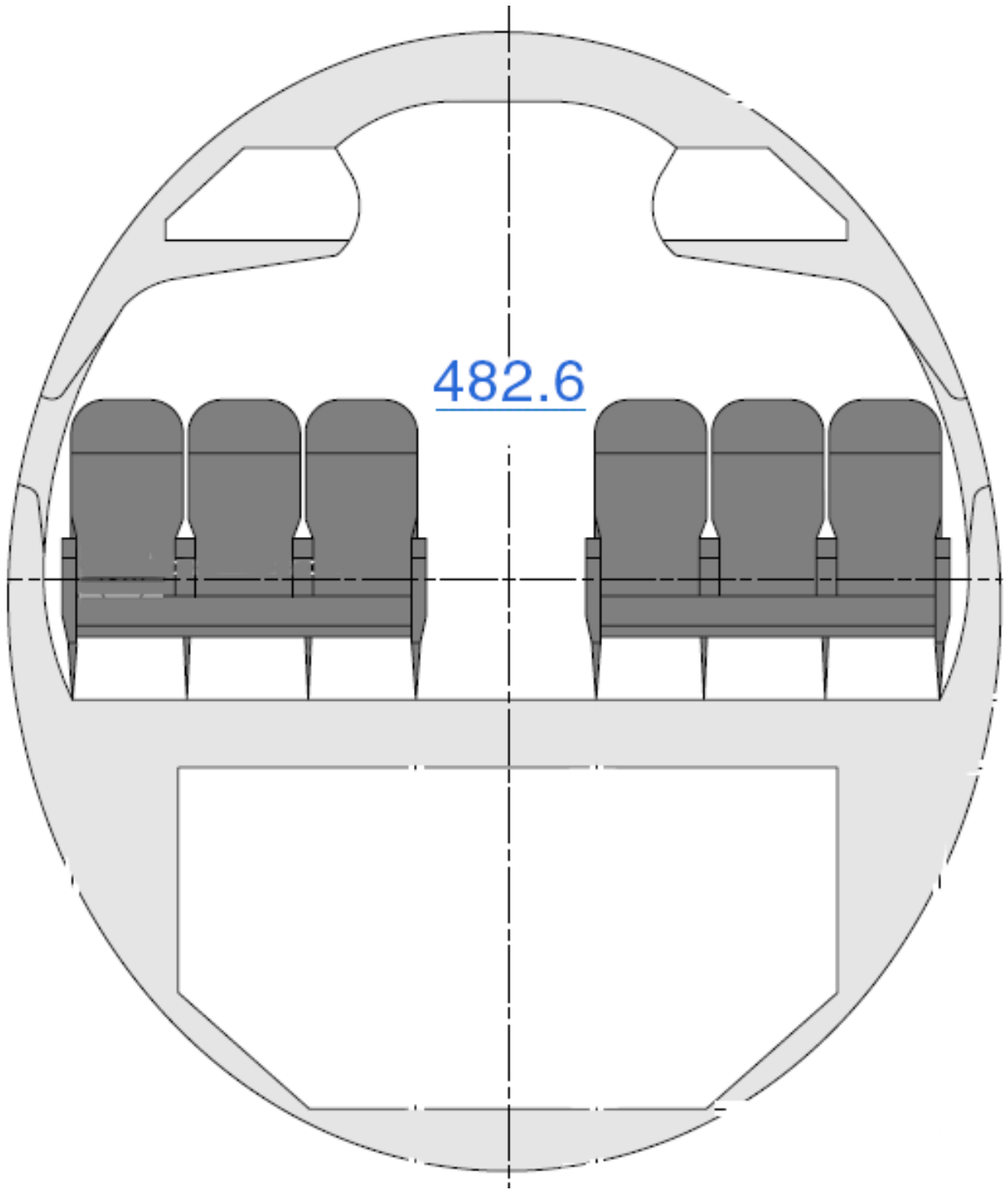
Aisle is Blocked	Enough gap to cross over
Risk of Spilling	Something to contain, if spilled
Window Seat Service	Method to hand over safely

Design Brief




CREW
PASSENGER
BETTER EXPERIENCE
SMART
SMART
INTELLIGENT LOGISTICS
SAFE
SPACE EFFICIENT
SMART
SMART
AIRLINE TROLLEY
RE-IMAGINING

Scenario of Product Usage



All Dimensions in mm

Aisle width 482.6mm (19”) (Airbus A320)

For Economy class

Domestic Flight- Max 5hrs of flight

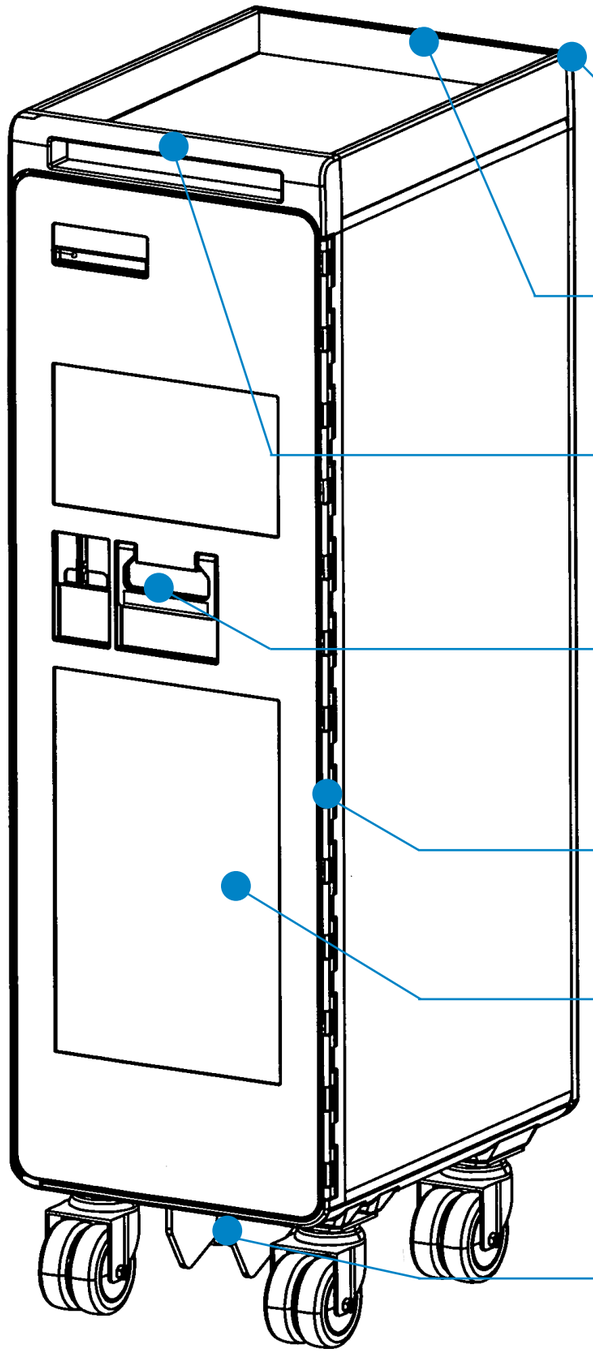
ATLAS Galley standard

Used by two crews at a time

To be used only inside the aircraft

Meals served in food packets

An Existing Trolley



Corners/ Edges
Sharp Corners

Width
Covers the entire aisle

Handles
Uncomfortable, Wrist pain

Latches
Have to latch when door is closed

Door
Hinged; Takes up additional space

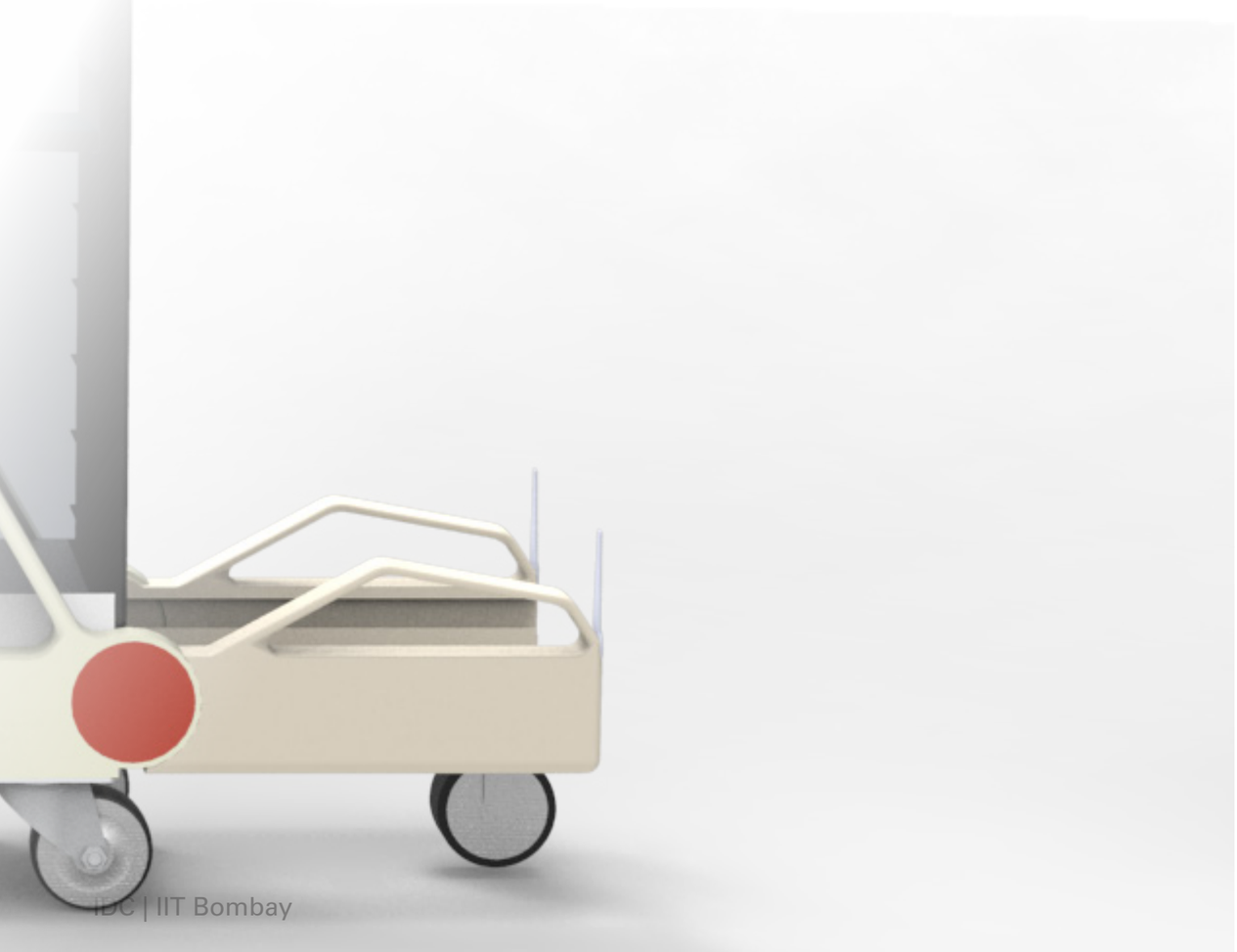
Location
Have to bend to locate trays

Weight
Approx. 31.86kg

Brakes
Difficult to locate; Risk of forgetting

Source: Data from the User Survey conducted during January to March 2015

Focus



Re-imagining

Enhancement

Efficient

Effective use of volume

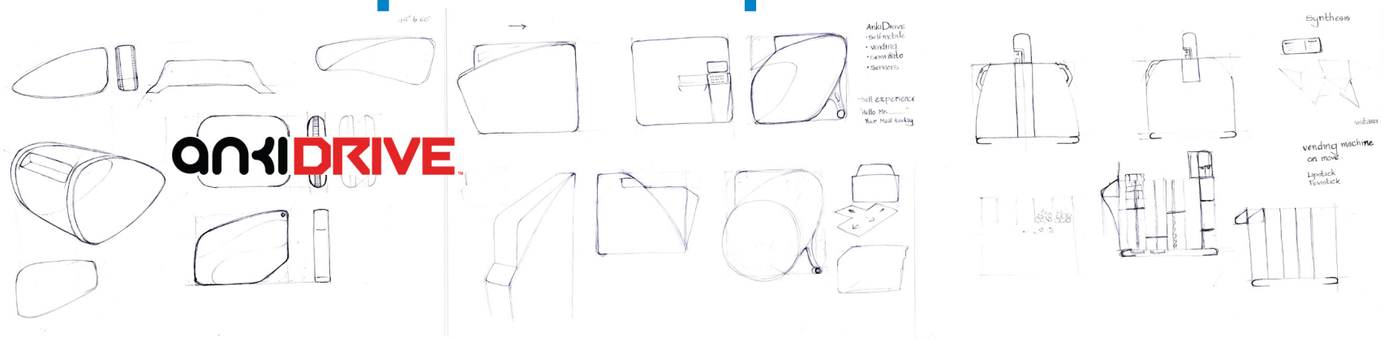
Experience

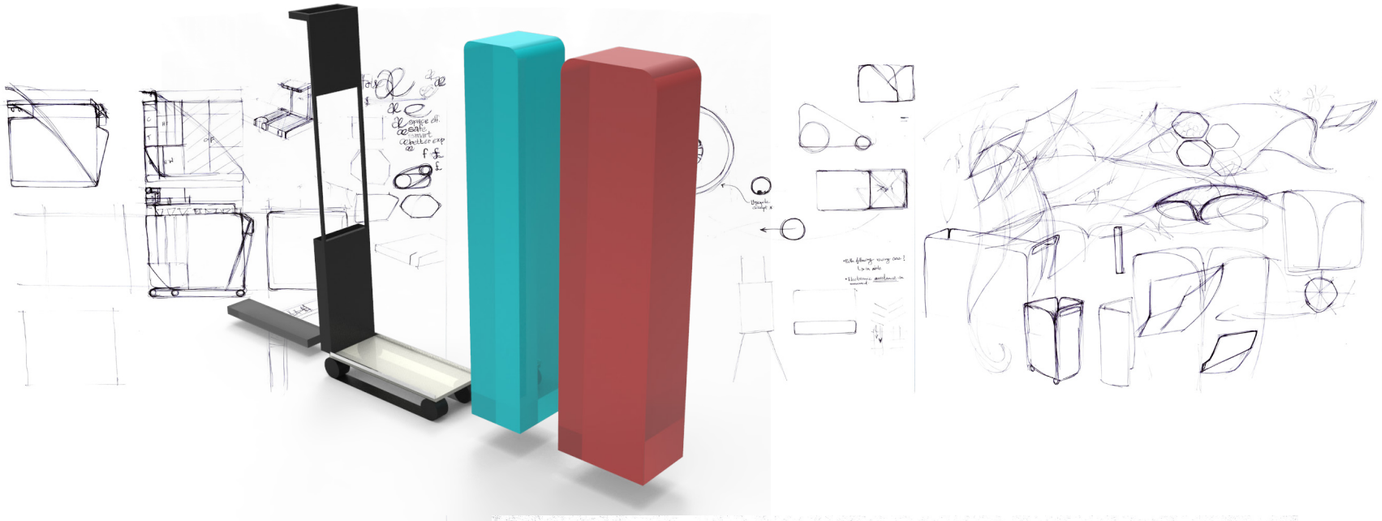
Modularity

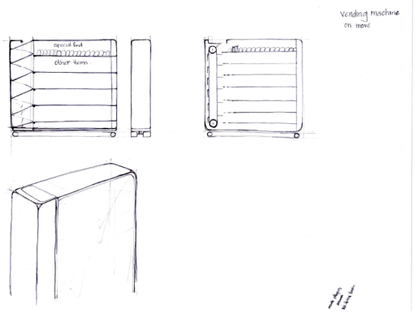
Useability

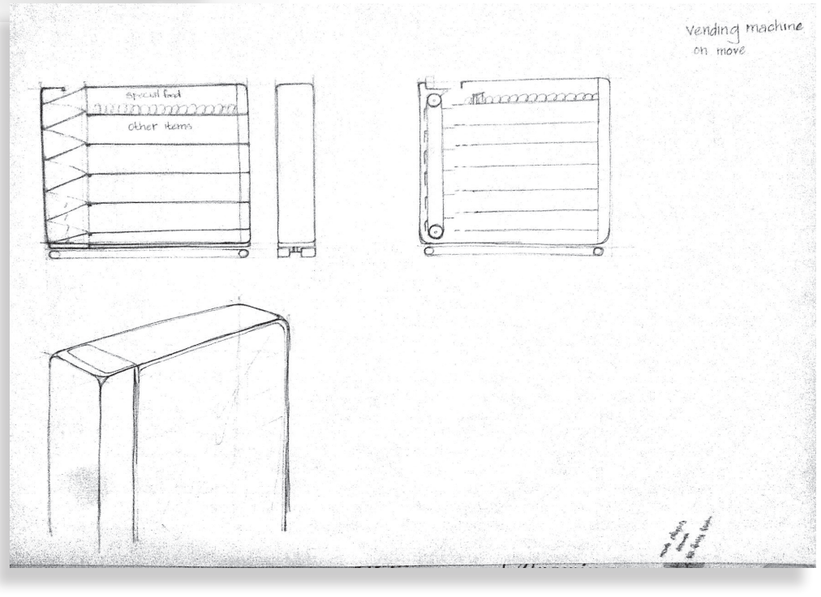
Technology

Concept Development: Phase 1









Vending Machine on Move

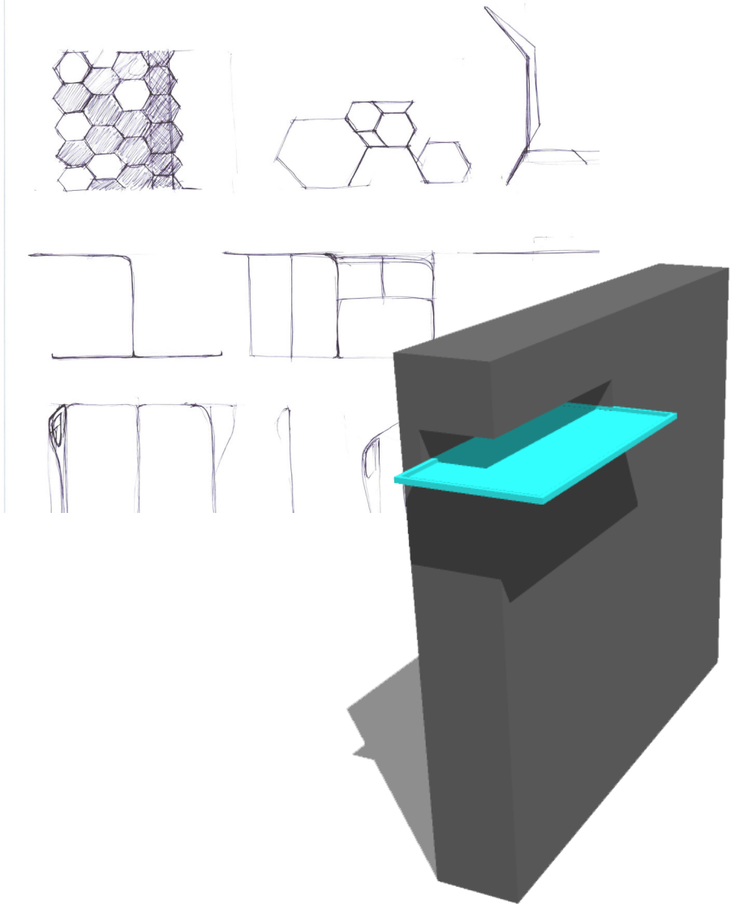
Single Chassis and Modular Components

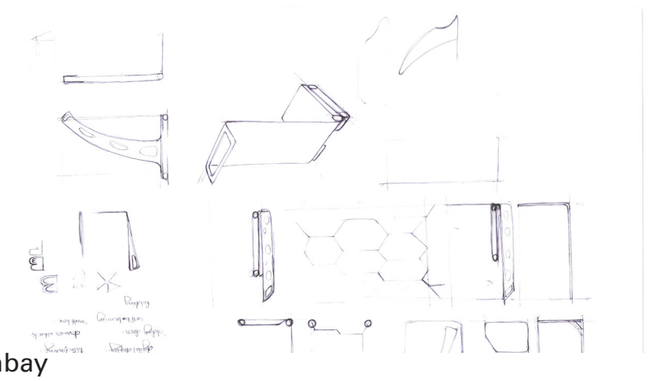
Concept from physical gaming: Self Control

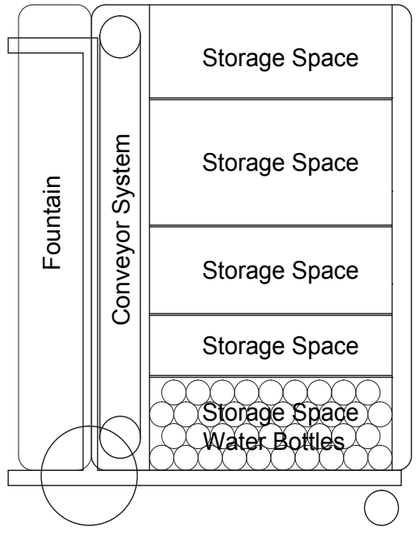
Ideas Taken Forward...

- A consolidated structure
- Modularity
- Power assisted drive
- Top loading/unloading
- Width reduction

Concept Development: Phase 2







Concept 1: Food Dispenser on Wheels

1030x 810x 150 mm

Dispenses out food for complete meal

Systems and mechanisms similar to vending machine

Evaluation

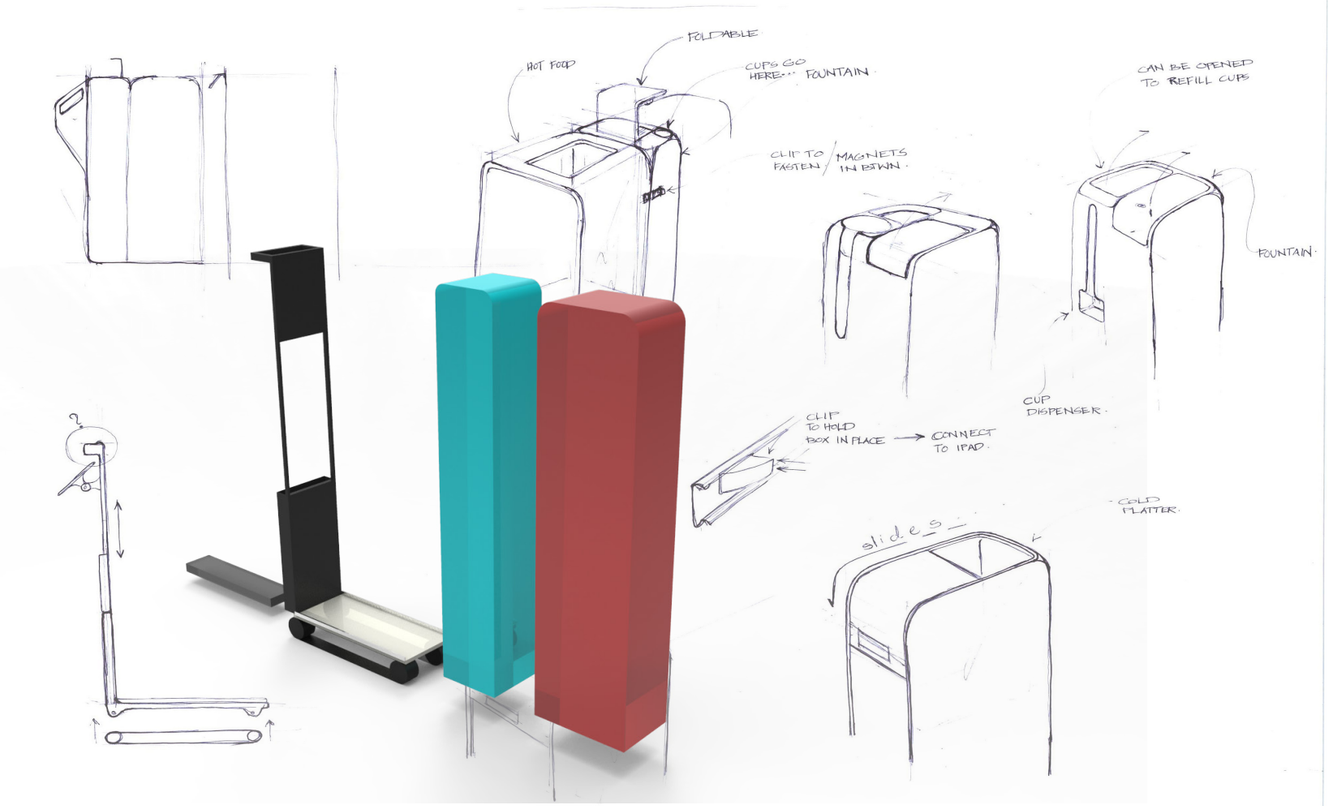
Easiness in service

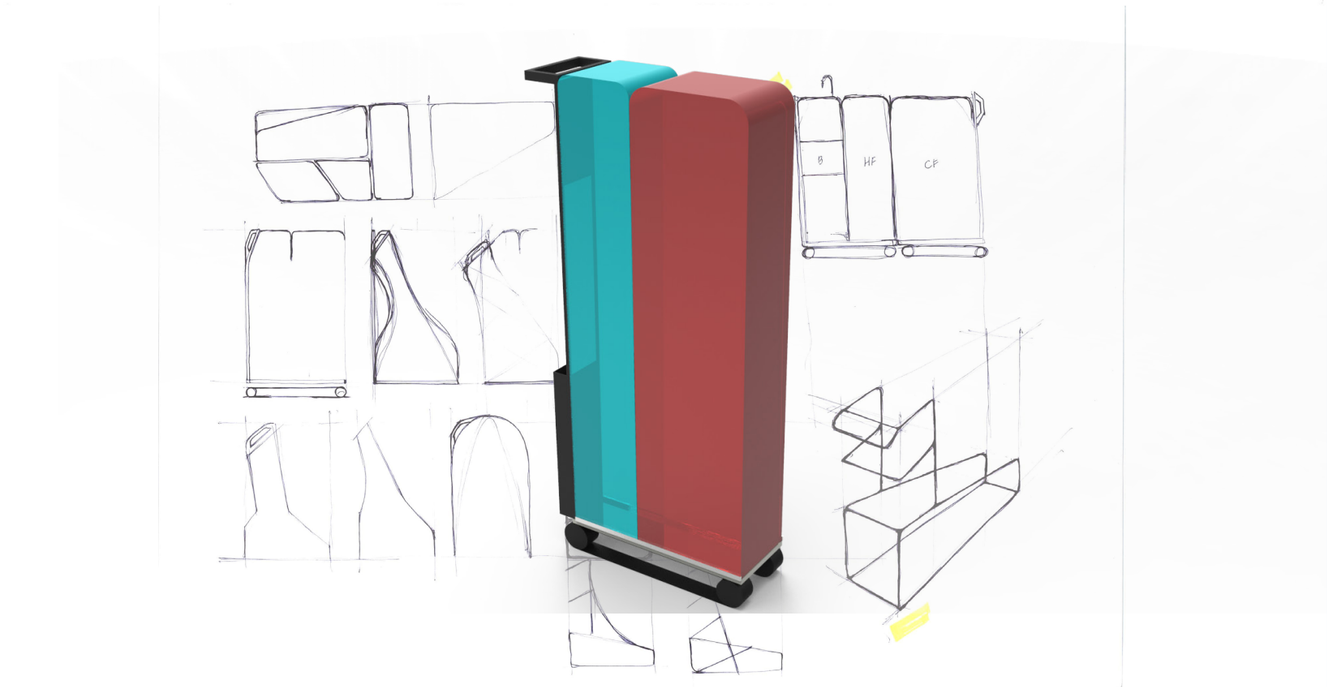
Less or no spillage during turbulence

Complex mechanism- Increase in weight

No hot beverages

Mechanisms eat up space





Concept 2: Single chassis with modular components

1030x 710x 254 mm

Deconstructs the present trolley

4 Components:

- The Chassis - Structural support
- The Hot Container - For hot meals
- The Cold Container - For cold platter
- A Fountain - For tea, coffee and water

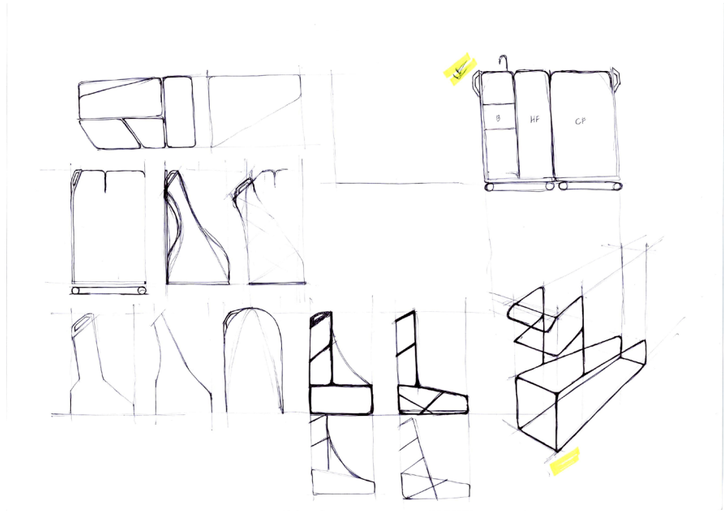
Evaluation

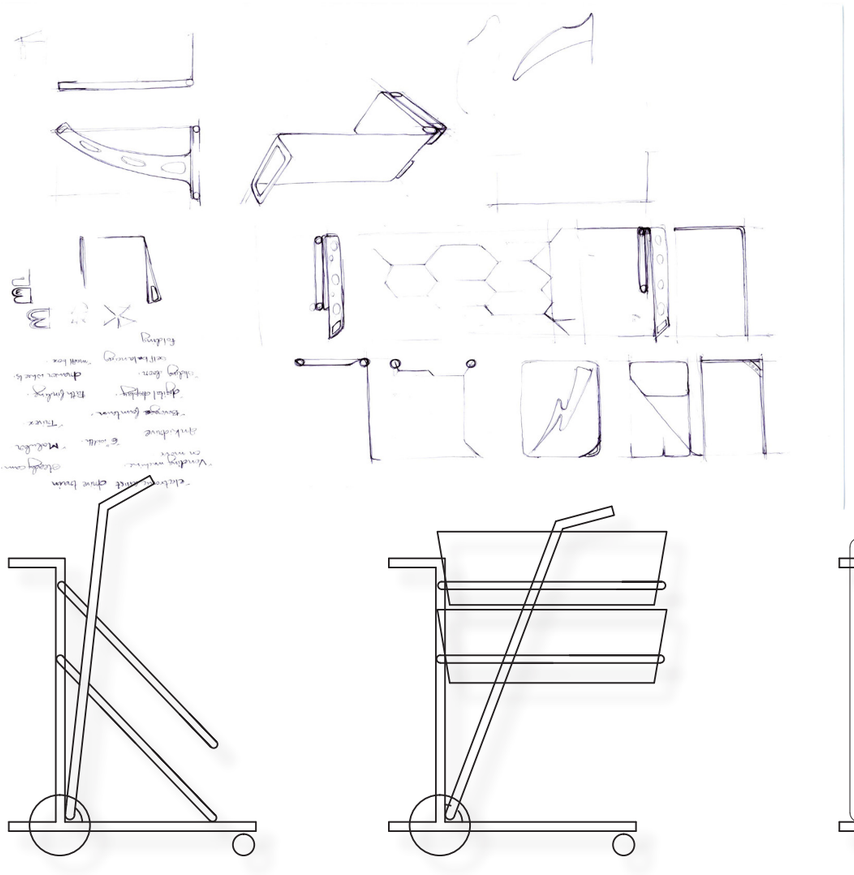
Versatile for various catering scenarios

Consolidating needs of crew at one place

Calls for a different trolley for caterers

Possibility of spillage during turbulence





Concept 3: Single chassis with modular components

Length: 710 Width: 203 mm

Deconstructs the present trolley

4 Components

Shifting the container is easier

Less mechanisms involved

Changing posture of chassis

Evaluation

Easy transfer of containers

Has additional space

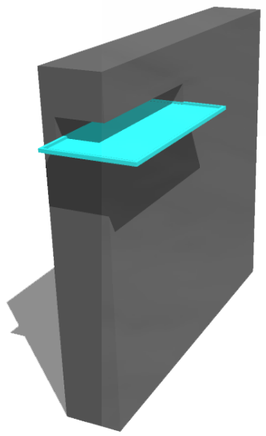
Height of chassis (at folded position) goes beyond 1030mm

Calls for major change in the galley

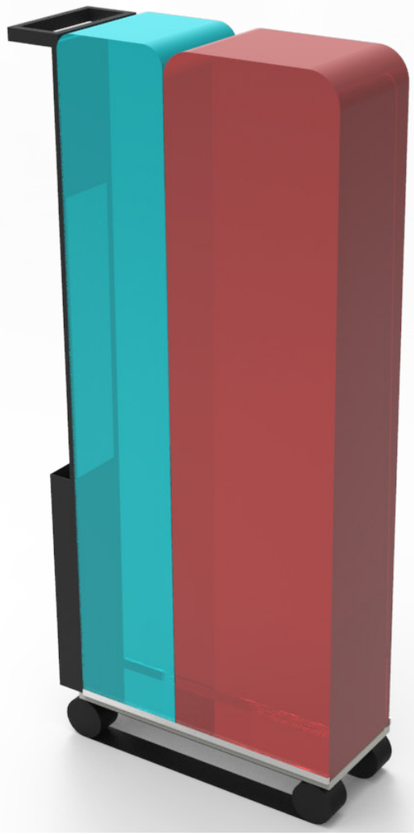
Evaluation of Concepts

Criteria	Category	Weightage	Concept 1		Concept 2		Concept 3	
			Rating	Weightage	Rating	Weightage	Rating	Weightage
Functionality (40%)	Ease of taking out meals	20	2	0.4	2	0.4	1	0.2
	Ease of manoeuvering	10	2	0.2	1	0.1	1	0.1
	Loading/ Unloading	10	1	0.1	2	0.2	2	0.2
Space Utilisation (20%)	Outside the trolley	10	2	0.2	2	0.2	2	0.2
	Inside the trolley	10	0	0	1	0.1	2	0.2
Complexity of mechanism involved (10%)		10	0	0	1	0.1	2	0.2
Visual Aesthetics (10%)		10	1	0.1	2	0.2	0	0
Experience (20%)	For Crew	10	2	0.2	1	0.1	0	0
	For Passengers	10	1	0.1	2	0.2	0	0
Total (100%)		100		1.3		**1.6**		1.1
0-Does not satisfy								
1- Up to 50%								
2- More than 50%								

Based on Evaluation, Concept 2 is taken ahead



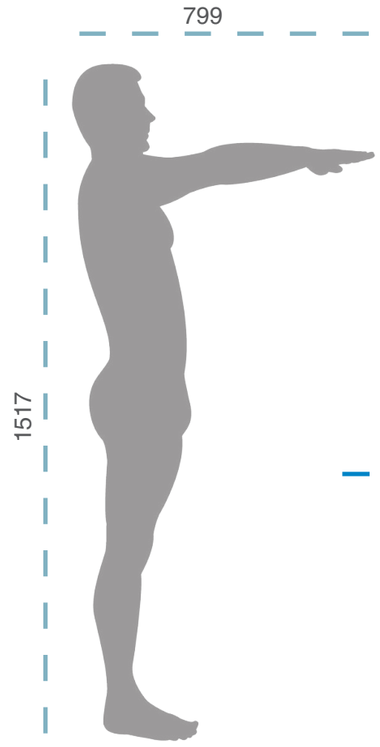
Concept 1



Concept 2

Concept 3

Mock- Ups



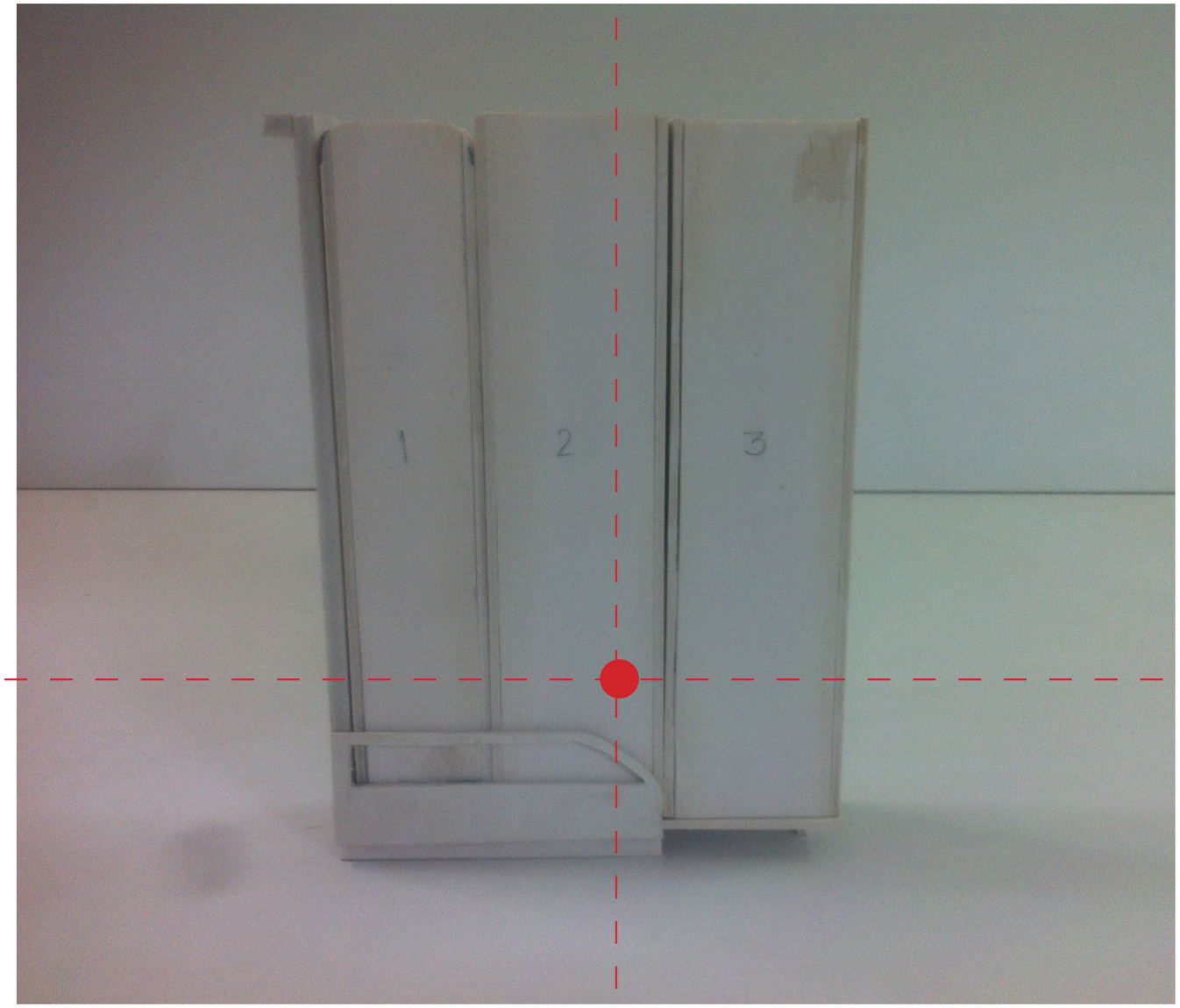
Anthropometric Dimensions

Scale Mock-up

Full-Scale Mock-up

Center of Gravity

For Achieving Sleekness



Parameters

Length

Breadth

Height

Fully loaded mass of the trolley

Concept Development | Stage 1

Co-Creation | Feedback

First Feedback on Concept

“I like the idea how the containers slide-in and slide out of stowage”

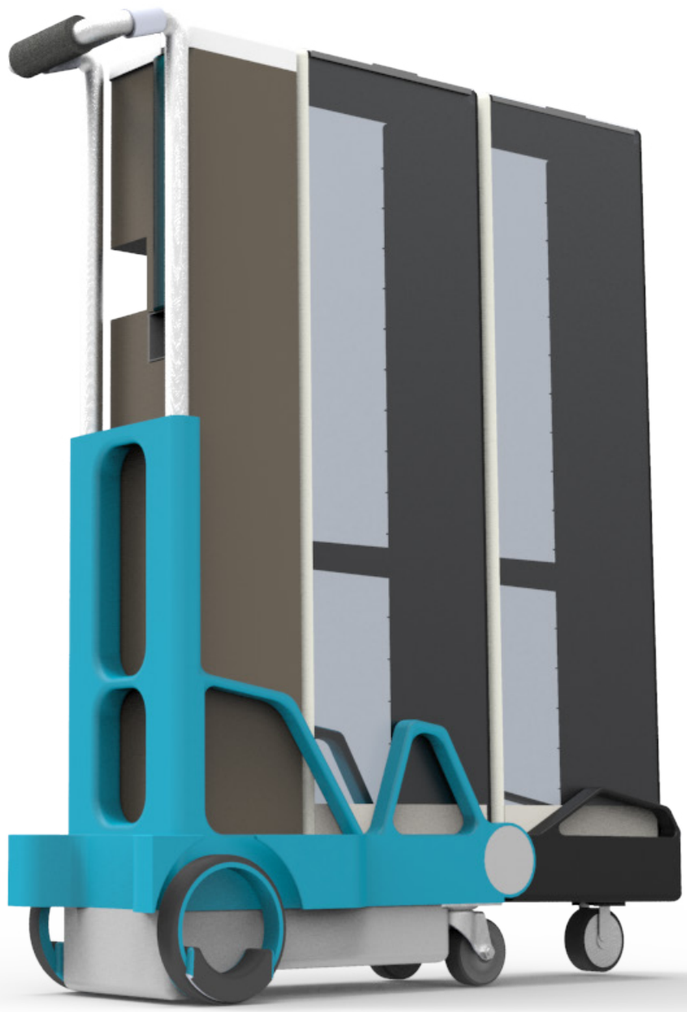
“This can definitely be used for full service airline”

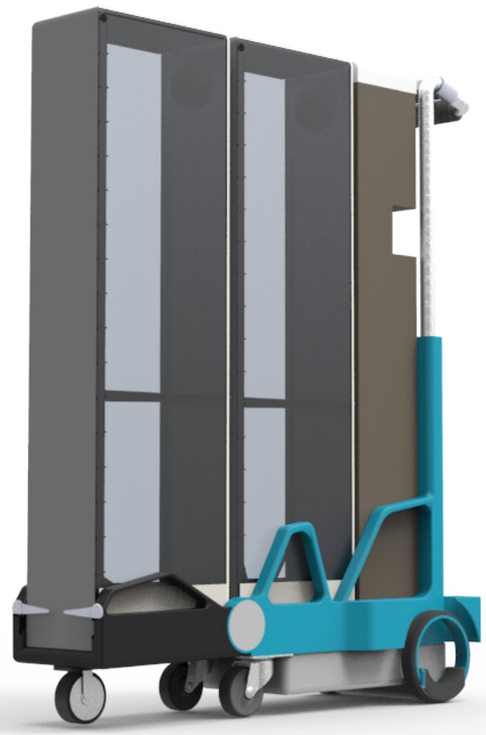
“254mm (8”) width is awesome”

“It is good to have an all in one; comprehensive; trolley”

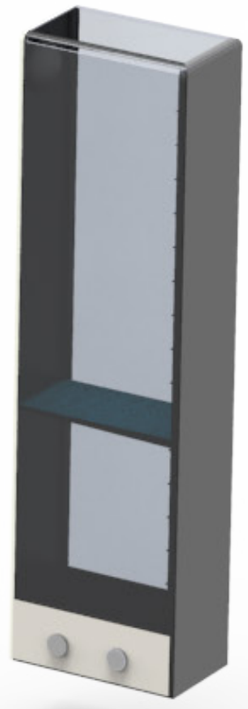
-Responses from various users

Concept Development | Final



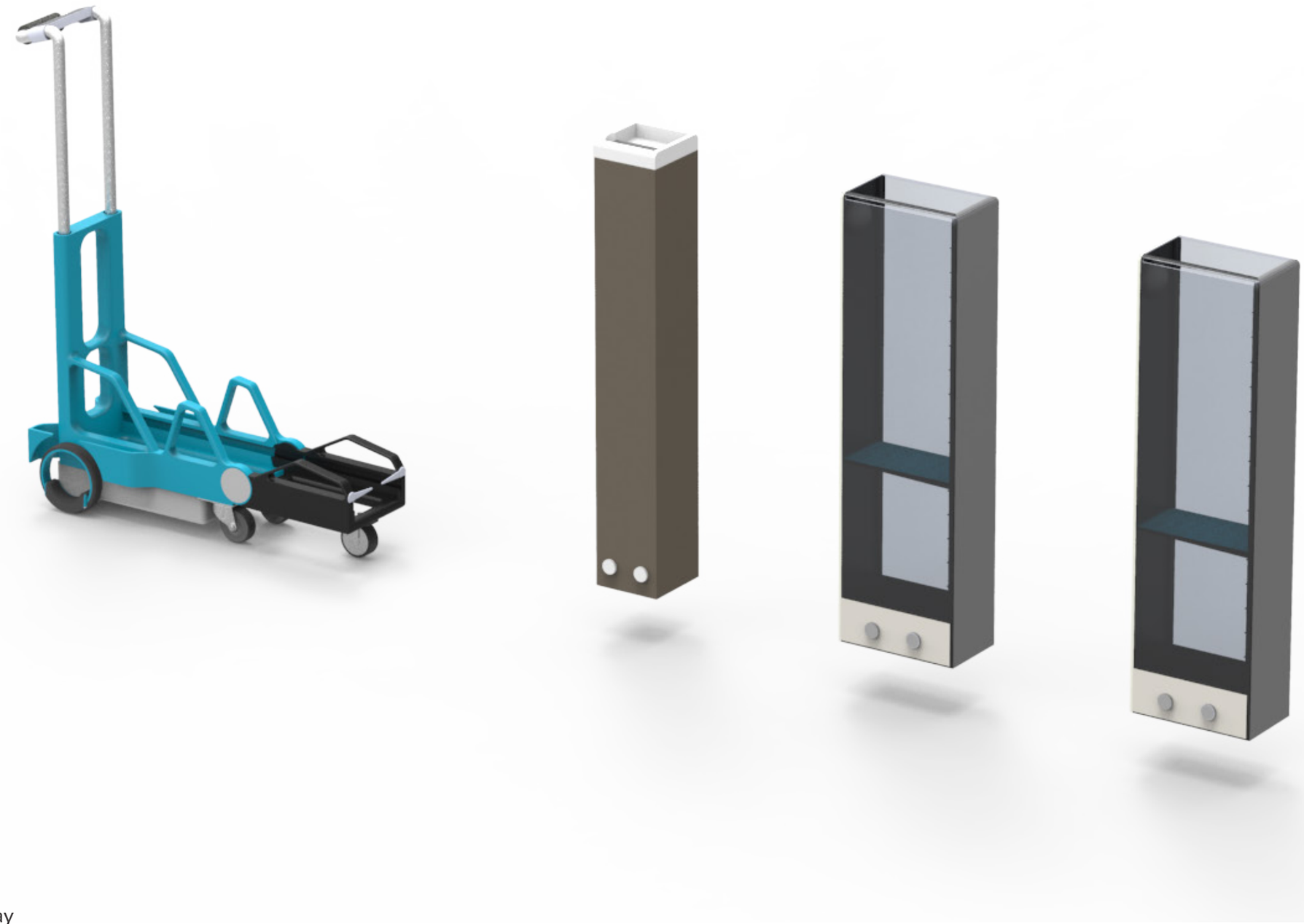


Basic Components

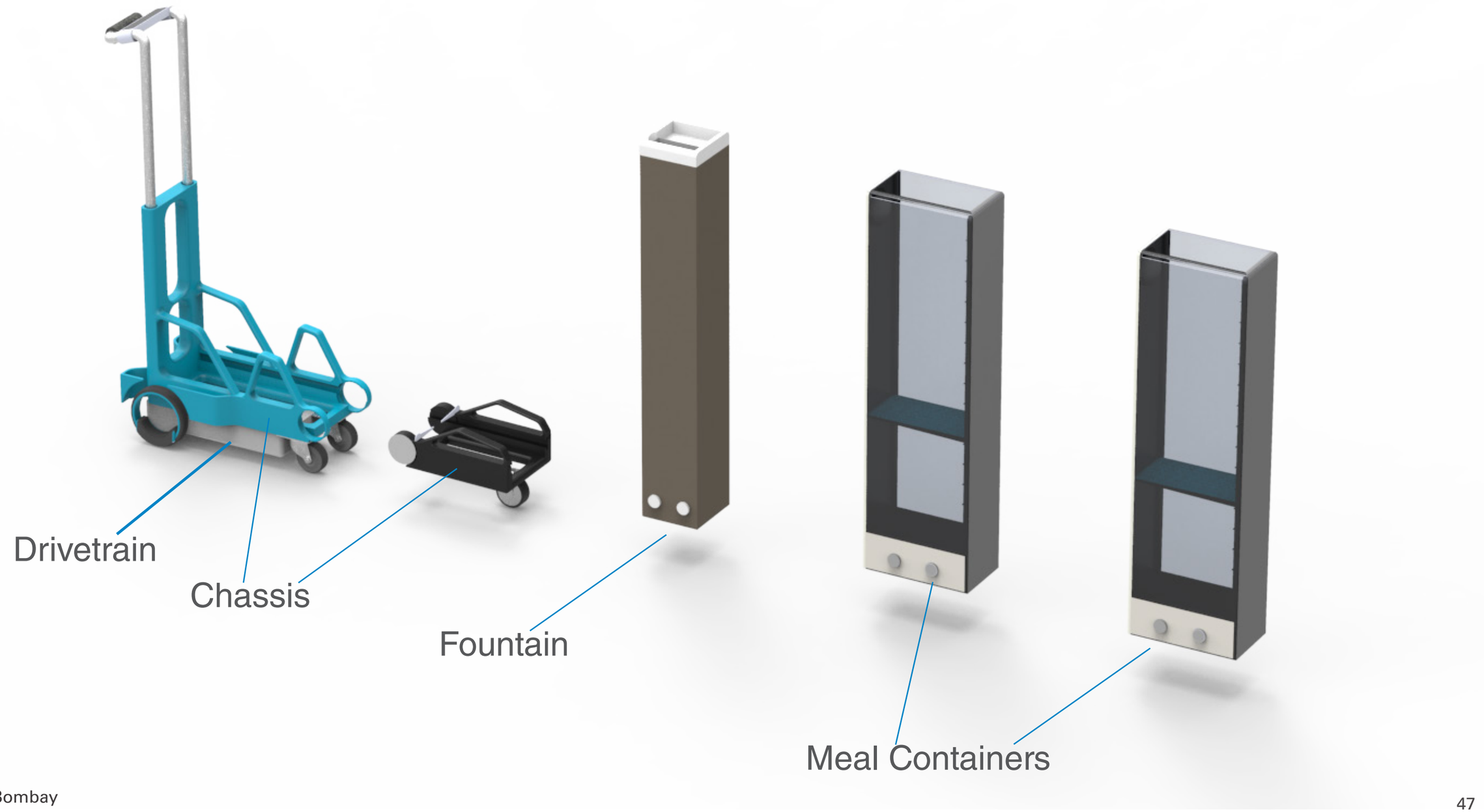


Basic Components

Basic Components



Basic Components



Detailing of the Concept

Detailing of the Concept

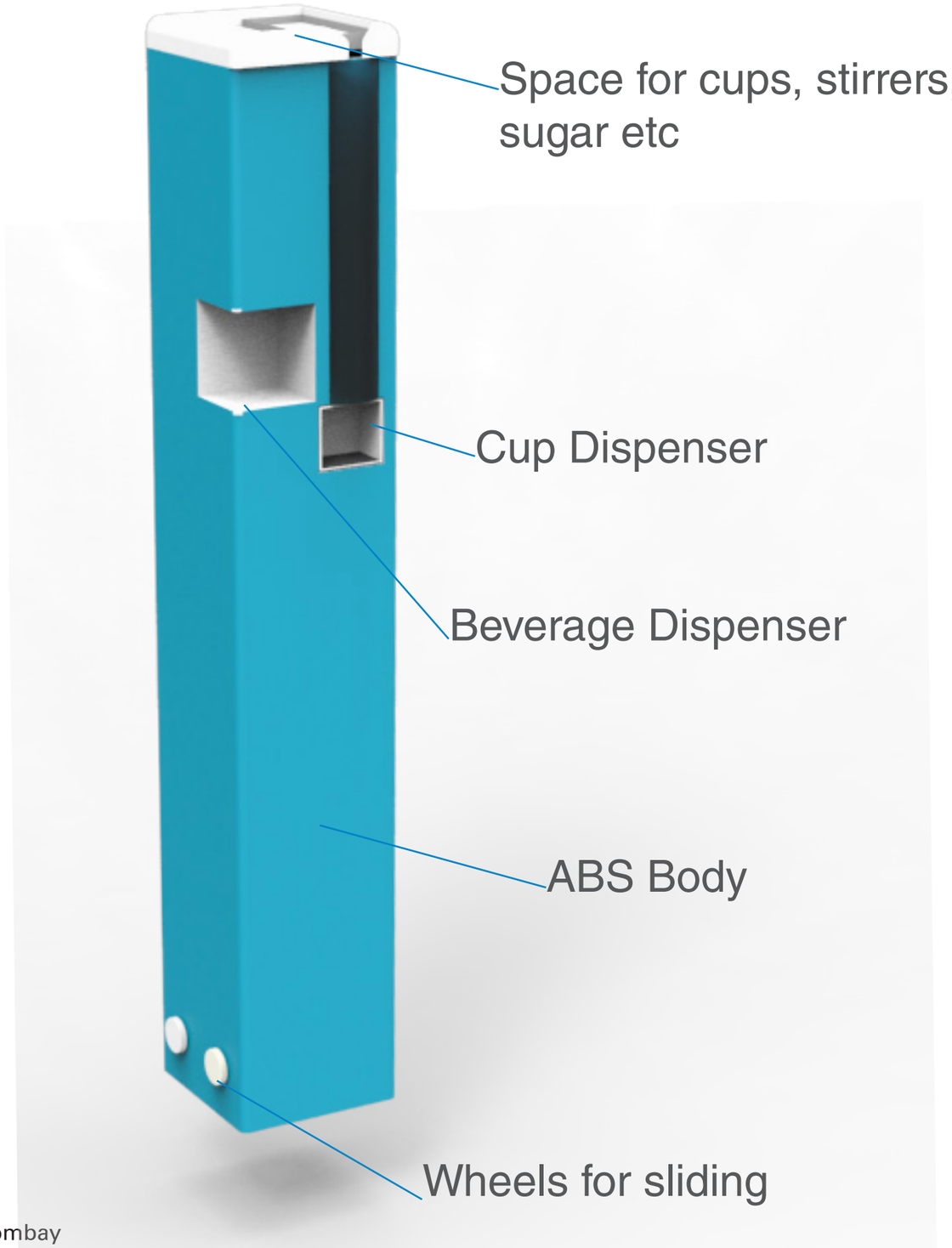
The Chassis

Length: 710mm Width: 254mm

Height adjustable handle (Aluminium)

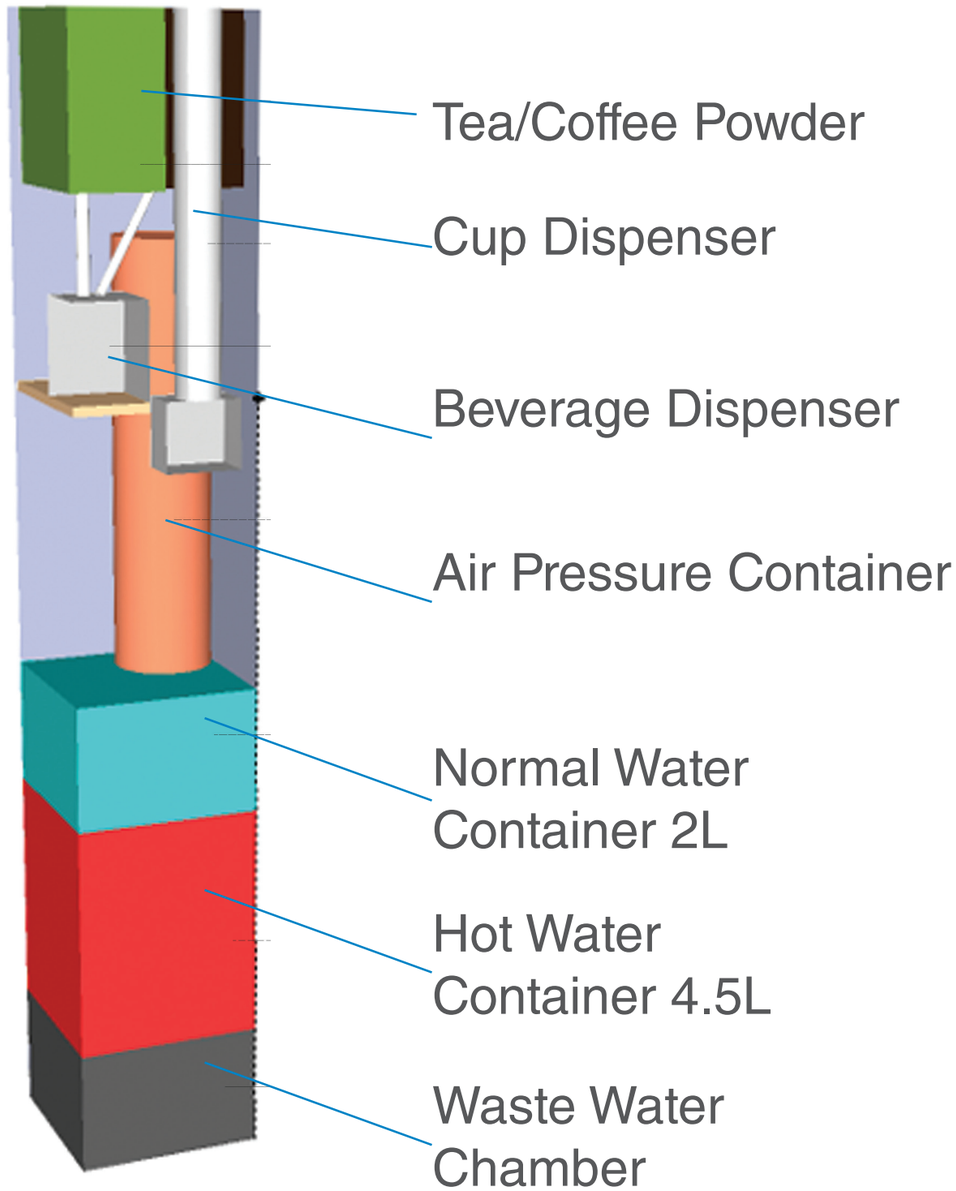
Minimalistic, Strong and Lightweight bone structure chassis (Carbon Fibre)

Extendable Chassis (Carbon fibre)



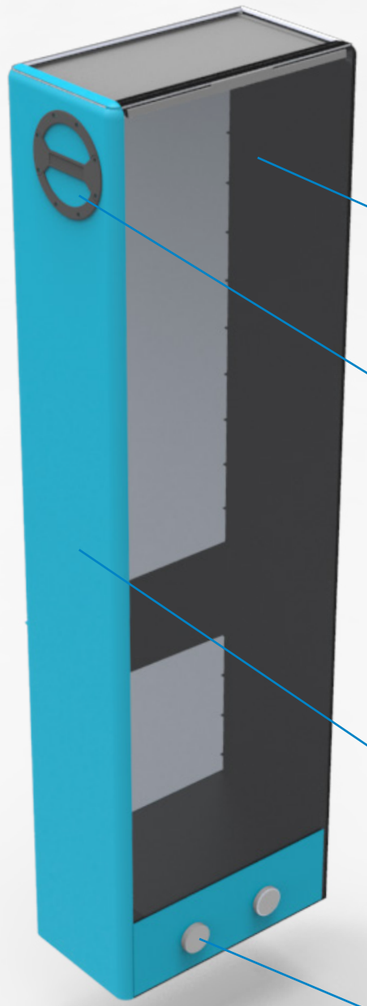
The Fountain

Size: 152.4mm x 152.4mm x 930mm



The Containers

Size: 279.4mm x 152.4mm x 930mm



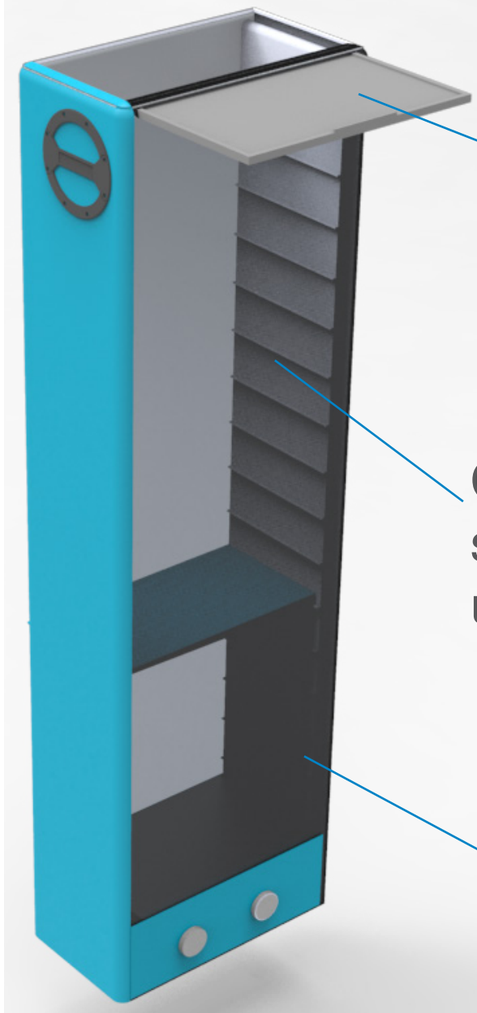
Trivex for transparency; Would be lit

Handle

Aluminium cage

Wheels for sliding

Transparency enhances experience



Lid - Space for pre-service arrang-ments

Conveyors on either side. Top loading/ unloading possible

Vents for air circulation

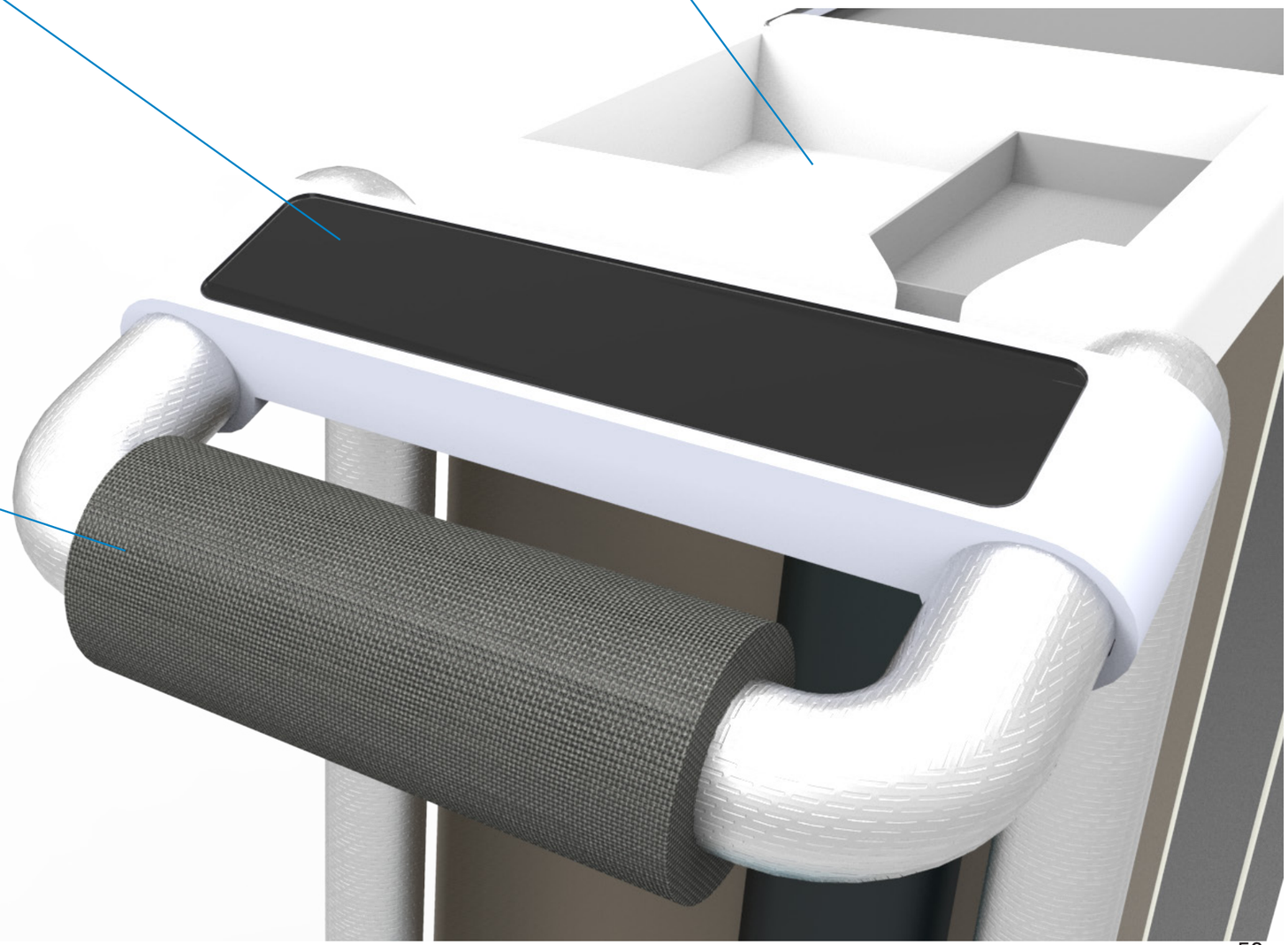
Two Meal Containers- Hot Platter and Cold Platter

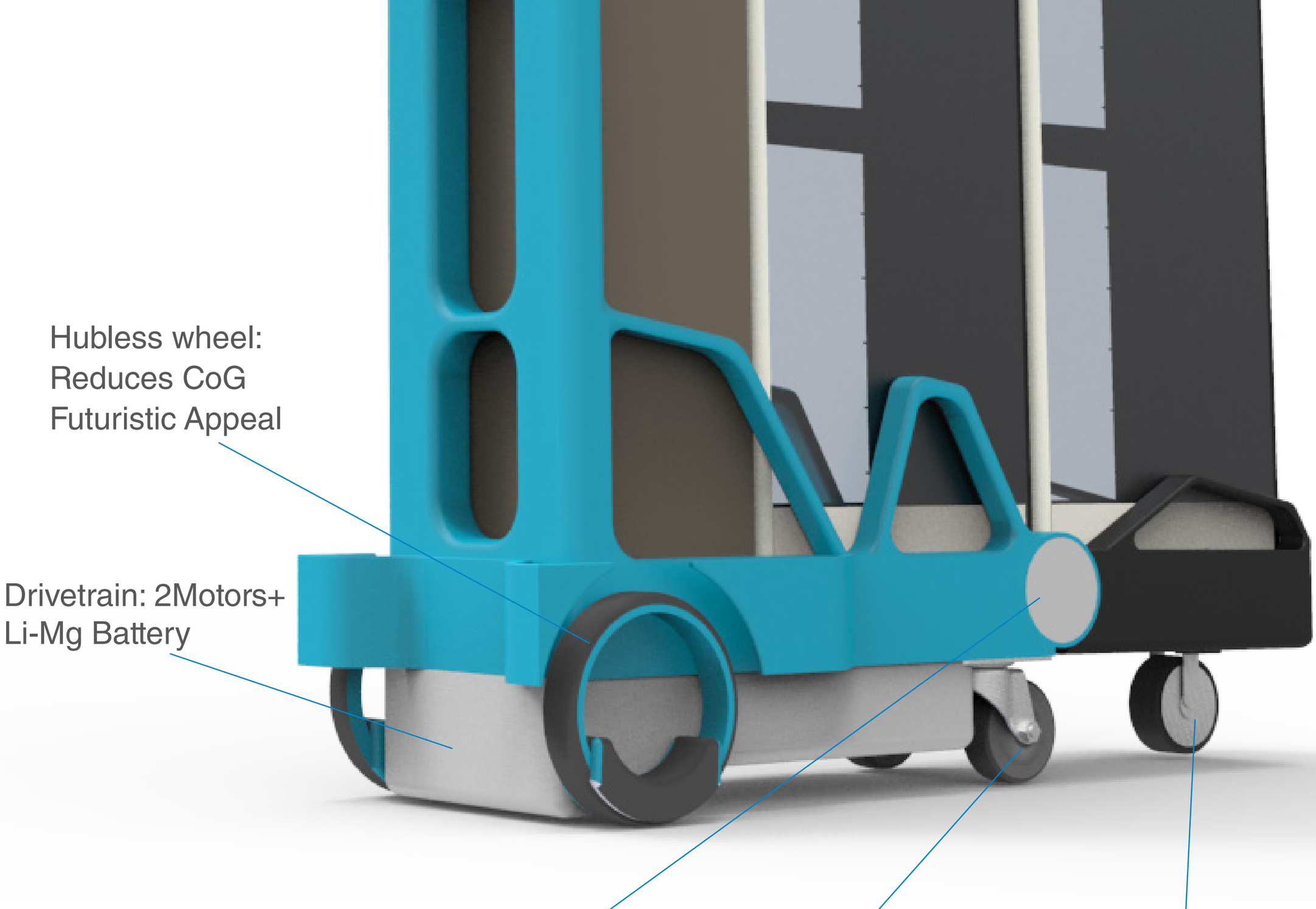
The Handle

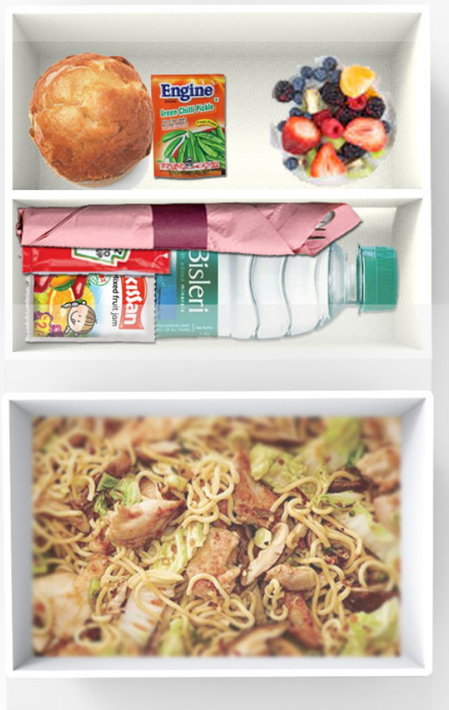
A soft interface for display and commad inputs

Space for cups, stirrers, sug-ar etc

Soft rubber grip




Hubless wheel:
Reduces CoG
Futuristic Appeal
Drivetrain: 2Motors+
Li-Mg Battery
The Fulcrum
In-Flight Caster
Wheels
Foldable Caster



The Meal Box

Food packed in a designed box

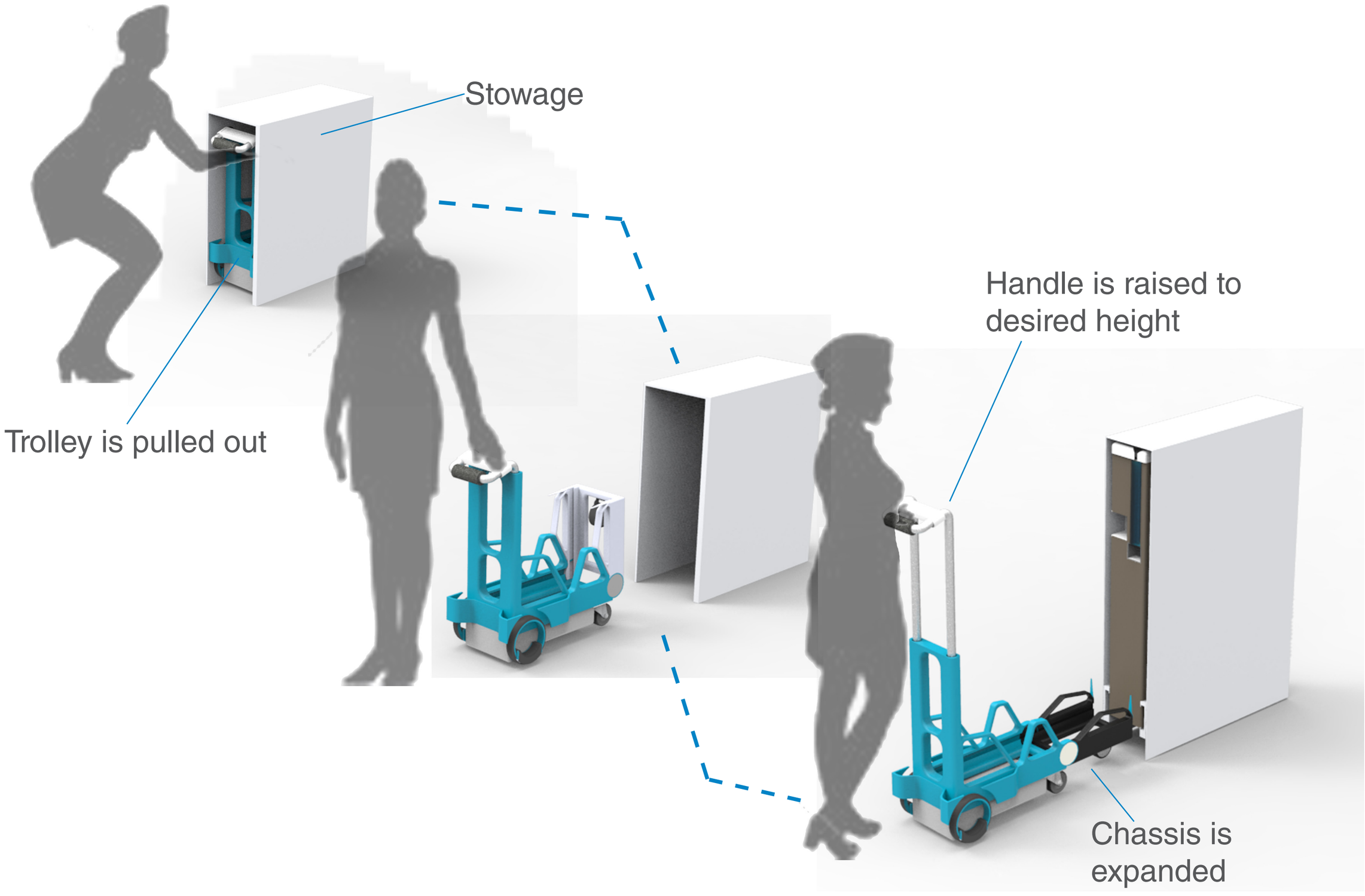
Separate boxes for hot and cold platter

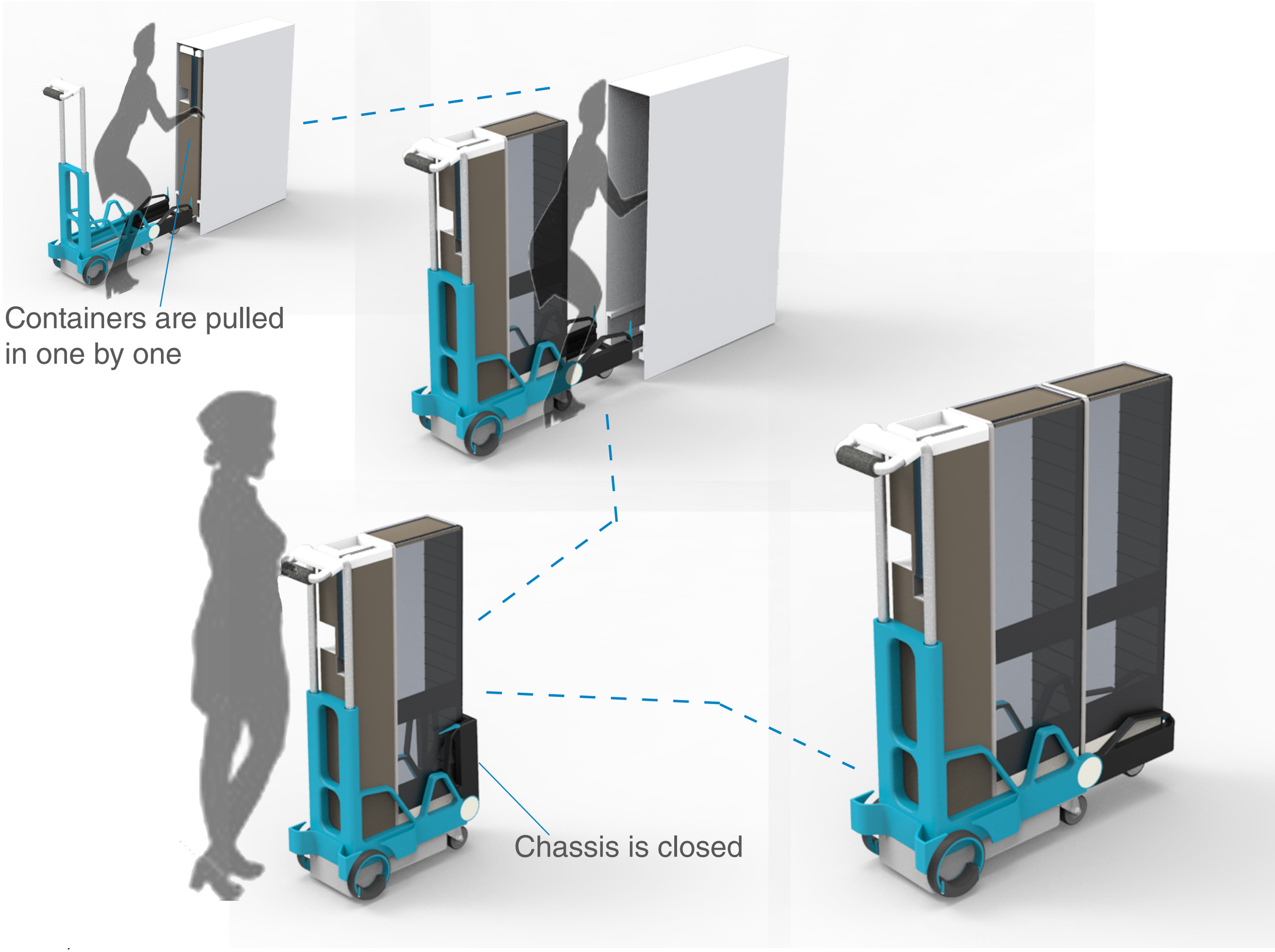
Why a Meal Box?

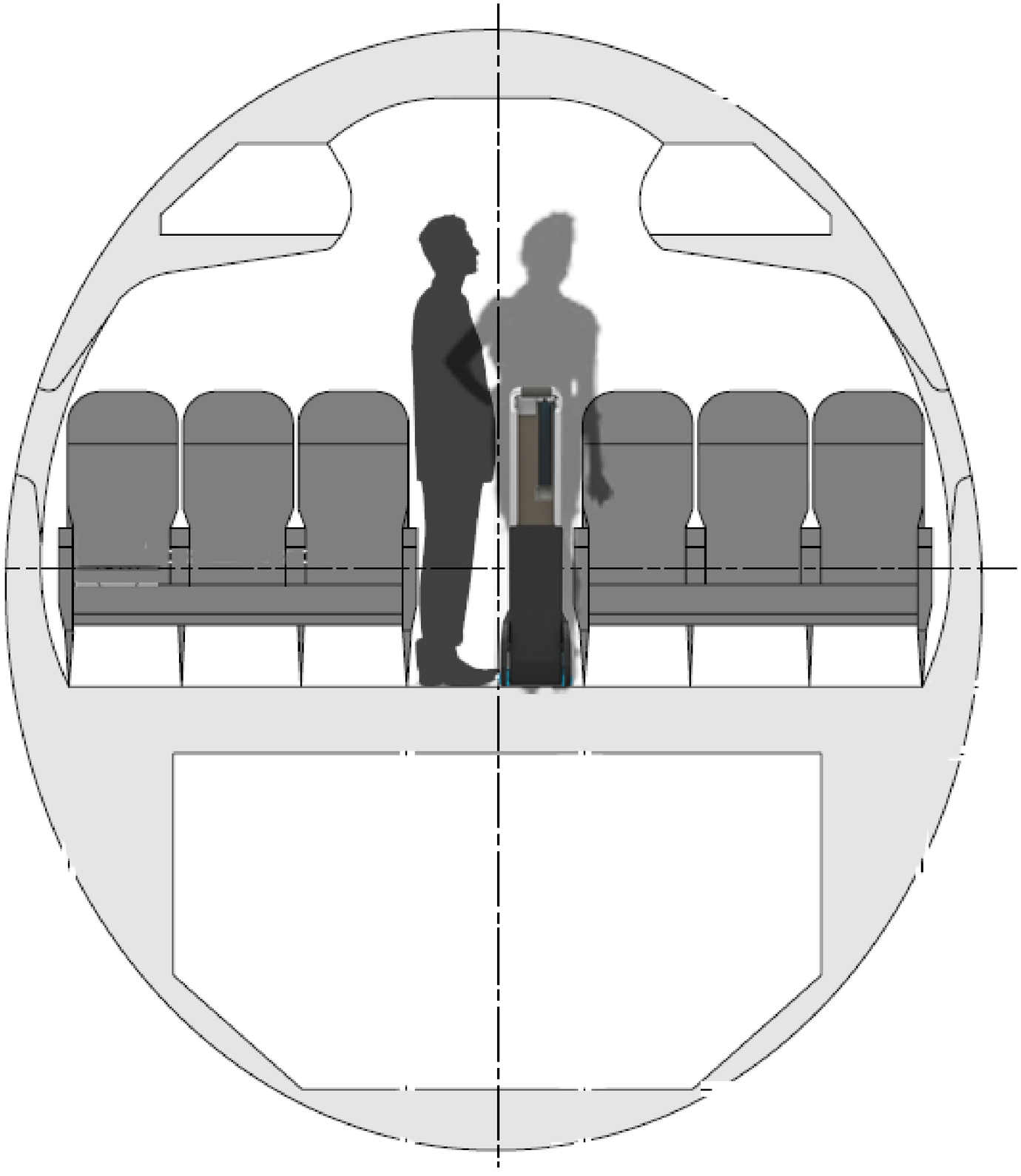
- Space Efficient
- Width is 152.4mm (6”)
- Easy handling and stacking
- Reduce spillage
- Better service to window seat

PET containers- re-usability

Working of the Concept


Stowage
Trolley is pulled out
Handle is raised to desired height
Chassis is expanded


Containers are pulled in one by one
Chassis is closed



An Airplane Journey

A Study

Interior formal aspects

Close and critical observation on activities of cabin crew

Imagining the new trolley w.r.t the existing

Quick feedback from cabin crew and passengers

Finding the Right Form

A Study in Forms

From the personal experience inside the aircraft

Should be part of the family

Characters observed:

- Soft
- Generous radius given
- Mostly white and off-white shades (except seats- specific to airline)
- Matte texture

No extras

Each line has specific function; converted to beautiful visual aesthetics

Light

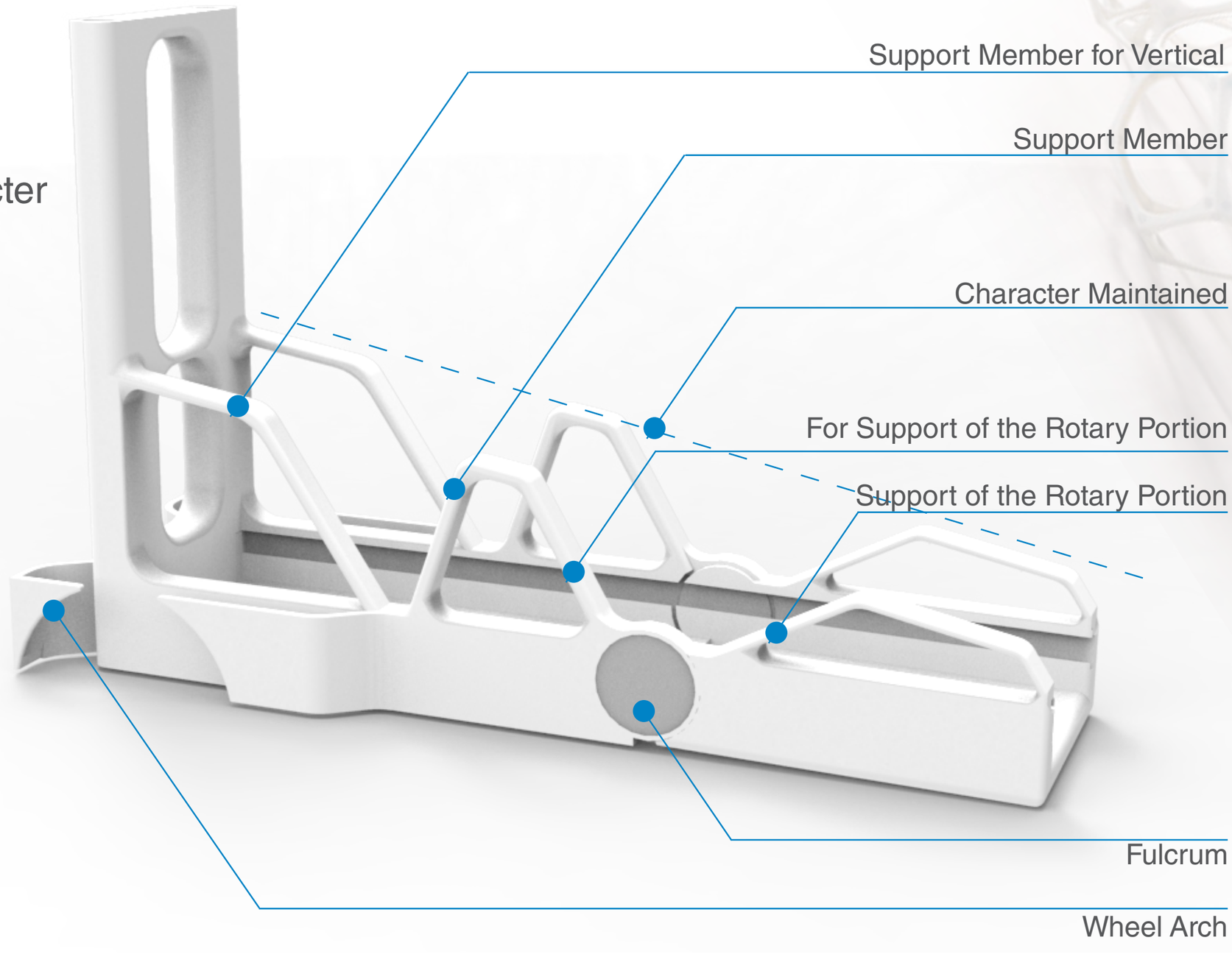
Stable

Visually strong

Maintaining character

Minimalistic

Futuristic



Weight Calculation

Weight of the New Trolley

Weight of motor - 0.8 kg
Weight of battery - 2 kg
Motor - 5W
(Resistance force is 8.8N, taking total weight as 40 kg to be safe)

No. of motors - 2 on rear wheels

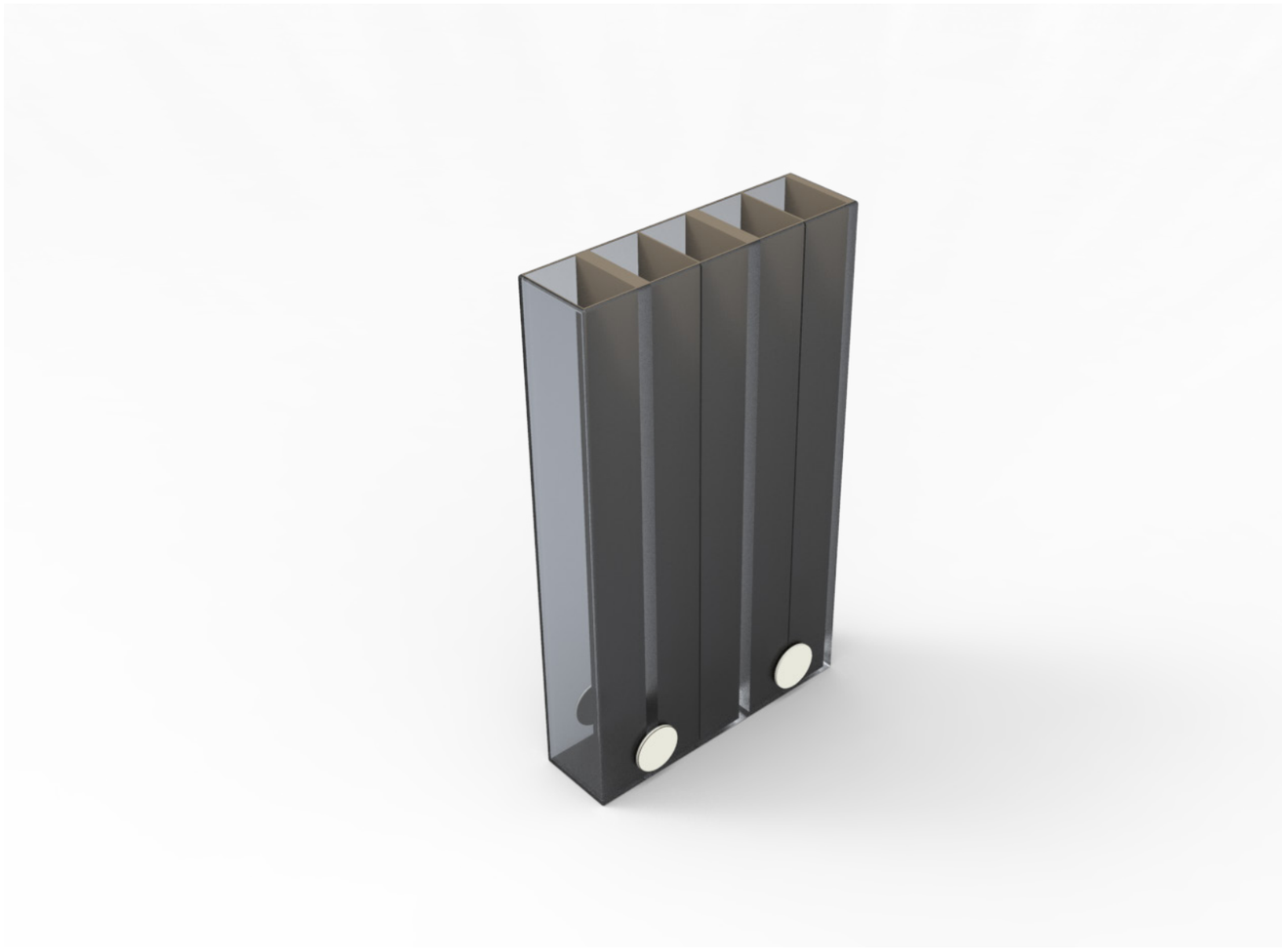
Total weight of powertrain - 2+2x0.8 = 3.6 kg

Total Weight of Trolley - 30kg + 3.6 kg

- **33.6 kg** Approximate

Probable Colour Schemes

Way Forward...



Point of Sale Container

Accommodates various kinds of food

Compartmentalised into sections

Combination of Trivex and aluminium

Compartment would be lit

Enhances the pleasure of buying and selling

A Check...

Needs

- Better method to take out food ✓
- If the cart could be lighter... ✓
- The cart shouldn't topple or roll-on ✓
- Reducing push/pull efforts ✓

- Tracking systems ✓
- Method to load in bulk/ Automatic ✓
- Digital entries ✓

- Enough gap to cross over ✓
- Something to contain, if spilled ✓
- Method to hand over safely ✓

Trivex

Optical Quality

Strength and Durability

Ultra light-weight

Thinness

Density- 1.11g/cu.cm

Casting process

Urethane based pre-polymer

Polycarbonate

No Optical Quality

Fair Strength and Durability

Light-weight

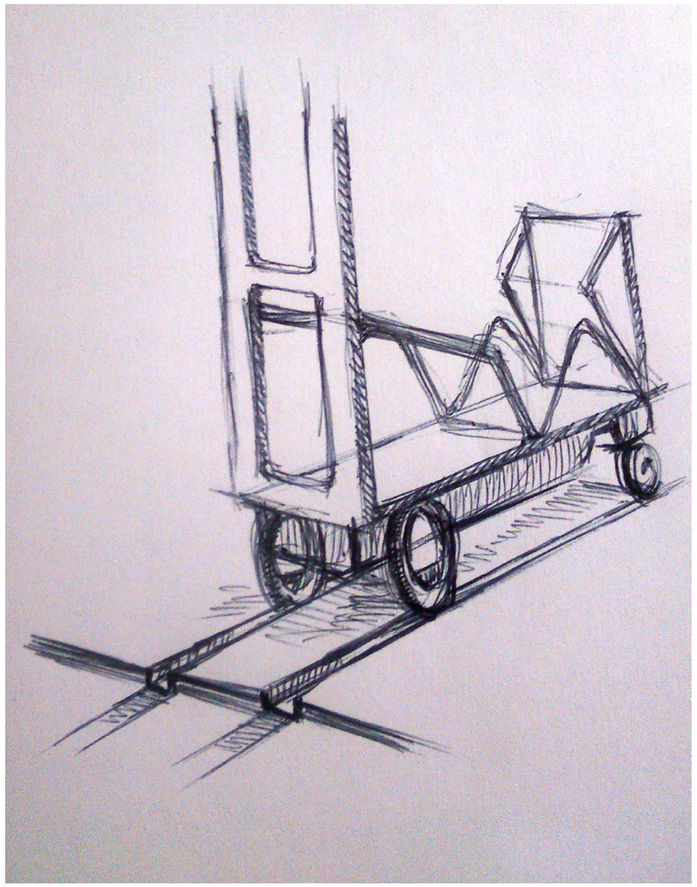
Thinness

Density- 1.20 - 1.22 g/cu.cm

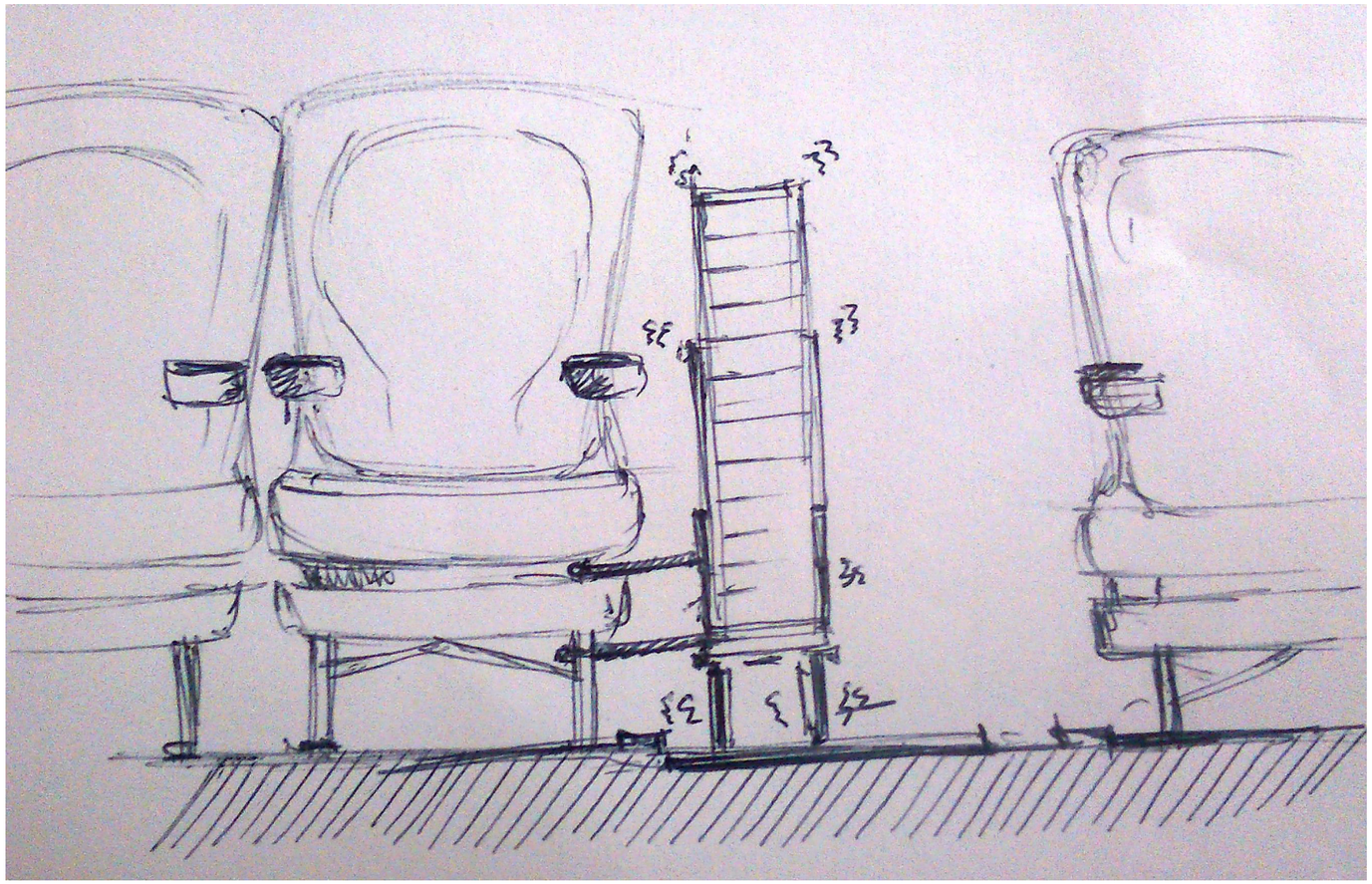
Calendering, thermoforming or injection molding

Suggestions for Safety during Turbulence

Not recommended for usage during turbulence



Suggestion 1



Suggestion 2