



Remodelling waste, brick by brick

Javier de la Fuente  
César Asensio  
Warren Tai  
Caesar Shi



# THE PROBLEM

**LONDON'S STREETS ARE COVERED IN RUBBISH. AND IT IS GETTING WORSE.**

## DESIGN BRIEF

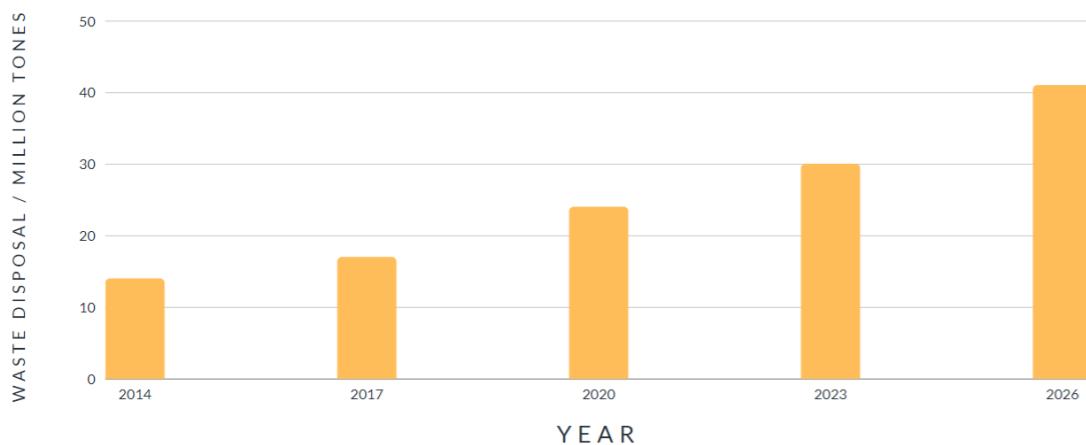
Our society is **growing exponentially**, and so is our waste (1). Since the removal of the vast majority of public bins due to **terrorism history in Central London** (2), Londoners have to stack their waste on the streets, leading to **public health and environmental hazards** (3).

Therefore, the aim of this report is to document the creation of an **engineering solution with a human-centred approach** to this issue, focussing on **user research findings, prototyping and user testing and experience**.



## DATA & STATISTICS

**Waste Disposal** in London will grow by 1,000,000 T next year (1)



**1 Tonne**

Of waste produced by each London Household



**17.4 %**

London Recycling Rate.  
Lowest in England



**750,000 Tonnes**

Of junk is dumped into landfills



## IMPACT ON USERS

### SOCIAL

Londoners can develop **birth defects, cancer & cardiovascular diseases** due to **bacteria and vermin** in the trash.

### ECONOMIC

Fly-tipping is a criminal offence: **£50,000 fines**, worsening **living cost crisis**.

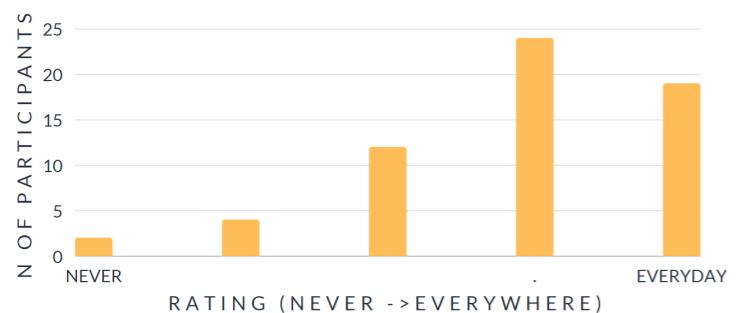
### ENVIRONMENTAL

Landfill dumping promotes the **emission of methane and carbon dioxide**, as well as water pollutant (leachate).

# USER RESEARCH

## Survey Results

Do you notice garbage piles on your street?



Nearly 100% of the people have noticed garbage piles at least once. Over 35% have trash bags on their streets every day.

Are you aware of current regulations?



60% were totally unaware of the current regulations. Any person had complete understanding of them.

## Observation & Interviews



Garbage collectors don't stop at designated areas; they stop at every pile of bags. As they are in a rush, they violently throw trash to the truck, ripping bags or spreading the content of open ones. This impedes recycling and poses a health hazard to the workers.

Jade, an interviewee, was concerned about appearance but not health hazards. She felt impotent, judged when fly-tipping and pressured when friends come over.

## Target Users & UX Mapping



International Students  
Age: 18-24

### WHY?

- Clueless regarding regulations
- Generate most waste (take-away, fast food shopping)

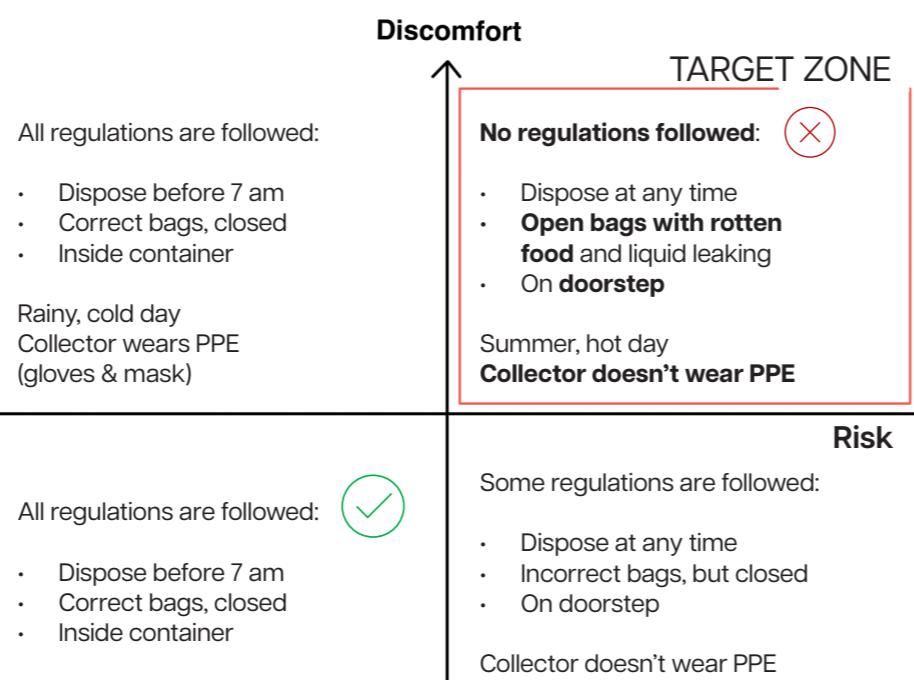
### PAIN POINTS:

- Scared of fines: living cost crisis
- Dirty house: social pressure
- Lack of energy and time

### OTHER STAKEHOLDERS:



Garbage Collector  
We aim to humanise and facilitate their job as well



## Main Insights



Piling trash can tear down and spread the content of the bags. Its content may be deteriorated by rain or high temperature, which results in discomfort and health hazards.



International students need to learn about ongoing regulations in order to not be fined with £50,000. Nonetheless, different rules and schedule apply to each street, which makes them frustrated and stressed.



Users show contradictory conducts. They loathe garbage piles because it makes their streets look dirty. However, they end up contributing to it for personal convenience: they don't have the time nor energy to take their trash bags to the few streets that have proper containers.

## Selected HMW Question

How might we simplify the garbage collection system and create a standardised, safe and coherent procedure for Central London residents and garbage collectors?

# MARKET RESEARCH

## A. Titan Trash Compactor



£200

Titan Trash Compactor is a stainless-steel compactor that pushes down into the bin to crush waste, **increasing** the total **volume** held in the bin. It features a **hygienic compaction** handle to reduce contact with the waste disposed.

Reviews:

“Doesn’t crush plastic or paper. I was told it was intended for general mixed waste [...] Everyone splits their waste and recycles so it is **badly designed**.”

★★★★★

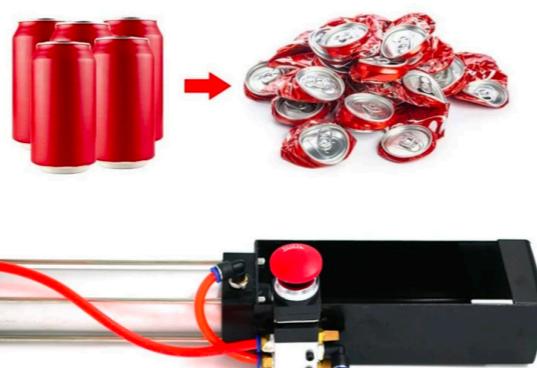
“The pressing down function doesn’t work well [...] Having to lean my body to push is also **tiring**.”

★★★★★

Opportunity:

Could we think of a bin or household item that allows the compression of **mixed recycling waste** with a **comfortable motion** to prevent pain or tiredness?

## B. Air Can Crusher



£42

Air Can Crusher is a steel compactor **easily crushes** aluminium cans using compressed air. This reduces the cans height and total volume for improved disposal.

Reviews:

“Coolest can crusher EVER! The downside: you have to have an **air supply**.”

★★★★★

“Great item, but it **does not come built**. You have to put it together yourself.”

★★★★★

Opportunity:

Ideally, the solution should not use any external energy in order to be more convenient and cheap. **Materials should be stiff** to make sure the waste is compressed easily.

## C. Manual Can Crusher



£9

Manual Can Crusher is a metal can crusher **manually powered** with a vertical motion. It is very **cheap** and still helpful to try to minimise waste volume.

Reviews:

“It only does the **smallest cans** out there, not slightly larger nor plastic bottles.”

★★★★★

“It **doesn’t crush to fully flat** since the crushing block doesn’t go all the way down when you pull it.”

★★★★★

Opportunity:

It is important that our compressor is able to reduce the volume of as many materials and sizes as possible to improve its **versatility**. Small or large, tin cans or plastic.

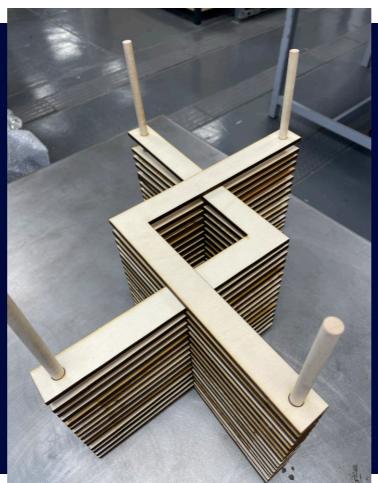
# WORKS-LIKE PROTOTYPE: STAGE 1 - MECHANISM

Which mechanisms could be used to compress items?



## Uniaxial compression:

This is a quite standard mechanism as seen in the market research. Garbage is enclosed in a container and crushed downwards to flatten it. All of the trash must be able to fit within the container in order to compress it.



## Biaxial compression:

We designed a compression mechanism that acts on two directions. This is something quite new to household products and would allow an efficient and uniform compression.

Co-Design session



## We developed the prototypes with the users

Users from Physics and Electrical Engineering were given both mechanisms without too many instructions other than: "Which system compresses better?"

Observations for Uniaxial:  
"Typical tin-can advert crusher. Looks good, but I'm **not sure if it works well** or if I would use it."



Observations for Biaxial:  
"I had never thought of this method to compress waste, if done well it could work great. It **should be placed somewhere** in order to make it more convenient"

"Will the **trash escape between the gaps** during compression?"

"Seems **fragile**."

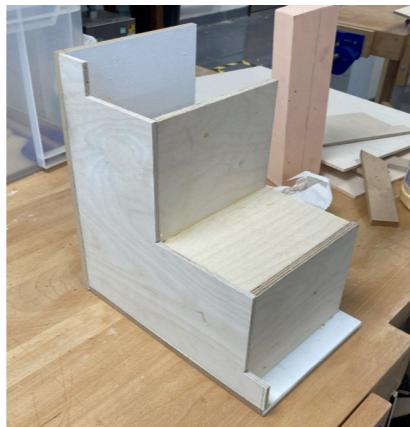
**USERS PREFER:** Biaxial mechanism

## Improvements based on feedback

Co-Design Recommendations:

- 1 A base or support needs to be added
- 2 Needs to resist the force exerted
- 3 Adjust the system to avoid trash escaping between the gaps

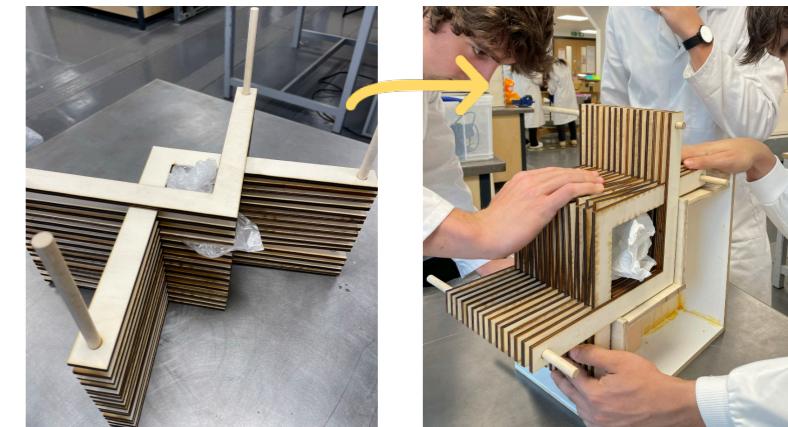
1 Box stand created to support the compressor



2 We implemented interior supports in the box to resist the force applied diagonally



3 We confirmed that trash escaped so we included additional pieces in between



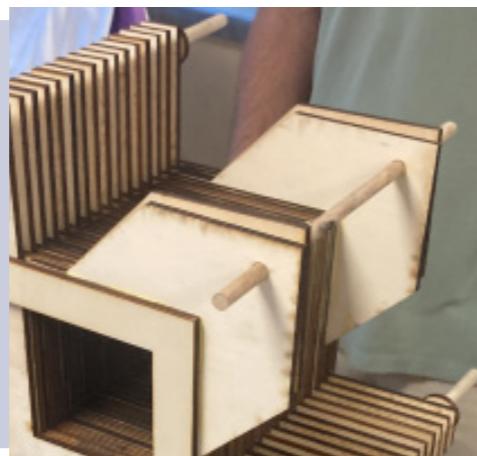
# WORKS-LIKE PROTOTYPE: STAGE 2 - UX DESIGN

In the first stage, we defined a biaxial compactor. With the help of our users we designed a set of intertwined pieces that fit smoothly together until a final rectangular cuboid is formed with the waste. This “waste brick” will be easy to store and transport while reducing the volume of waste.

## Mechanical Characteristics

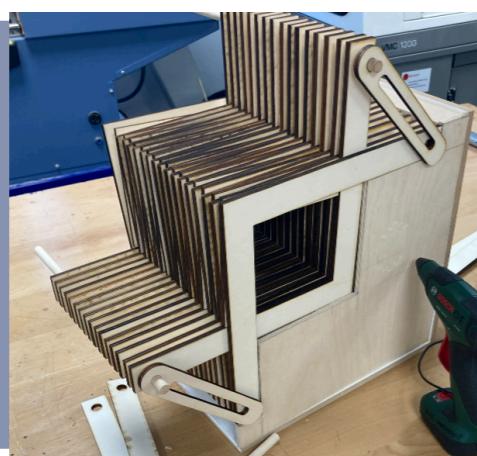
### Handle:

When showing our mechanism to users at the workshop, we identified how **difficult handling** the product was. We designed a handle located diagonally to clearly show the direction of compression.



### Railing system:

It was also seen how the compression process was **not uniform** and therefore it did not fulfill our objective. For this, we created rails. These rails join the compressor when it is fully open to its closed or “brick” position.



### Brick box:

After the garbage has been crushed, it was **difficult to remove** the brick and it was **not hygienic**. Creating a box that could easily be removed solved this issue.

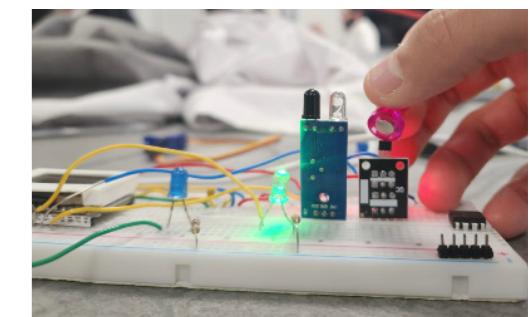
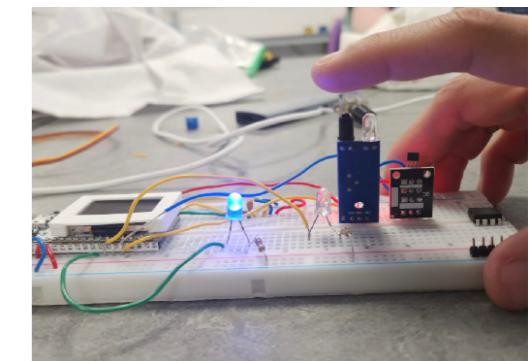


## Electronic Feedback

After some initial testing, it was unclear if the trash had perfectly been reduced to the desired “brick size”. By implementing some electronics we thought of possible ways to detect if total compression had been achieved by lighting a green light.

We decided to test **infrared, hall effect sensor (magnetic), momentary push-button switch and a force sensitive resistor**. These were all able to achieve our goal by either measuring distance, magnetic fields or a mechanical force.

Due to the **size restrictions** of our box, we had to choose the smallest and simplest circuit which was the **force sensitive resistor**.



## Final Works-Like Prototype

The final prototype implemented each individual mechanical characteristic as well as the electronics into a functional product.

### User Satisfaction:

Compressing system

Low  High

Handle

Low  High

Railing system

Low  High

Brick box

Low  High

Electronic feedback

Low  High



## Co-Design Comments and Actions:

Miko: “Trying to place all the garbage with the brick box inside is difficult”

Celia: “The compression is not smooth at all”

James: “I really like everything, but it could be more aesthetically pleasing”

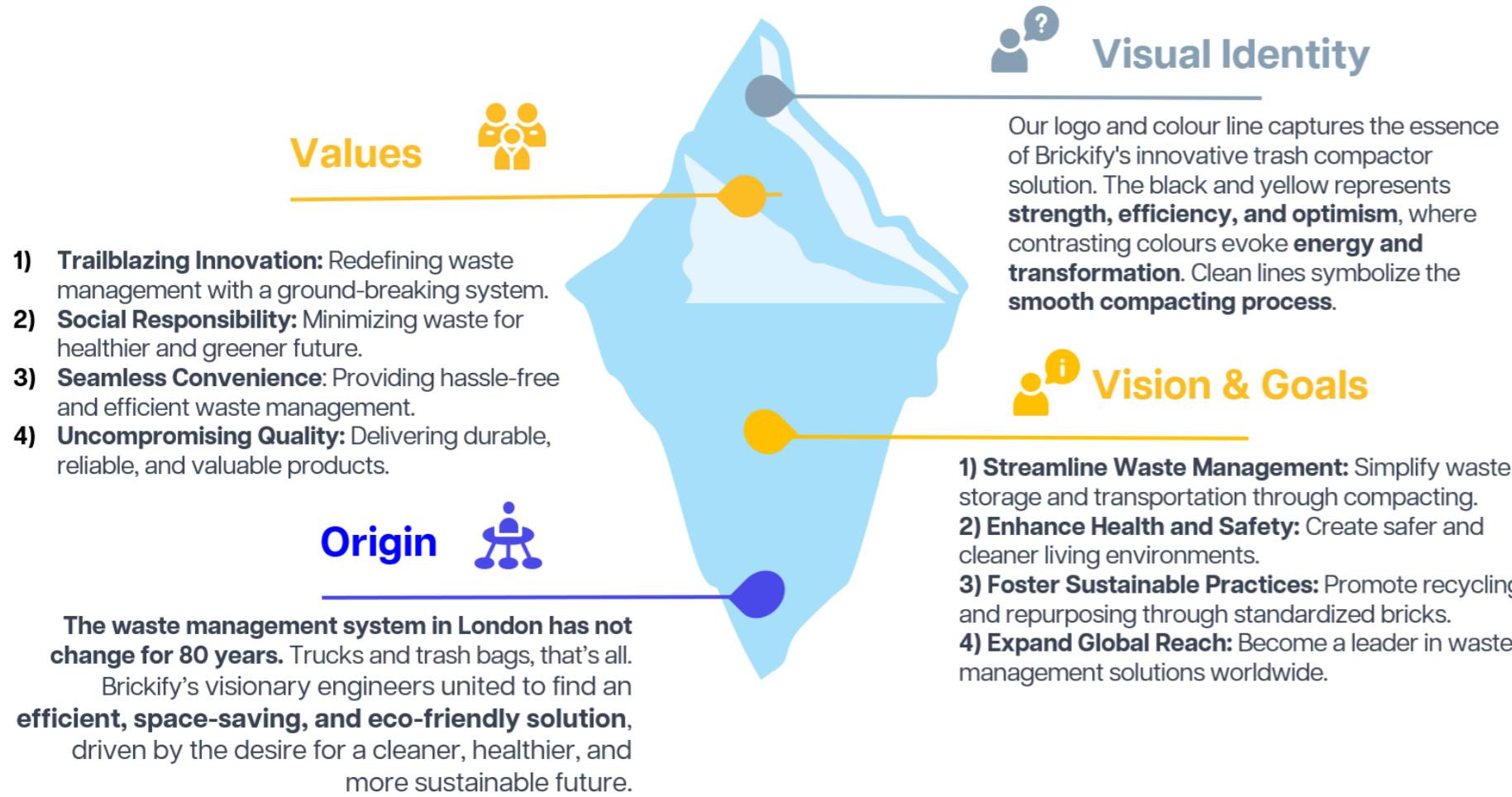
The sides of the box will be adjusted to **open and close**.

**Sanding every piece** and the rails is required.

**Looks-Like prototyping** will take place to enhance its aesthetics.

# LOOKS-LIKE PROTOTYPE

## User Suggestion 1: Develop and implement branding in the final product



## Logo Development: Initial Iterations



Malak: "Lego block reminds me of a toy brand."  
Miko: "Orange is not the ideal choice. Gold represents much better your optimistic and strong values."

## Final Logo



## Logo Implementation: Engraved Feature

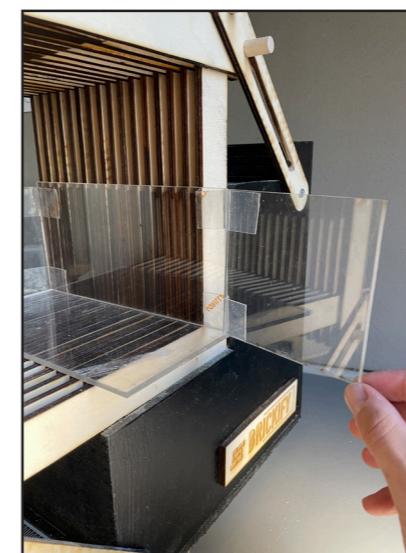


## User Suggestion 2: Design a more ergonomic handle

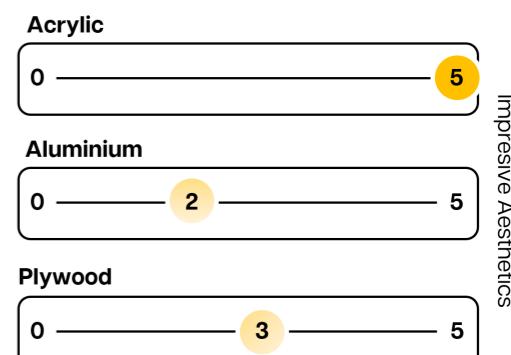


Instead of a wooden handle, **foam** was chosen as it is a shapable and comfortable material. The final iteration (handle n°3) was designed with a joint space for the ring finger and pinkie, and an external curvature for the thumb.

## User Suggestion 3: Improve the aesthetics of the brick case



Users proposed suitable materials and then filled up a poll to decide which one provided the best aesthetics to the brick case.



**Additional feature:** the sides of the case now rotate, hence making it easier to place the garbage inside.

# FINAL OUTCOME



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The traditional waste management system has not changed in London for 80 years, until now.

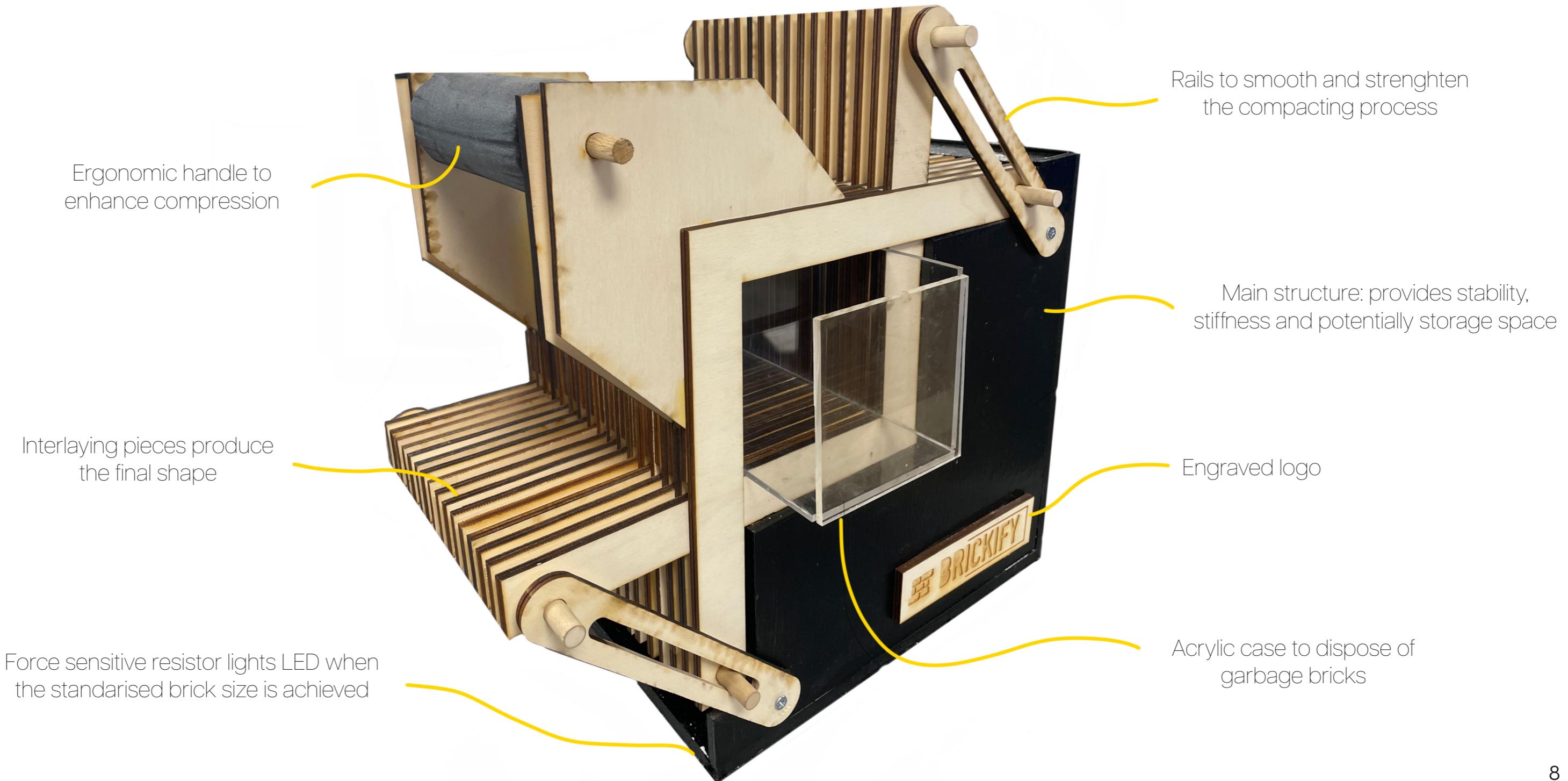
- ① Place trash in the case
- ② Use handle to compress
- ③ Dispose of your brick

Decreases Volume

x3

Reducing health and environmental risk

Enhances storage and transportation





 **BRICKIFY**



# ■ PROTOTYPE VALIDATION: USER TESTING

Our testing group was formed by 10 international students from different countries (target audience), 5 women and 5 men, studying Engineering, Physics and Medicine.

## A. Smooth movement

### Requirement

The interlaying pieces must **slide in a single movement**, without notable friction

### Specifications

The rails and interlaying pieces must be appropriately sanded in order to **make the product as easy as possible to use for the user**.

Validated? **41/50 successful attempts**



Each user performed 5 attempts. During the first ones, the mechanism was stiff. However, when the friction was reduced, the users found simple to use.



\*Video in Appendix Link

## C. Compression

### Requirement

The device must **effectively compact the trash** from the user

### Specifications

The volume must be reduced by **at least x3** in order to comply with our health and environmental goals

Validated? **x2 volume reduction**



The initial instants of the compression were successful. However, it was not possible to fully compress to the desired brick size due to the low stiffness of plywood



\*Solutions will be explored in the next slide

## B. Electronics

### Requirement

The force **sensitive resistor circuit must light the LED** when the brick size is achieved

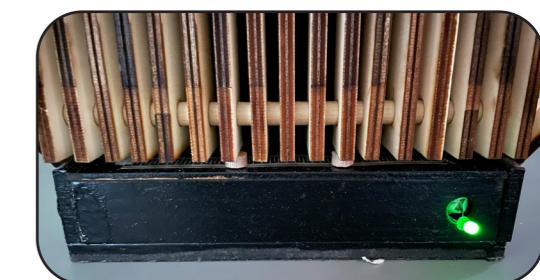
### Specifications

The resistor must create an **open circuit** due to its high resistance (LED off), and a **short circuit** when the resistor detects the force of the interlaying pieces (LED on).

Validated? **48/50 successful attempts**



Each user performed 5 attempts. The LED lighted in practically all attempts, even when weaker forces were applied. Hence, the resistor magnitude was chosen correctly.



## D. Overall Aesthetics

### Requirement

The device must be **desirable**, perceived by users as **high-quality, durable and eco-friendly**.

### Specifications

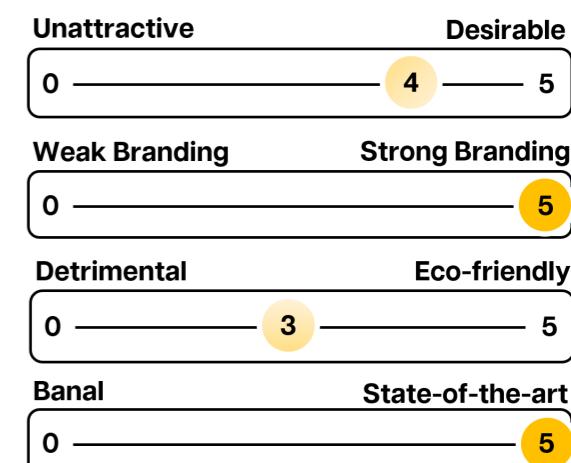
The product must incorporate design features including **appropriate materials, colours, appealing shapes and a strong brand identity**.

Validated?



The 10 users participated in the poll. The diagram showcases each question's average mark. The product was perceived as completely innovative and with a strong visual identity. Some users noted that the colour black reduced its eco-friendly appearance.

### Semantic Differential Scales



# CONCEPT VALIDATION: WILL IT BE USEFUL?

Storyboard with User Interaction

1 Open Brickify



2 Place the trash



3 Compress



4 Check it has fully closed



5 Take out brick



6 Stack your bricks in a bin



What happens after?

The process

## 1. Collection (Co-mingled scheme):

All recyclables are put into one compartment on the truck before taken to a Materials Recovery Facility (MRF).

## 2. Sorting:

- Separation of cardboard/paper with vibration machines
- Steel removal with magnets
- Non-ferrous metals separated with an Eddy Current machine
- Plastics identified with optical scanners
- Glass is the remaining material



Brickify

## 1. Easy Collection:

Users will use the compressor with mixed recyclables.

## 2. Unchanged Sorting:

The garbage will ideally arrive in bricks at the MRF where it will be easily dismantled and sorted using the current machinery methods.

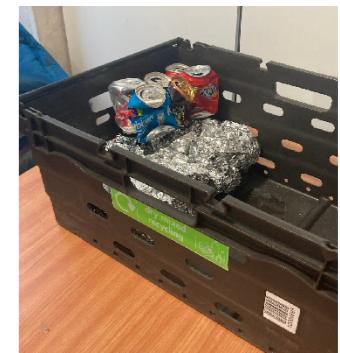


Collection & Stakeholders

Storing your bricks will be fun like playing Jenga Blocks while still providing a stable and solid construction.



“Tower” garbage packs on the street will not tumble, reducing hygiene and urban organisation. This not only improves societal wellbeing, it also solves some pain-points identified in the user research for garbage collectors.





# References

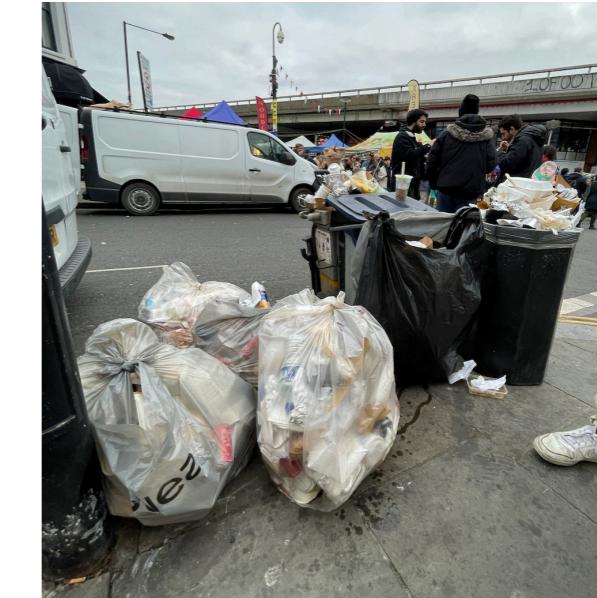
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- Cover: Deer, R. (2018) Landfills: We're running out of space, rr-Igo-1. Available at: <https://www.roadrunnerwm.com/blog/landfills-were-running-out-of-space> (Accessed: March 21, 2023).v
1. Department for Environment, F.& R.A. (2022) UK statistics on waste, GOV.UK. GOV.UK. Available at: <https://www.gov.uk/government/statistics/uk-waste-data> (Accessed: March 21, 2023).
  2. Lawrence, I. (2022) Is it just us or... is London covered in rubbish?, Time Out London. Time Out. Available at: <https://www.timeout.com/london/city-life/is-it-just-us-or-is-london-covered-in-rubbish> (Accessed: March 21, 2023).
  3. Network, E.D. (2021) How our trash impacts the environment, Earth Day. Available at: <https://www.earthday.org/how-our-trash-impacts-the-environment/> (Accessed: March 21, 2023).
  4. Wan, H. (2021) London's 7 Biggest Waste & Recycling Statistics, Junk Hunters. Available at: <https://www.junkhunters.co.uk/blog/londons-biggest-recycling-facts-stats/> (Accessed: March 21, 2023).
  5. Environmental Center (2021) The hidden damage of landfills, Environmental Center. Available at: <https://www.colorado.edu/ecenter/2021/04/15/hidden-damage-landfills> (Accessed: March 21, 2023).

# Appendix 1

## Meeting Minutes & User Testing Videos

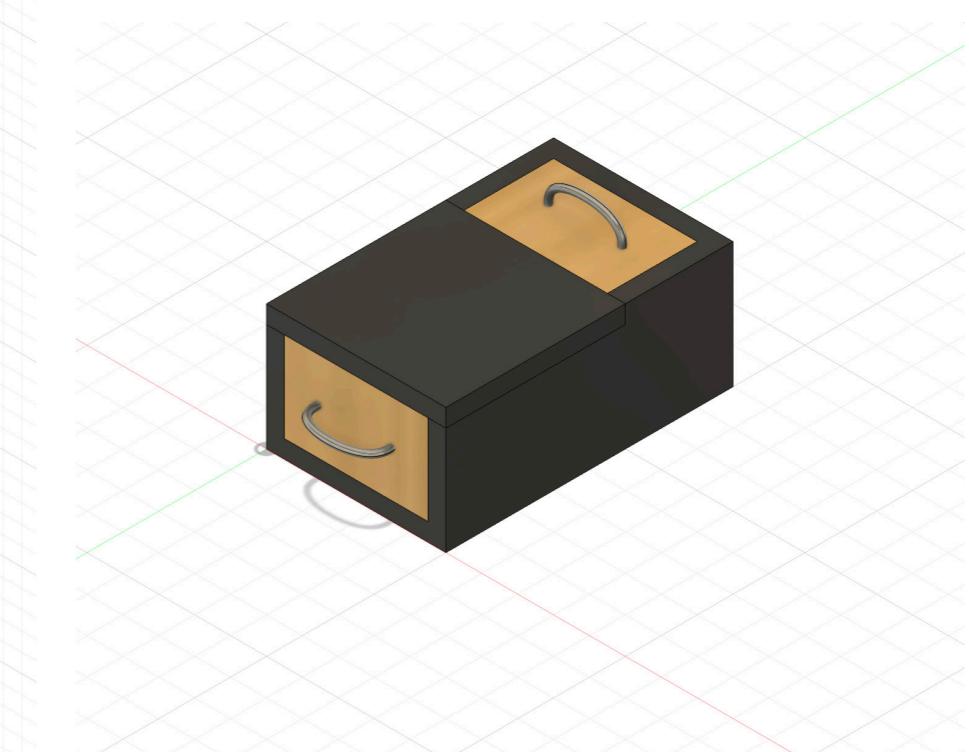
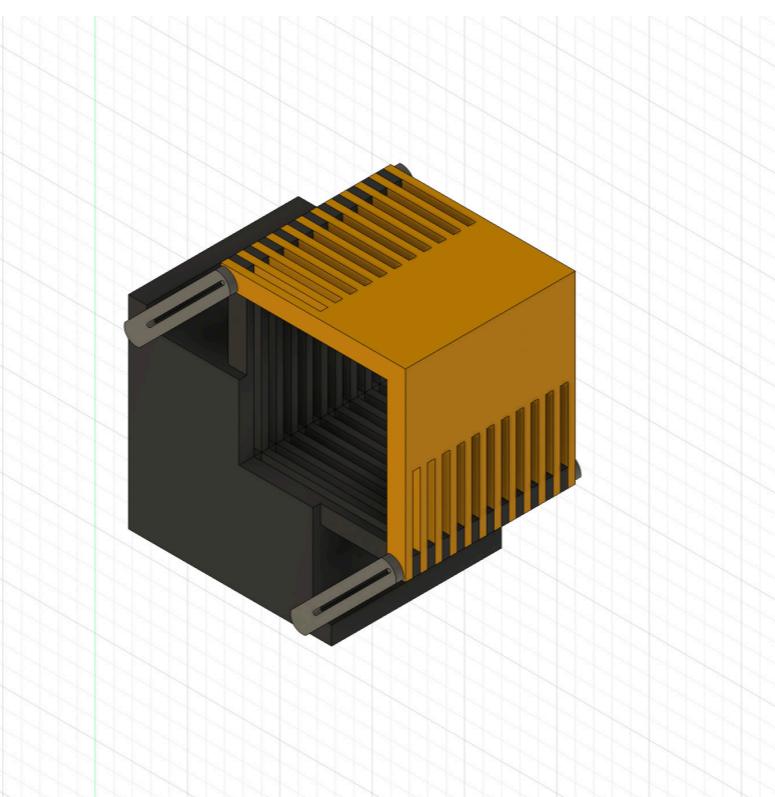
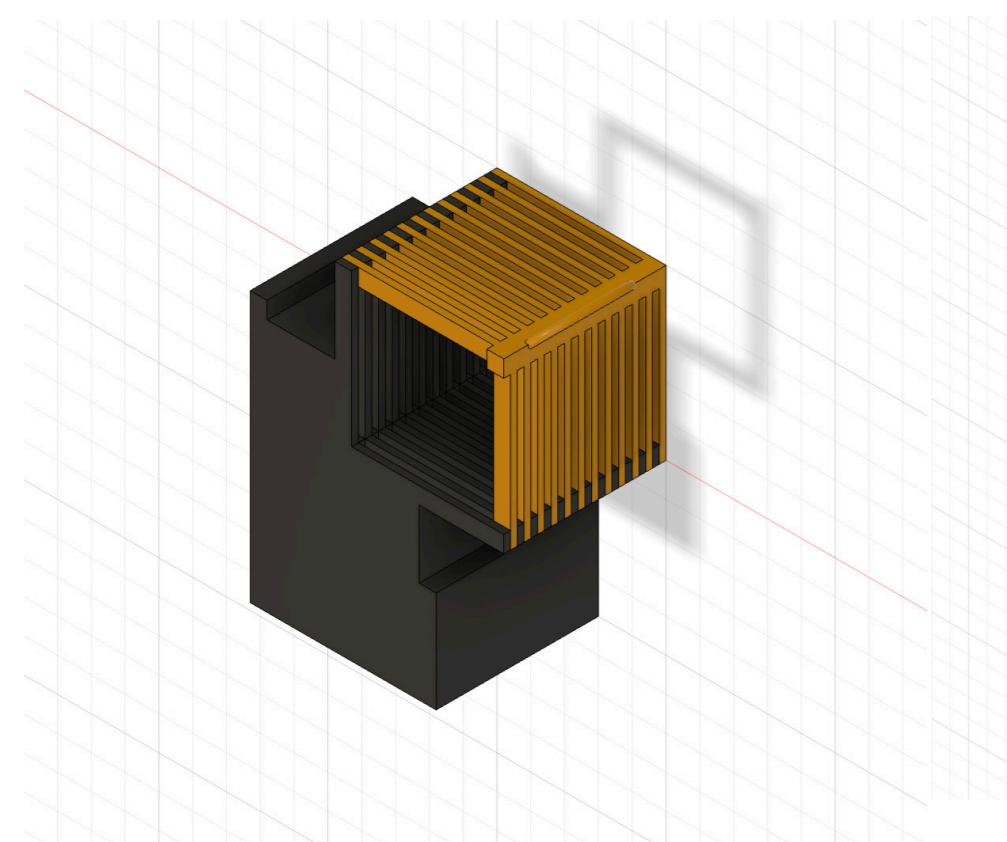
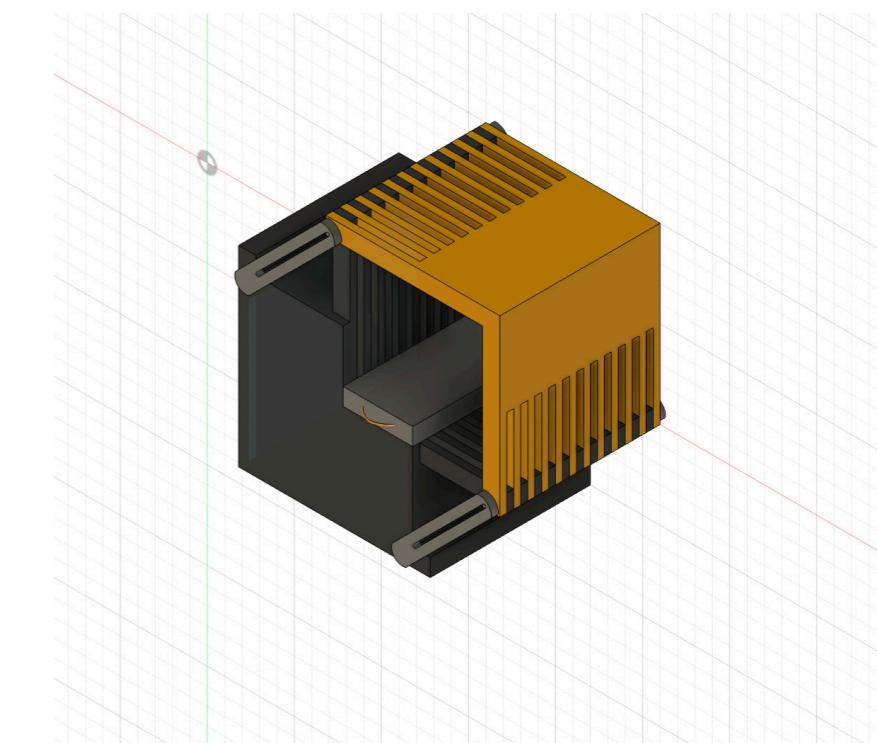
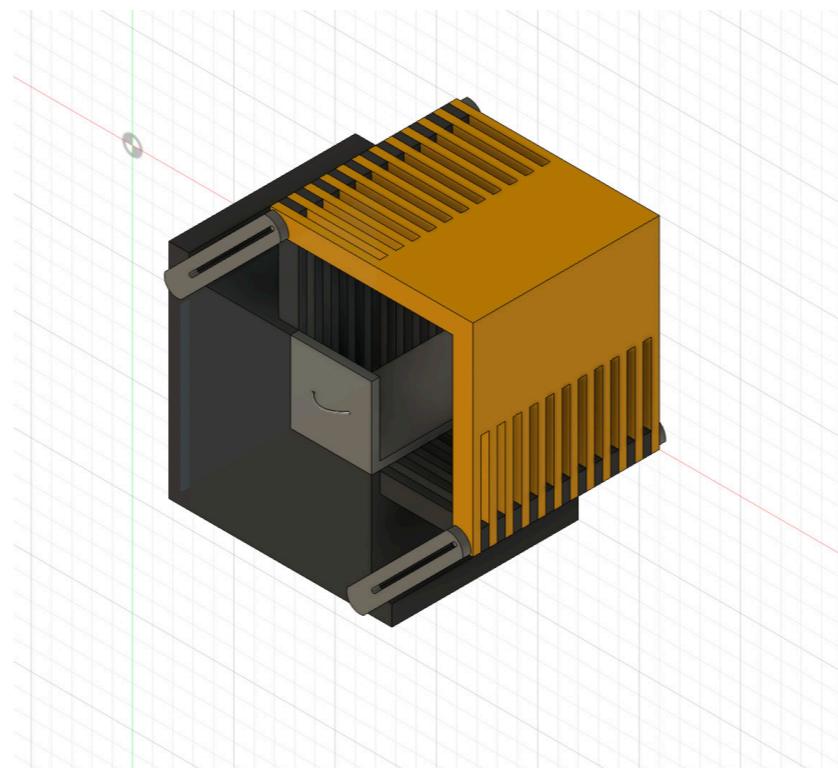
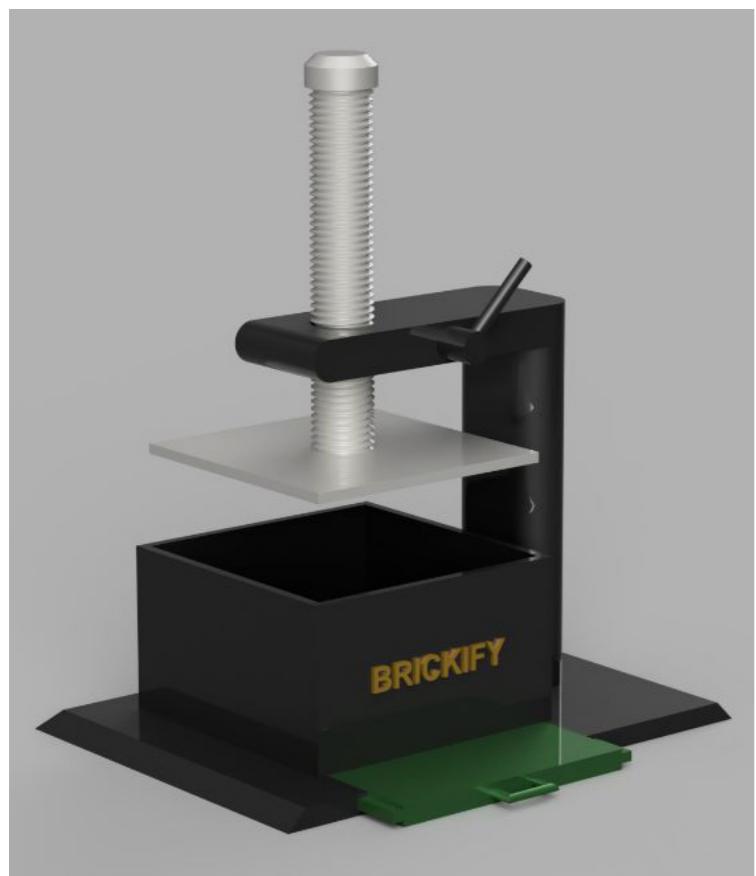
<https://drive.google.com/drive/folders/1NQrFt4RQ2zVuj9NZLUpGV5auPmUU4qnB?usp=sharing>





## APPENDIX 2: CAD MODELS

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# APPENDIX 3: VISUAL COMMUNICATION

## Font

Articulat FC

Articulat CF Extra Light otf (400)  
The quick brow

Articulat CF Extra Light Oblique otf (400)  
*The quick brow*

Articulat CF Light otf (400)  
The quick brow

Articulat CF Light Oblique otf (400)  
*The quick brow*

Articulat CF Normal otf (400)  
The quick brow

## Colour Palette

Jet, Gold & Marine Blue

