Design Innovation Plastics

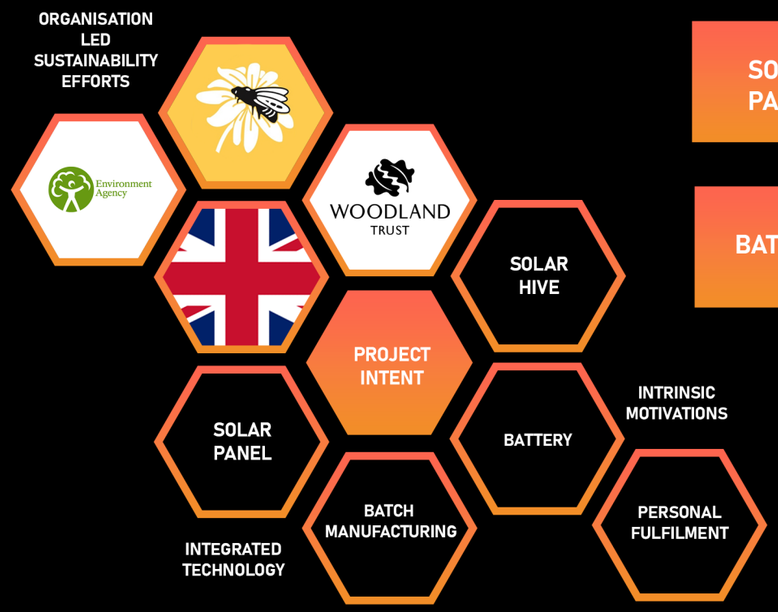
PROJECT INTERPRETATION

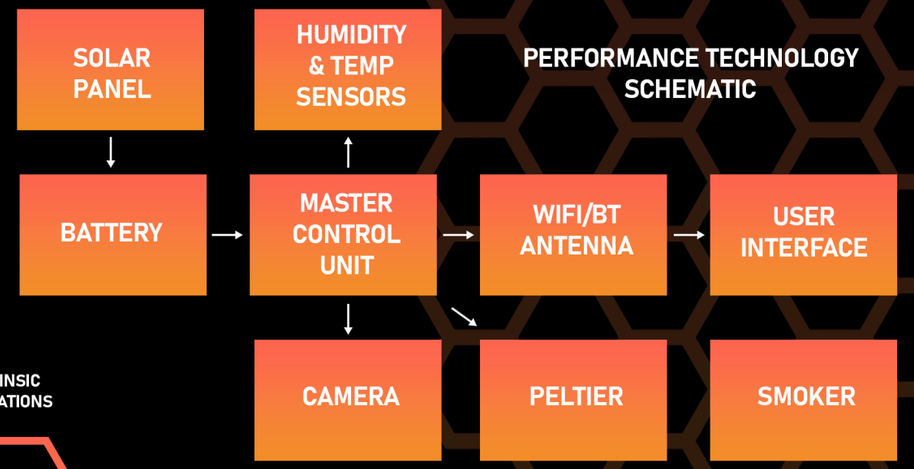
- Design a product focused on domestic or sport and leisure market.
- Significant improvement on an existing product or new product.
- Focus on sustainability and manufacturability.
- Needs to be a plastic product.

A smart beehive meets all of these criteria. Beekeeping is both a commercial activity and, more importantly to this brief, a recreational hobby and leisure activity. Beekeeping aligns strongly with the focus on sustainability as it has several ecological benefits such as pollination (Wratten et al., 2012). Artificial beehives are also well suited to plastic manufacturing.

Many new beekeepers have anxiety around their bees (Tew, 2021) and a smart product that provides monitoring information and notifications if the hive is in jeopardy would provide significant comfort.

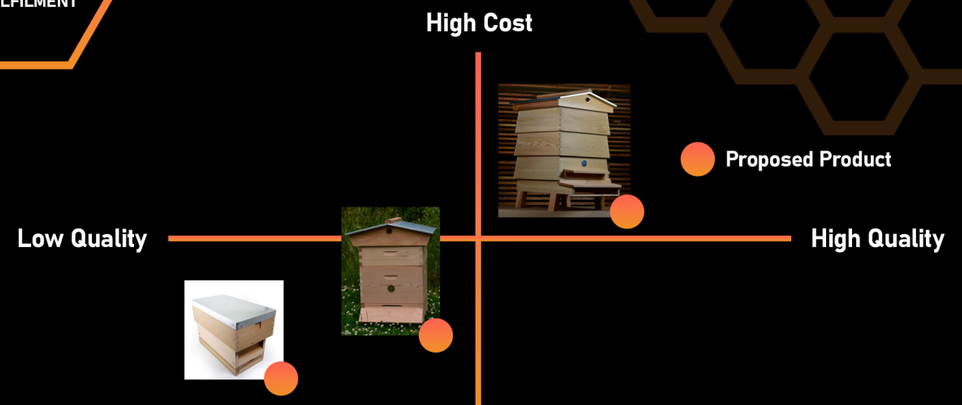
Additonally, an auto fumigation feature could be provided to make inspection of the hive easier. Heating / cooling could be added to keep the hive in a productive temperature window.





1. Connect to hive via bluetooth or wifi
2. Open app to see monitoring information
3. App notification of condition changes
4. Take action if necessary

1. Fumigate hive
2. Remove beehive lid
3. Extract frames
4. Harvest honey



"I NEED TO MAKE A PURCHASE"

"I FEEL LESS ANXIOUS"

AWARENESS → CONSIDERATION → PURCHASE → SERVICE → ADVOCACY

"I'M ALWAYS WORRIED ABOUT MY BEEHIVE"

"MET PRICE EXPECTATIONS"

"I WOULD RECOMMEND TO MY FRIENDS"

PERSONA

Beekeeper Dave

- Recent Retiree
- Early adopter
- Aged 57-64
- Married
- Income: £50,000

- Took up beekeeping as a new hobby
- Anxious about his bees
- Member of beekeeping Facebook groups
- Wants to be a better keeper

TARGET AUDIENCE

- Recreational beekeepers
- Aged 40-70
- Tech literate
- Passionate about beekeeping

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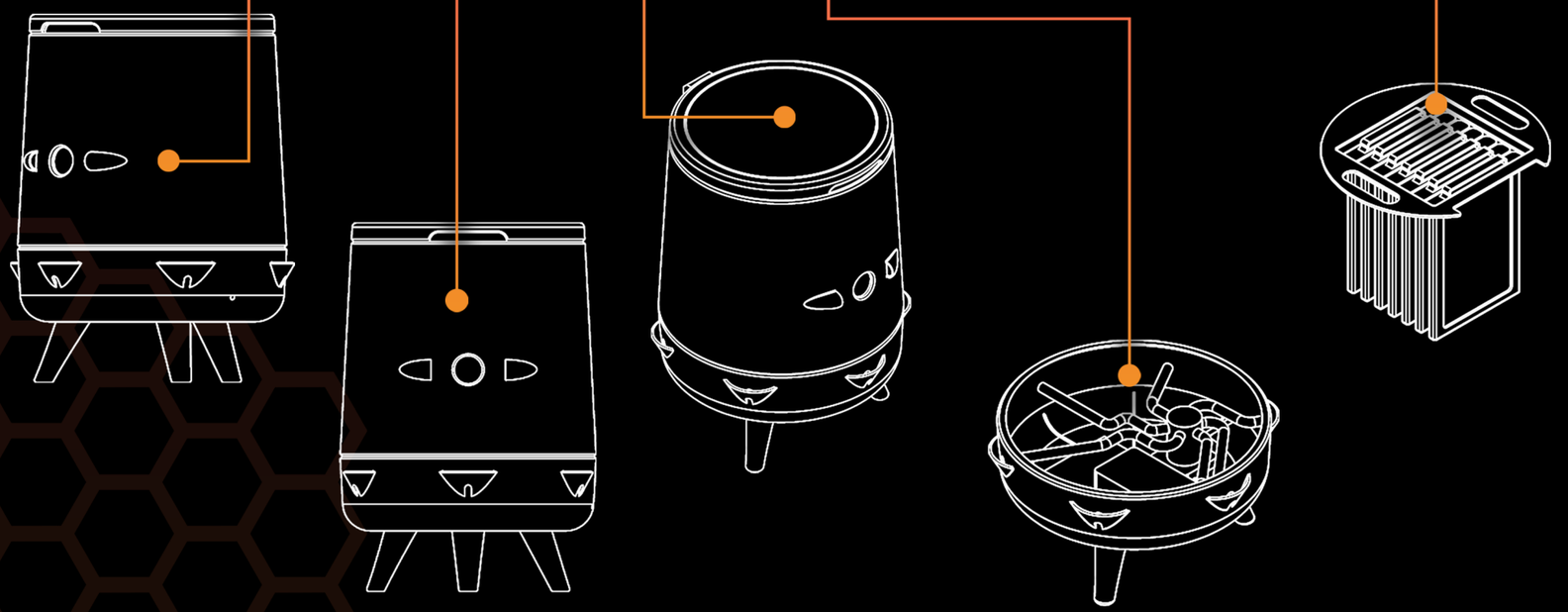
Smart Beehive
Product function-user-interaction cycle

STAGES	CAMERAS	HIVE SENSORS	SOLAR PANEL	SMOKER	HIVE FRAMES	CAMERAS	SOLAR PANEL	HIVE SENSORS
Product Functions	Remote visual of bees on demand Sensor information accessible (key hive statistics ie temp, humidity)	Automated monitoring Sensor information accessible (key hive statistics ie temp, humidity) Automated notification of issues	Automatic cooling Internal temp controlled in response to temperature changes	Auto fumigation Remote fumigation relaxes bees through release of smoke	Visual check Clip on hive frames for easy, smooth removal	Remote visual of bees on demand Sensor information accessible (key hive statistics ie temp, humidity)	Automatic heating Internal temp controlled in response to temperature changes	Automated monitoring Sensor information accessible (key hive statistics ie temp, humidity) Automated notification of issues
06	09	12	15	18	21	00	03	
User interactions	Access live footage through app	Check key hive statistics	Minimal interaction	Releasing smoke through app prior to interaction with hive	Physically remove lid to access and inspect frames and bees	Access live footage through app	Minimal interaction	Check key hive statistics
User emotion	Relieved Confident Reassured	Relieved Confident Reassured Organised	Relaxed Content	Glad Satisfied Organised	Positive Satisfied	Relieved Confident Reassured	Relaxed Content	Relieved Confident Reassured Organised



DESIGN IMPROVEMENTS

The smart beehive offers several improvements on existing designs.

- A radical new innovation, the product greatly increases the pro ductivity of the hive and makes the activity of beekeeping signif icantly more easy and worry free.
- A peltier element is regulated via a Proportional-Integral-De rivative (PID) controller built into the motherboard which keeps the hive at a target temperature. This boosts its productivity in both pollination and honey production, providing a dual benefit to both the user and the environment. The polarity can be switched to change the hive facing side of the peltier to either heat or cool the hive. This is an entirely passive system with no moving components, eliminating any potential for bee death.
- Ventilation is provided through openings in both the main casing and electronics bay.

SUSTAINABILITY AND MANUFACTURABILITY

The product has been designed with a strong consideration for the environment and manufacturability.

- Most of the components are suited to rotational moulding and are specificed as bio-materials.

- Main casing: Bio-Polyethylene (Bio-PE)
- Electronics casing: Bio-Polyethylene (Bio-PE)
- Frames: Bio-Terraprene (Bio-TPE)

ERGONOMICS

Several ergonomic considerations have been made.

- A large grab handle has been added to each frame to allow easy insertion and removal. This is an important consideration as many beekeepers struggle with poor dexerity, especially when wearing gloves, which is becoming an increasingly pre valant issue as the average beekeeper (now 60) ages.
- A slot has been added to the lid and an assisted hinge added to reduce the physical demand on the beekeeper when inspecting the hive.
- The height has also been carefully chosen to maximise the the volume of the hive without forcing the keeper to bend over or reach uncomfortably to access the frames.

All of these small ergonomics changes, smart features and in- creased productivity lead to a hugely improved product making the beekeeping process much more enjoyable and fulfilling.

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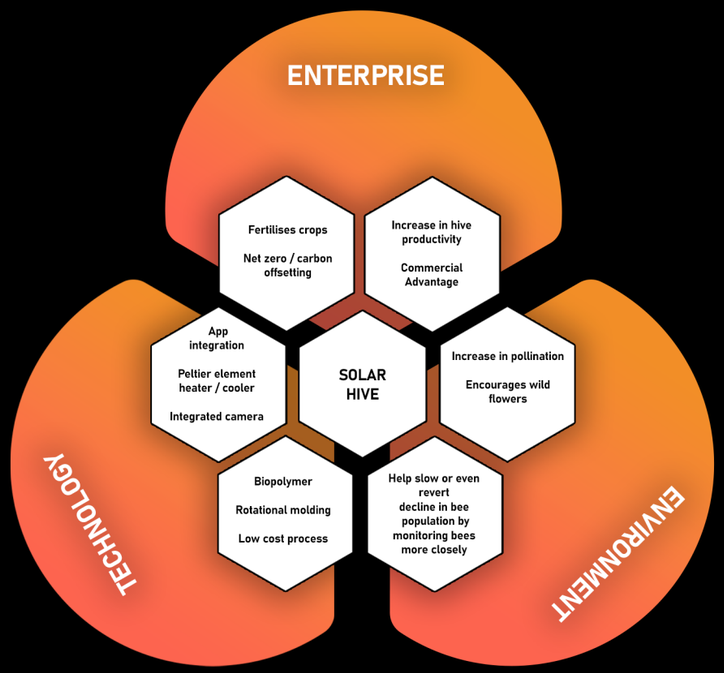
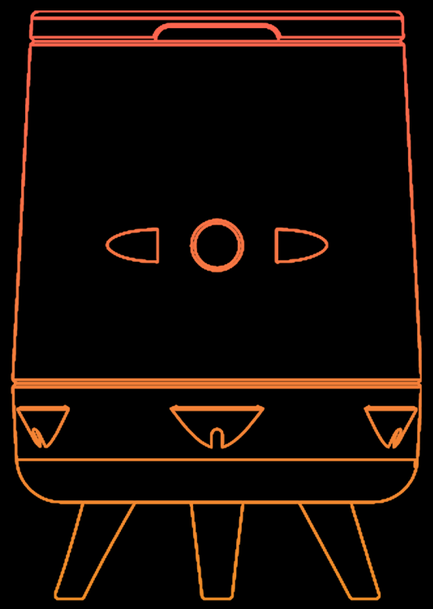
Smart Beehive
Proposal definition



BILL OF MATERIALS

01 Solar panel – As supplied
02 Lid casing – Bio-PE – Injection molded
02 Bearing – As supplied
03 Frame tray - Bio-PE – Injection molded
04 Frames 7x – Bio-TPE – Injection molded
05 Main Casing – Bio-PE – Rotational molded
06 Camera module – As supplied - X2
07 Camera glass – Tempered glass – Float glass - X2
08 Peltier Heatsink – Copper – Skived
09 M3x30 Cap head Mounting screw – As supplied - X2
10 M3 Nyloc Nut – As supplied - X2
11 Peltier Element – As supplied
12 Rubber tubing – Terrapene - Extruded - X6
13 Vaporisation chamber - Aluminium – Stamped
14 Li-on Battery – As supplied
15 Mainboard – As supplied
16 Electronics casing – Bio-PE – Rotational molded
17 Legs – Wood - Turned - X3



600 x 600 x 790 mm

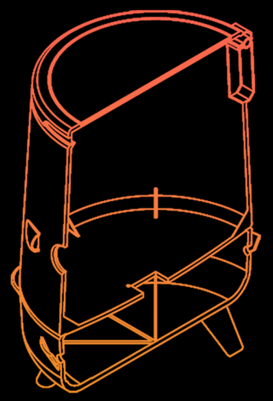
Manufacturing features:

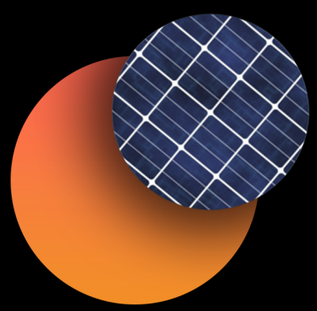
Internal ribbing to increase part strength and reduce warping

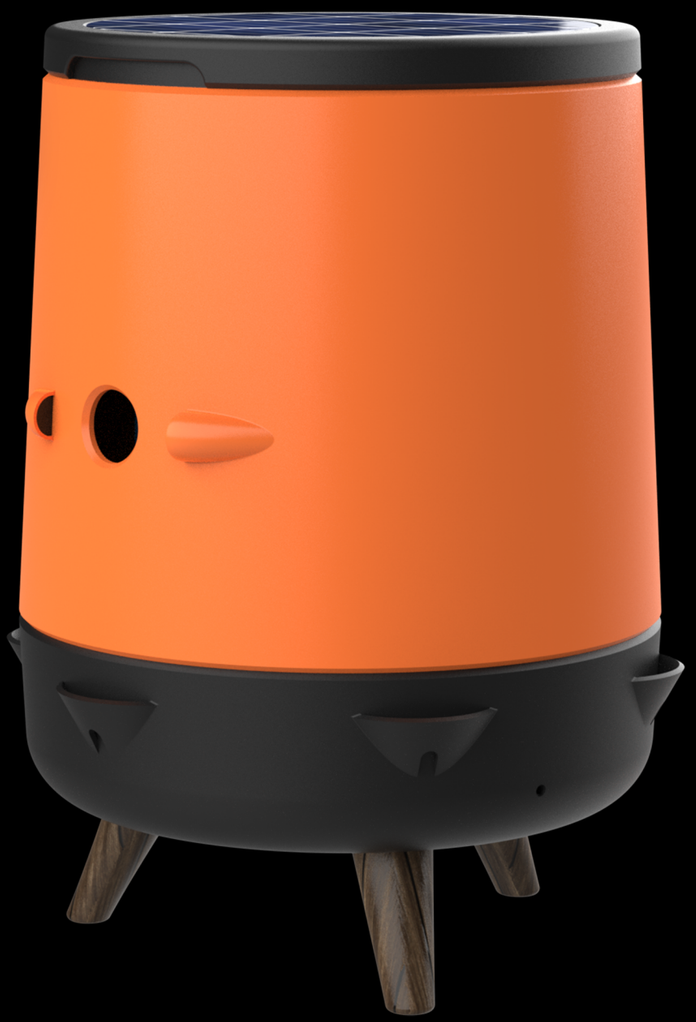
Consistent wall thickness

Chamfered edges and radius on all joins to promote mold flow

Drafted shell for easy removal from tool







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Smart Beehive
Proposal Life Cycle Analysis

UN SUSTAINABLE DEVELOPMENT GOALS

ECODESIGN DIRECTIVE

EUROPEAN COMISSION

UK PARLIAMENT

CONSUMER PRESSURE

ENTERPRISE

- Societal and legislative pressure
- Cost reduction and efficiency improvements
- Circular business model
- Marketing opportunity

PRODUCTION

- Low cost tooling
- Efficient process - less embodied energy
- Minimal retooling cost - highly adaptable

END OF LIFE (EOL)

- Recomissioning of entire product
- Component remanufacture
- Recycling of materials
- Rare earth material recovery - PCBs / Electronic components
- Emodied energy recovery - Incineration
- Easy disassembly

Buy back

Reject reprocessing

Repair

Material reclaimation

PROCUREMENT

- Bio-material
- Ethical supply chain
- Regional sourcing
- Continual supply chain monitoring

Regenerative feedstock

SERVICE PERIOD

- Design for emotional durability
- Eliminate planned redundancy at component level
- Tough, hard-wearing design, robust shell
- Larger wall thickness
- Ergonomic design & focus on user-experience
- Design for repair