DESIGN PROJECT PROCESS **BOOK**

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INTRODUCTION

The following process book documents all significant stages of a research-driven design project; initiated in summer 2016 and culminating in the delivery of an effective product solution in May 2017. The project called for the development of an inclusively-designed grocery shopping aid in response to the needs of a growing number of dissatisfied and disadvantaged elderly consumers.

The immersive process of research and creative design practice fell into four principle phases; the ultimate product proposal reflective of a systematic and user-centred course of study.

01
DISCOVER

Identify
Research
Observe
Understand

There is always a market pull for fresh innovation, often inspired by significant real-world problems affecting a proportion of the population. By exploring these reported issues, a gap in the market for an improved or entirely new product or system solution can be exposed.

02

DEFINE

Analyse
Visualise
Conceptualise
Collaborate

The evidence gathered from ethnographic and empathetic study must be "unpacked" to inspire the generation of a meaningful solution. In collaboration with the end user, a specification and brief are drawn up which will direct a divergent process of inspired ideation.

03

DEVELOP

Realise
Improve
Measure
Test

Highly creative work must begin to produce tangible solution iterations. A convergent process of modelling, comparison and improvement sees the conceptual design transform from "blue-sky" to a feasible and marketabe product. Functionality and user-centred design (UCD) take precedence.

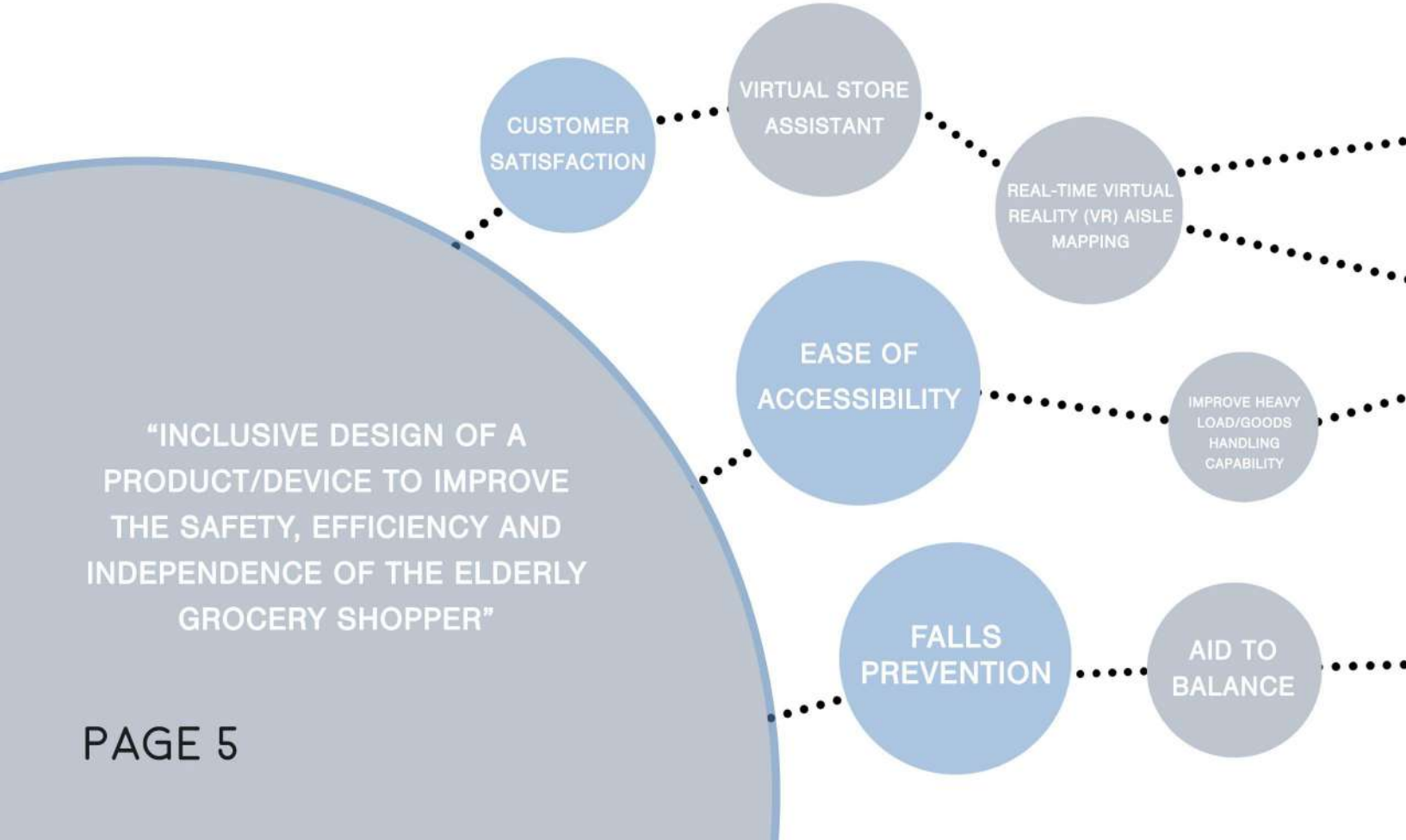
04

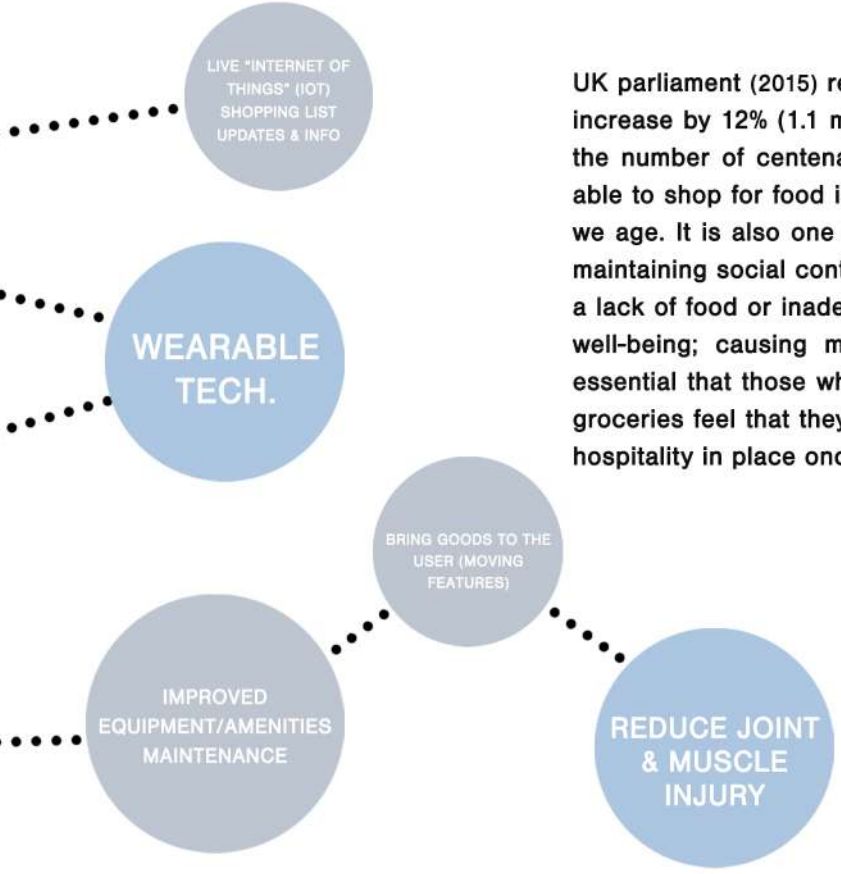
DELIVER

Prototype
Promote
Instruct
Implement

The solution can be modelled accurately, using CAD software, from which a proof-of-concept prototype can be produced. Coupled with strong branding, promotional materials and ethical foundations; the design can be presented and readied for implementation within its intended environment.

OPPORTUNITY FINDING

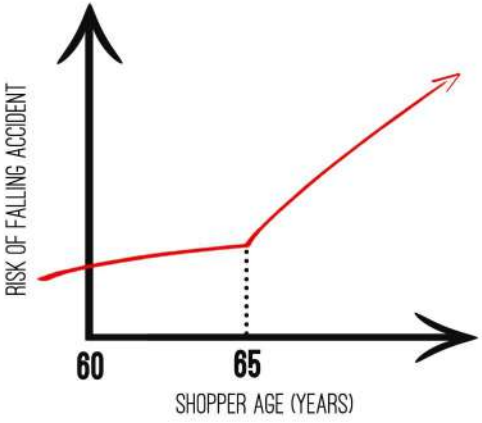




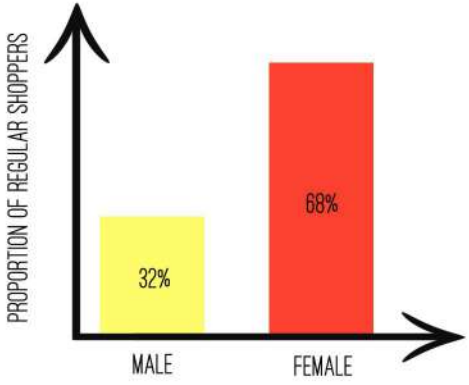
UK parliament (2015) recognise that "the numbers aged over 65 are expected to increase by 12% (1.1 million); the numbers aged over 85 by 18% (300,000); and the number of centenarians by 40% (7,000) [between 2015 and 2020]". Being able to shop for food is an important aspect of staying well and independent as we age. It is also one of the most common methods adopted by the elderly for maintaining social contact and physical activity (Age UK, 2012). Consequences of a lack of food or inadequate diet in the elderly can be detrimental to health and well-being; causing malnutrition, starvation and even death. Therefore, it is essential that those who are physically capable of accessing food retailers and groceries feel that they are catered for with the necessary support systems and hospitality in place once in store to do so effectively, efficiently and safely.

Published literature from charitable bodies and reputable consumer marketing journals has highlighted a number of areas for concern; from inappropriate interpersonal service standards to inadequate environmental design features and tools, discouraging or rendering the accessibility of groceries difficult or impossible for those most vulnerable.

PROBLEM IDENTIFICATION



ELDERLY SHOPPERS (65+) FACE THE GREATEST RISK OF FALLS AS A RESULT OF EXTRINSIC FACTORS (ENVIRONMENT & EQUIPMENT)



THE MAJORITY OF ELDERLY SHOPPERS ARE FEMALE & SHOP ALONE: REPORTING THERE ARE OFTEN NO SHOP ASSISTANTS AROUND TO OFFER HELP

41%

OF ELDERLY GROCERY SHOPPERS ADMIT TO EXPERIENCING DIFFICULTY CARRYING THEIR SHOPPING

(Journal of Marketing Management, 2013)
(Journal of Paramedic Practice, 2011)
(Age UK, 2012)
(Journal of Retailing and Consumer Services, 2009)

THE DESIGNED ENVIRONMENT & IN-STORE ASSISTANCE HAS THE GREATEST BEARING ON THE SATISFACTION OF SHOPPERS WITH REDUCED SELF-EFFICACY

(01) As of 2015, a charge was imposed to discourage the use of "single-use" plastic carrier bags in large UK grocery stores (gov.uk, 2016). As a result, the modern shopper is more likely to carry multiple bags with them as they travel around and away from the store; reducing dexterity and stability while acquiring goods. Tasks such as opening freezer doors or reaching for high or low items must be conducted with one hand unless the handbasket can be set down.

(02) The availability, performance and quality of in-store equipment and facilities is often cited as a leading cause of frustration and cocern amongst elderly shoppers. Whilst many shoppers use them as an aid to balance, their poor maintenance and antiquated design pose a risk to safety (Journal of Retailing and Consumer Services, 2009).

(03) There is a modern bahavioural trend which has seen personal trolley use rise dramatically. This deviation from using larger supermarket shopping trolleys reflects the little-but-often buying habits of elderly households and consumers. Should supermarket equipment make the switch?

2

RESEARCH

Primary and secondary research activity; in the form of immersive ethnographic engagement and observation as well as extensive literature review and wider market research, are vital for interpreting the evidence surrounding the identified problem. Interviews and focus groups conducted with elderly consumers and age-related charities provide an insight into the voice of the customer (VOC); their motivations and bug-lists when it comes to the fundamental exercise of grocery shopping.

Physical shopping activity is crucial for maintaining health, well-being, independance and social interaction as we age and the following research provides the explicit user needs for which a safer and more accessible solution can be tailored.

VOICE OF THE CUSTOMER

ACCESSIBILITY

I'm shrinking and now I find many a time articles which I could once reach are now very hard to reach. I always have to go and search for someone to help me and often there's nobody around to give you a hand (female, 50-64).

I can't stretch because of my neck, and sometimes I can't even see if there are any products left on the high shelves (female, 50-64).

We have sort of stopped going to [super-market] because we find it very confusing where the items are, you get it here one week and the next it's somewhere else.

Now sometimes the things tend to be too high; I find the height very hard, very hard when you're 5ft 4 inches and no high heels.

They're that small you'd have to nearly have big jam jar glasses to see them. Someone else has to do it [read them] for you.

I'm not tall and can't reach things. There are signs saying items available on lower shelves but they're all gone. I have to climb up to get them or rely on other customers (male, 65 +).

EQUIPMENT/AMENITIES

[trolleys] give you balance you see if you're not able to walk. I take a trolley so I can lean on it.

The wheels needing checking perpetually. It's a staff problem again . . . they need a handyman or someone to check them (female, 65 +).

The trouble is the trolleys are abused and not maintained (male, 65 +).

The trolleys have a terrible design that has never been updated (male, 65 +).

There's no seats in the shops where you do you're shopping, you have to stand waiting on your lift coming back.

"You always meet somebody and get talking to someone", "Shopping gets you out and about, it's a good social aspect about it".

I shop everyday and I'm living on my own. I like to get out and I go.

"That's too technical", "I haven't got an internet" and "What is that?"

MOTIVATION

ENVIRONMENTAL CONDITIONS

(01) "Self-service" is becoming increasingly popular amongst busy supermarket patrons; with more numbers of modern checkout systems being installed within both smaller retailers and the "major-multiples". This environmental revolution, and reduction in manned checkout services, may be involuntarily excluding older shoppers with an aversion to the new fast-paced technology.

(02) Many older shoppers report a lack of shop assistants, particularly in larger supermarkets, as a major area for concern (Age UK, 2012). 74% of elderly shoppers believe that ensuring supermarket staff are friendly and efficient is "very important" (Journal of Consumer Marketing, 2015). Shoppers are regularly left to seek assistance from members of the public, endure long queueing times or leave empty handed.

03

(03) Elderly shoppers typically conduct frequent but small shopping trips, buying only the "essentials" for a single or two-person household. Multi-purchase promotions, as well as regularly changing store layouts and confusing pricing structures, are a major cause of dissatisfaction. Shelf height, store size and product labelling have all been reported as key issues.


04

(04) The maintenance of supermarket equipment (trolleys, baskets and freezers) is rated as a major concern by 75% of elderly shoppers. Large trolleys are too big, unsteady and cumbersome for the average elderly female shopper to manoeuvre and navigate around busy supermarket aisles; while handbaskets can become too heavy and unstable to operate comfortably.

OBSERVATIONS

(01) This shopper was found carrying a personal shopping trolley + a handbag + a supermarket handbasket as she navigated her way through the store. She only visited the store for "about 10 items" but was encumbered by the additional load she was manually carrying.

(02) This ALDI shopper was found using a personal trolley, for transport of goods away from the store as well as balance, in addition to a handbasket. The carriage element of the basket is overlooked or undesired; serving only as a storage vessel at a comfortable height.

(03) 100% of shoppers found using these M&S baskets were observed to be pulling their goods along using the wheels rather than carrying them in the traditional style.

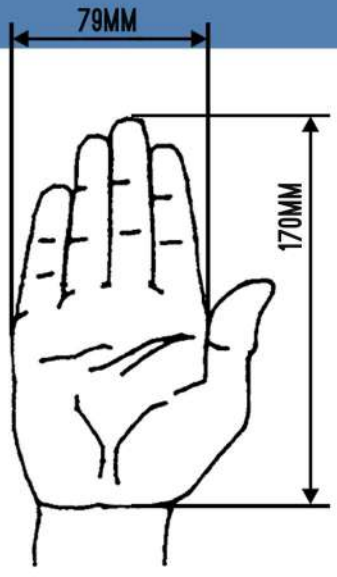
(04) Another case of a shopper forced to carry multiple "carrying aids" around the store. This shopper "only went in for a few items" and reported that she found the basket handles "unstable and likely to tip over".

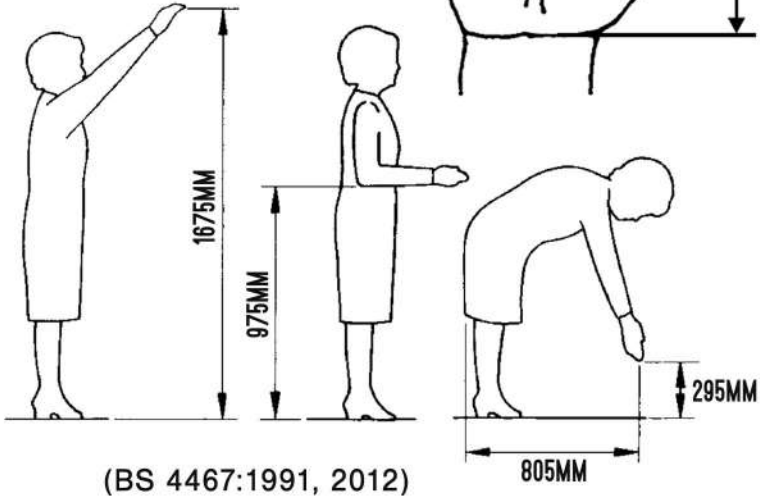
(05) In many cases, shoppers left their baskets unattended or set them down on the floor, on top of freezer units or balanced uncomfortably on their forearm when 2 hands were required to reach or access goods. This poses a risk of theft as well as a to health and safety; calling for frequent stretching and bending to pick up and set down potentially heavy loads.

DESIGN CONSTRAINTS

(01) Standard UK supermarket shelving sizes and arrangements are not enforced, although a common minimum shelf depth is 560mm to house 2 x 280mm cases of goods. The average standing eye height for an elderly female is 1.46m from the ground. Supermarket and grocery store top shelves can be as high a 2m, alienating the older demographic with generally reduced stature and vision. A 1.33m shelf height is recommended to accommodate the average elderly female for domestic design applications (International Journal of Occupational Safety and Ergonomics, 2001).

As elderly females comprise the greatest proportion of shoppers in need of a more tailored user experience, their anthropometric data must drive the design specifications. Their minimum and maximum capable range of movement resulting from rheumatism, reduced muscle elasticity and dexterity will determine the effectiveness of the new assistive product/device.



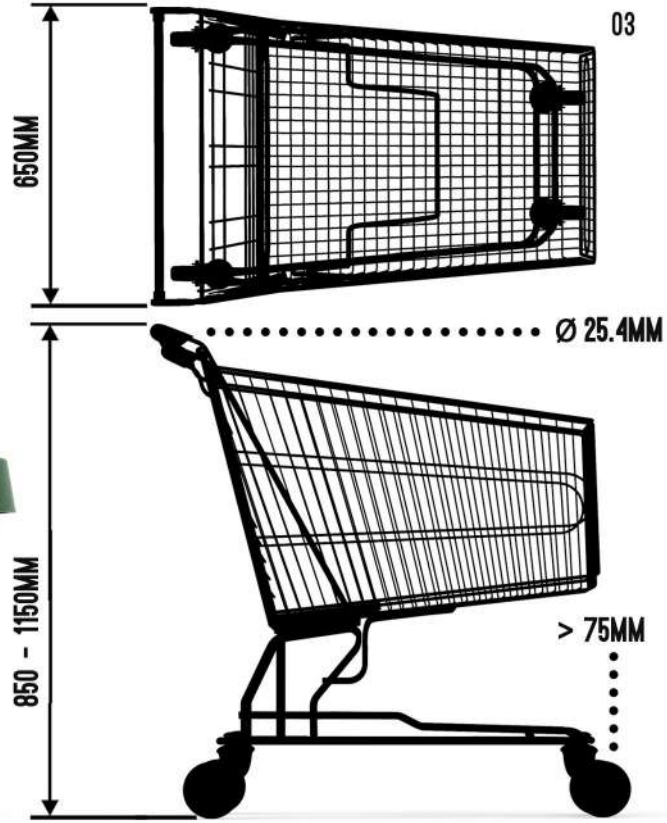


(BS 4467:1991, 2012)

(02) Many supermarkets, smaller grocery shops and convenience strores use standard-issue 25L capacity handbaskets. The baskets have known dimensions of 430 x 292 x 228mm, which could help to constrain the design of an improved small-capacity portable device.

The weight of a typical elderly shopper's "full" basket is 6kg; which when evenly distributed over two hands, has been shown to improve postural and gait stability when carried.

(03) British Standard BS EN 1929-1:1998 provides vital dimensions for the width and handlebar height for supermarket trolleys.



(BS EN 1929-1:1998, 2000)

"COOL" HUNTING


02


03


04

01

(01) Wanzl are a German design comany who specialise in shop fixtures and fittings; having produced a vast range of both lightweight steel and UV-stabilised polypropylene shopping trolleys. The Tango series features a modular and configurable design; acting as a hub onto which multiple gadgets and accessories can attach quickly and simply. Additional accessories include (02) magnifying glasses for reading small product packaging and labels (03) bag hooks for extra capacity and (04) ergonomic handle grips. Anti-theft variations are available for the same highly adaptable and innovative model.

05

(05) The Clax folding shopping cart is a German-made personal shopping trolley with exceptional space-saving capabilities and portability. The device, with a tiny footprint, weighs just 7kg and boasts a 20kg carry weight potential.

06

(06) The Levo shopping dolly concept facilitates portability through the use of optional individual shopping baskets, hooked onto a central wheeled unit. The revolutionary personal device negates the use of heavy trolleys, clumsy supermarket baskets and carrier bags.

07

(07) The Italian Rabtrolley is a range of modern all-polymer shopping trolleys with huge space-saving potential, almost silent operation and high recyled content. The organically-shaped PP, GRP or clear PC models feature almost infinite colour combinations.

"FUTURE CONCEPTS"

(01) Keedoozle was a futuristic concept store; the first fully-automated grocery store, which used a system of vending machine-style goods selection and distribution to customers possessing a key card. Three stores were opened briefly in Memphis, Tennessee, between 1937 and 1948, but failed as result of the technology's limitations when processing high levels of demand and traffic.

Patrons receive a "key" with which they can select numbered goods as they travel around the store's closed displays and freezers.

Selecting goods creates perforations on the paper key card element and a running bill total is calculated.

The key is handed to a cashier who reads and processes the selections electronically.

The goods are transported via a closed-circuit conveyor system; removing all physical effort from the process.

The shopping is paid for manually and the customer recieves their goods boxed or bagged.

(02) The Metro Group Future Store Initiative proposes that RFID chips located throughout the supermarket and embedded into personalised ID cards are the future of shopping. The internet of things (IOT) will facilitate "smart trolleys" which can remember your shopping list and map out aisles as you shop in real time.

(03) The Amazon Go store in Seattle uses "just walk out" technology to eliminate queueing times and dependance on shop assistants. Smart scanners detect goods on exit and charge the bill to your connected device.

(04) German logistics company WITRON are pioneering a system of laser-detection automatic shelf replenishment, which could grow into a fully "automated grocery store".

3

"UNPACKING"

Analysis of the research activity provided a number of significant findings; including many both in support of existing material and observations not previously explored in published literature. The most compelling evidence that there is a common problem amongst elderly shoppers to be adressed came in the form of a behavioural trend identified on multiple occasions and in at least 3 different stores. A model developed from one such case illustrates how a shopper must bend down at least 15 times during the process of buying just 5 separate items. A device which could reduce this physical demand on the shopper would be a welcome innovation where existing systems and devices have failed.

SHOPPING PROCUREMENT PHASE...

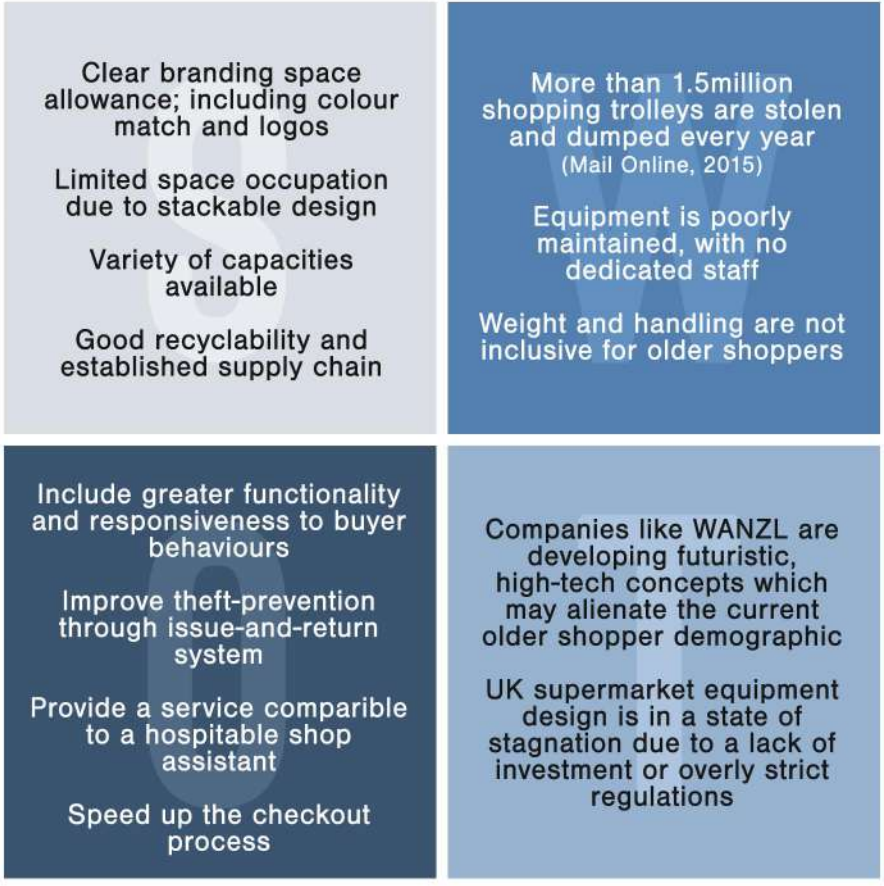
CHECKOUT PHASE...

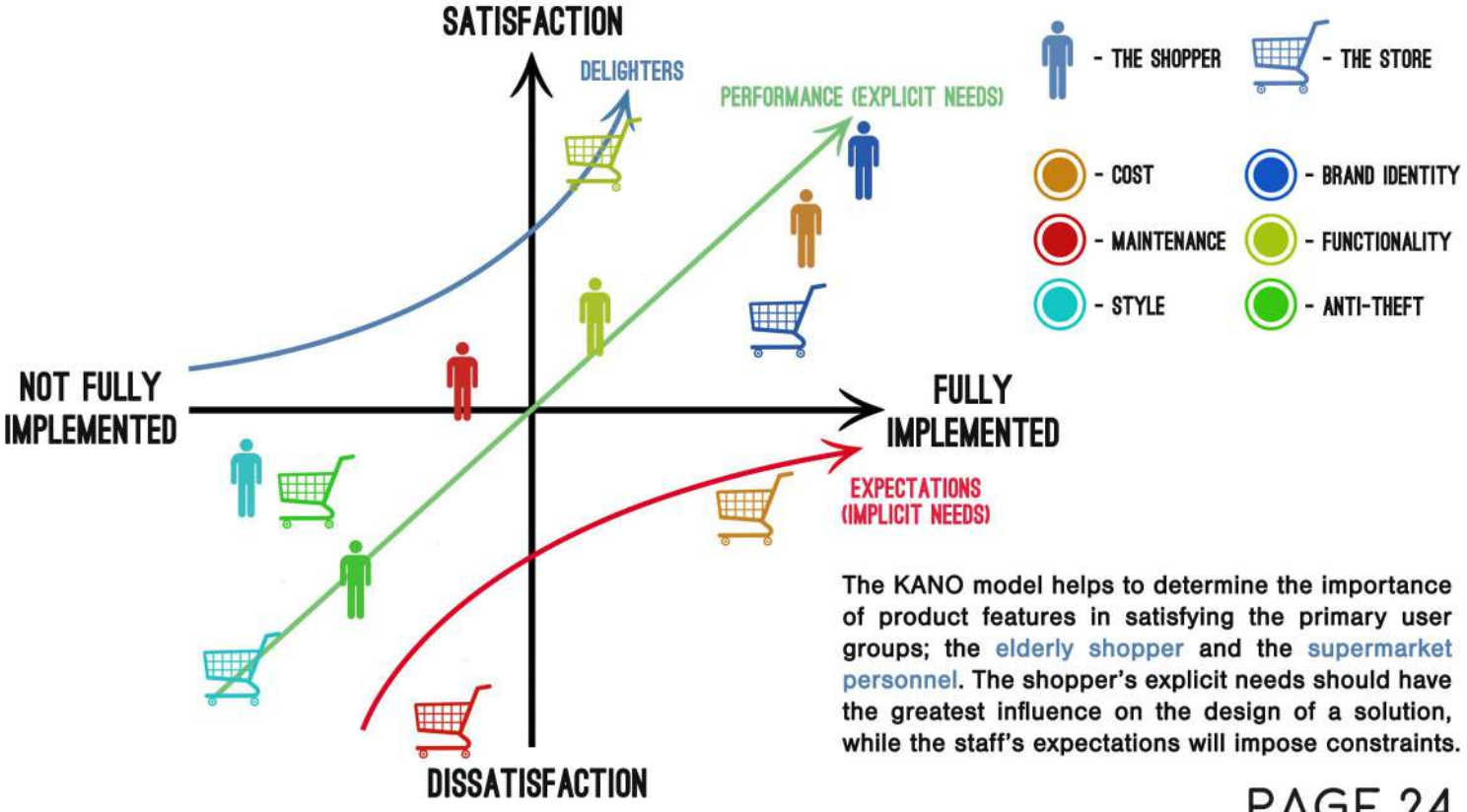
PACKING PHASE...

COMPETITOR ANALYSIS

In order to assess current market competitors and expose a gap in the market for the new assistive shopping aid; strength, weakness, opportunity and threat (SWOT) analysis was conducted. Well-established fixtures within UK supermarkets (trolleys and handbaskets) as well as the innovative products in use in European stores were reviewed. The market pull for an alternative device which can be maintained more readily and features a less antiquated design and more intuitive functionality is a common theme.

Some of the equipment used in Europe and Australia is far more advanced and demonstrates better UCD considerations than the UK equivalent. This state of design stagnation is the result of a culture which will need to be changed in order to better satisfy shopper satisfaction.





The KANO model helps to determine the importance of product features in satisfying the primary user groups; the elderly shopper and the supermarket personnel. The shopper's explicit needs should have the greatest influence on the design of a solution, while the staff's expectations will impose constraints.

MARKET SEGMENTATION

CONSUMER PROFILE

Name: *Eunice Sutton*
Gender: *Female*
Age Group: *75-84 (elderly)*
Location: *Coventry, 10 minute walk from nearest town centre*
Career: *Retired former cleaner*
Relationship Status: *Single with 1 son (50) and 1 grandson (32)*
Income: *£18,000 from all sources*
Health: *Eunice has average general health and mobility for an elderly woman and tries to remain socially and physically active via regular trips into town on foot. She is farsighted and struggles to read packaging information without glasses*
Consumer Habits: *Eunice cannot drive and walks into town almost every weekday; she says that the shops are too busy at the weekend and her family will offer to drive her thereinstead. She lives alone and is the sole source of any income*

"The trolleys have a terrible design that has never been updated"
"I shop everyday and I'm living on my own. I like to get out and out I go"
"They're that small you'd have to have big jam jar glasses to see them"

CONSUMER PROFILE

Name: *Alfred Richards*
Gender: *Male*
Age Group: *65-74 (young old)*
Location: *North-west England, 20 minute walk from the nearest town centre*
Career: *Retired former civil servant*
Relationship Status: *Married with 2 daughters (40 and 35) and 1 grandson (12)*
Income: *Both alfred and his wife are retired and have no earnings; annual household income is £38,000 from all sources*
Health: *Alfred has naturally limited mobility, about average for his age. His eyesight is deteriorating and he frequently forgets to wear his prescribed glasses. His wife has very poor mobility and finds walking for any sustained length of time difficult*
Consumer Habits: *Alfred owns a car but prefers to walk to the nearest town centre 3 times a week for groceries as a means of exercise. He is the sole shopper for his household*

"I'm not tall and can't reach things. There are signs saying items available on lower shelves but they're all gone. I have to climb up to get them or rely on other customers"

PROBLEM NARRATIVE

PROBLEM NARRATIVE

(1) Eunice completes a 10 minute walk from home to the nearest supermarket; an ALDI store in the town centre. She takes with her a handbag containing 2 reusable "bags for life". She is shopping for "essentials" which are likely to weigh around 6kg (the typical mass of an elderly grocery shopper's full basket) (Gait & Posture, 2016).

(2) She enters the store and spends a moment inspecting the smallest available trolleys, located just inside the store entrance, to pick out one which appears well-maintained and offers good mobility.

(3) She follows overhead signposting towards the dairy aisle, where she looks for a 2 pint bottle of milk.

(4) Her eye height is 1.4m above ground level and her maximum reach height is 1.8m; the shelf containing her goods is 5ft above the floor (BS 4467:1991, 2012). The shelf appears empty but there may be more bottles hidden towards the back and out of her line of sight.

(5) Eunice cannot find a step ladder provided and doesn't want to risk falling by climbing or overreaching. She waits 3 minutes until a shop assistant is available to fetch a bottle down.

(6) She bends down to place the bottle in her near-empty trolley and continues to procure a few other items before waiting at the checkout, buying her goods and packing them away once more into her bags.

(7) She carries her 2 bags full of shopping home; where she will unpack and store her groceries.

MOOD BOARD

Inspiration for the coming design process can be found in a vast bank of cultural, visual and emotive sources; to provide the most imaginative starting point for idea generation. The elements within the mood board are a selection of objects, scenarios, motivators and even obstacles which may appear in a day in the life of the elderly shopper. A meaningful solution must appeal to the current elderly shopper, but should also lay the foundations of a more inclusive and empathetic retail environment and culture for the current "young-old" and future generations of shoppers. For this reason, the inclusion of high-tech features, forms and connectivity should be explored.


navigation
interaction


HAM

4

CONCEPTUALISATION

Analysis of the primary and secondary research activity provides inspiration for conceptual design work. One of the most fundamental findings was the lack of efficiency involved in typical shopper behaviours; a result of the current supermarket environment, equipment and system. Elderly shoppers in particular are locked into a system whereby they must exert excessive energy and physical effort to procure even a small number of goods. The aim of the shopper is to move goods from the shelf or freezer into their personal shopping trolley or bags before taking them home; however the supermarket handbasket or trolley serves as a "middle-man" creating an extra cycle of lifting and bending.

A new conceptual solution would see this extra step removed by issuing trusted customers with a branded personal "shopping assistant", into which goods could be placed, scanned, payed for and removed from the store legally and quickly. This was one of many innovative design ideations generated to solve the identified existing product and service problems.

CURRENT SYSTEM...

"GOODS RETRIEVAL STEP"

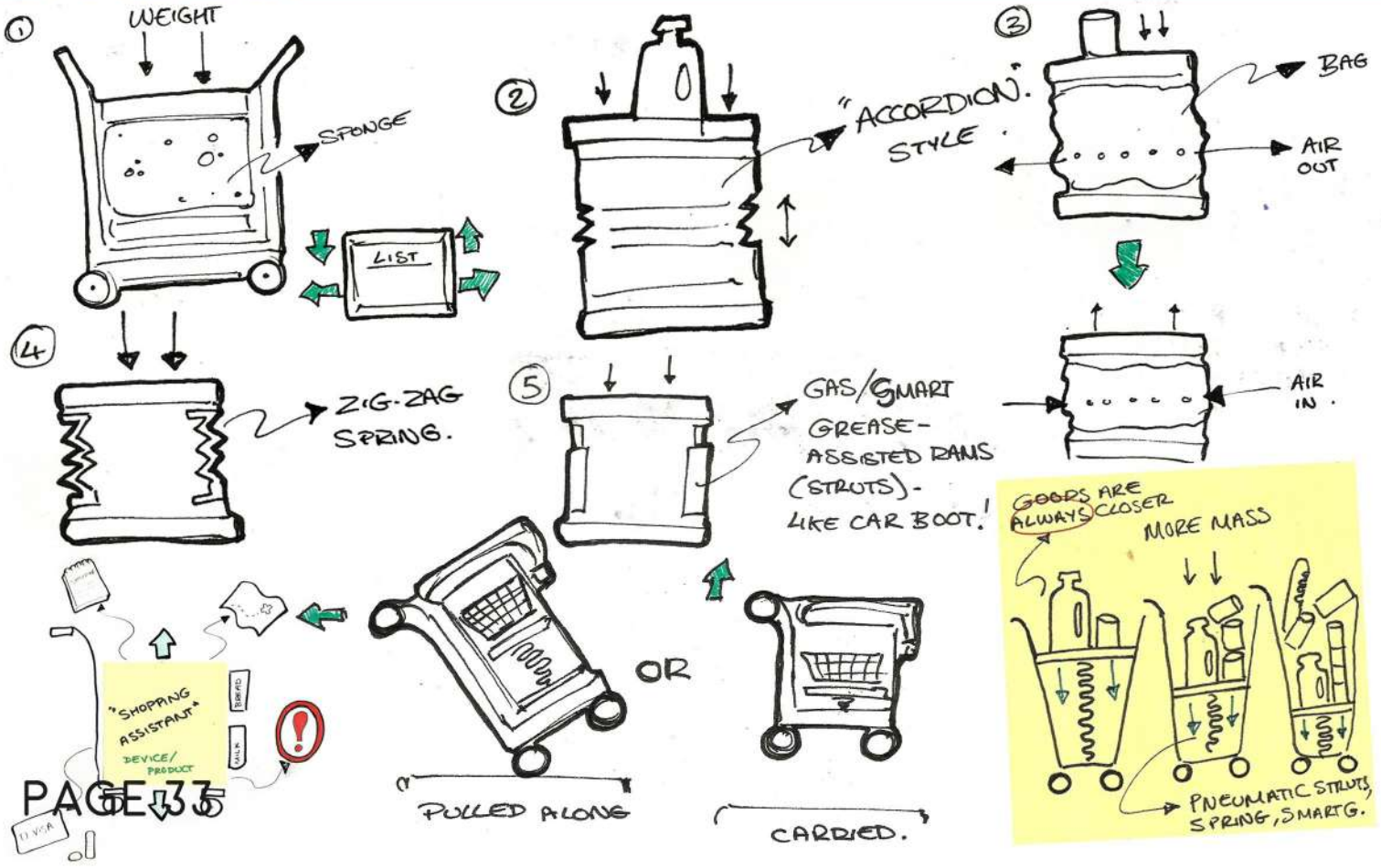
FREEZER/FRIDGE UNIT
SHELF
POS STAND

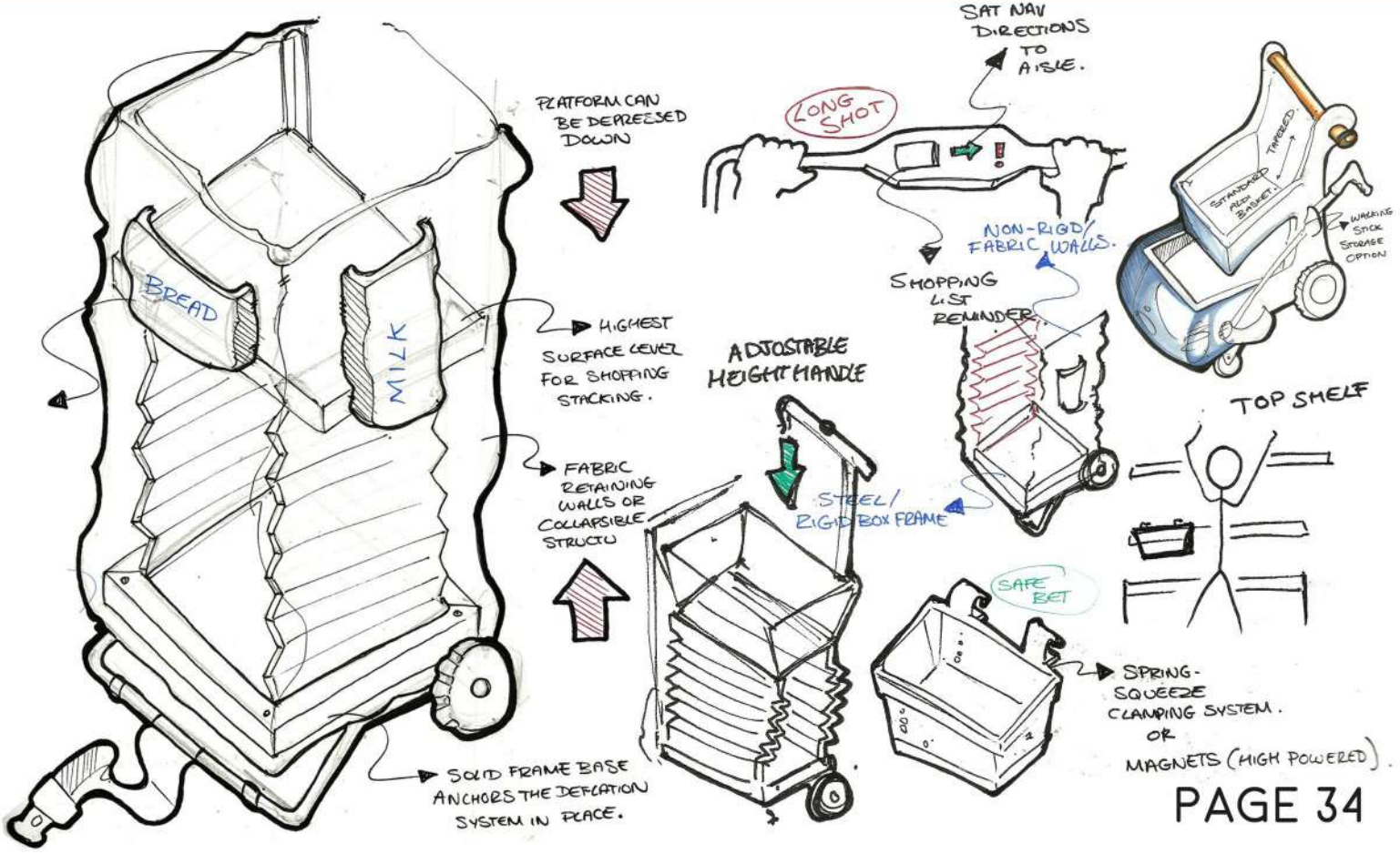
"GOODS PROCUREMENT STEP"

SHOPPING SECURED
DISCREETLY &
REMOVED FROM THE STORE

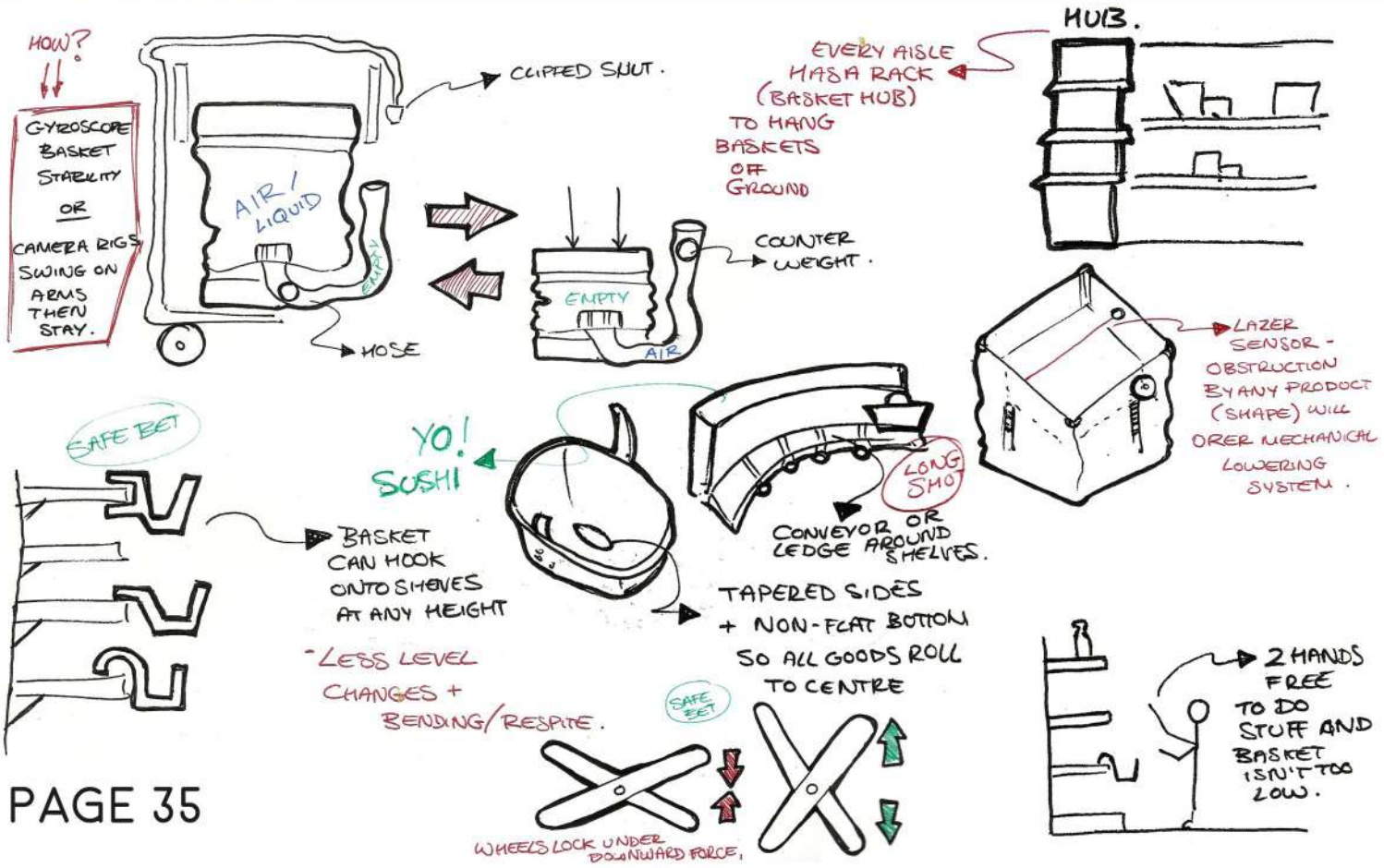
FUTURE SYSTEM CONCEPT...

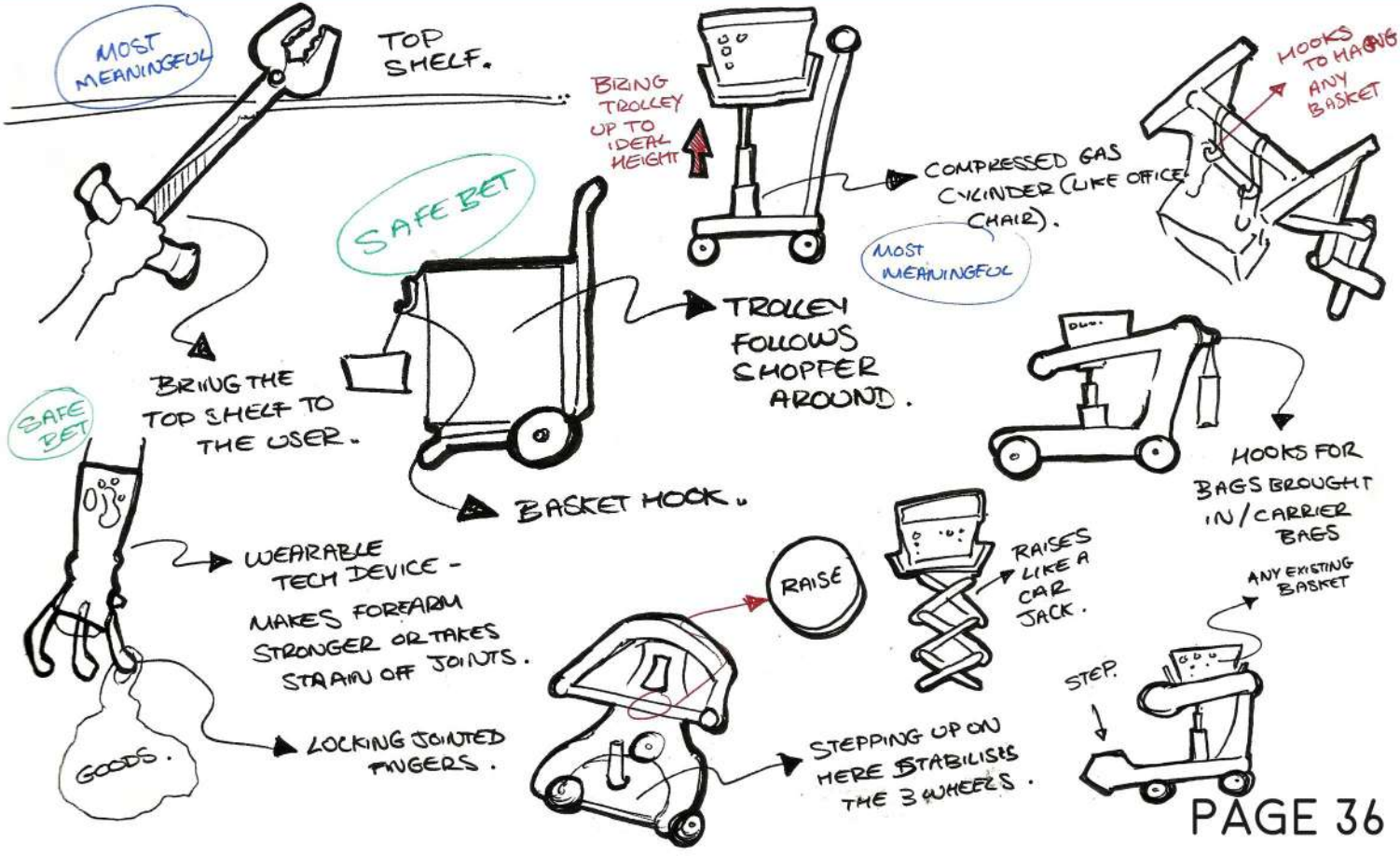
IDEATION


①
WEIGHT
SPONGE
LIST
②
"ACCORDION" STYLE
③
BAG
AIR OUT
AIR IN
④
ZIG-ZAG SPRING.
⑤
GAS/SMART GREASE-ASSISTED RAMS (STRUTS) - LIKE CAR BOOT!
"SHOPPING ASSISTANT" DEVICE/ PRODUCT
OR
POLLED ALONG
CARRIED.
GOODS ARE ALWAYS CLOSER
MORE MASS
PNEUMATIC STRUTS, SPRING, SMART G.

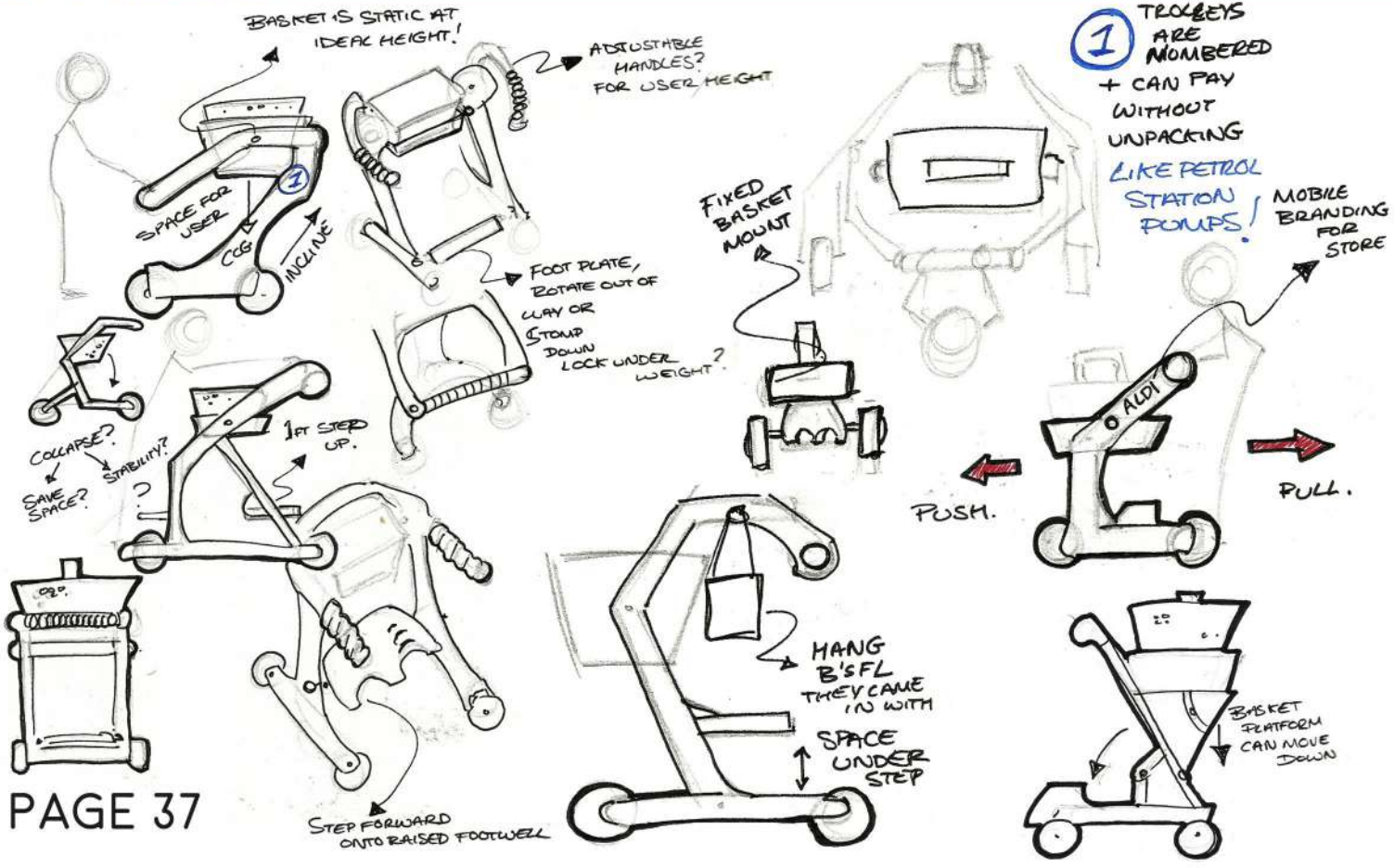

SAT NAV DIRECTIONS TO AISLE.
LONG SHOT
PLATFORM CAN BE DEPRESSED DOWN
NON-RIGID/ FABRIC WALLS.
SHOPPING LIST REMINDER.
STANDARD BASKET
TAPERED
WALKING STICK STORAGE OPTION
BREAD
MILK
HIGHEST SURFACE LEVEL FOR SHOPPING STACKING.
ADJOSTABLE HEIGHT HANDLE
TOP SHELF
FABRIC RETAINING WALLS OR COLLAPSIBLE STRUCTU
STEEL/ RIGID BOX FRAME
SAFE BET
SPRING-SQUEEZE CLAMPING SYSTEM. OR MAGNETS (HIGH POWERED).
SOLID FRAME BASE ANCHORS THE DEFICATION SYSTEM IN PLACE.

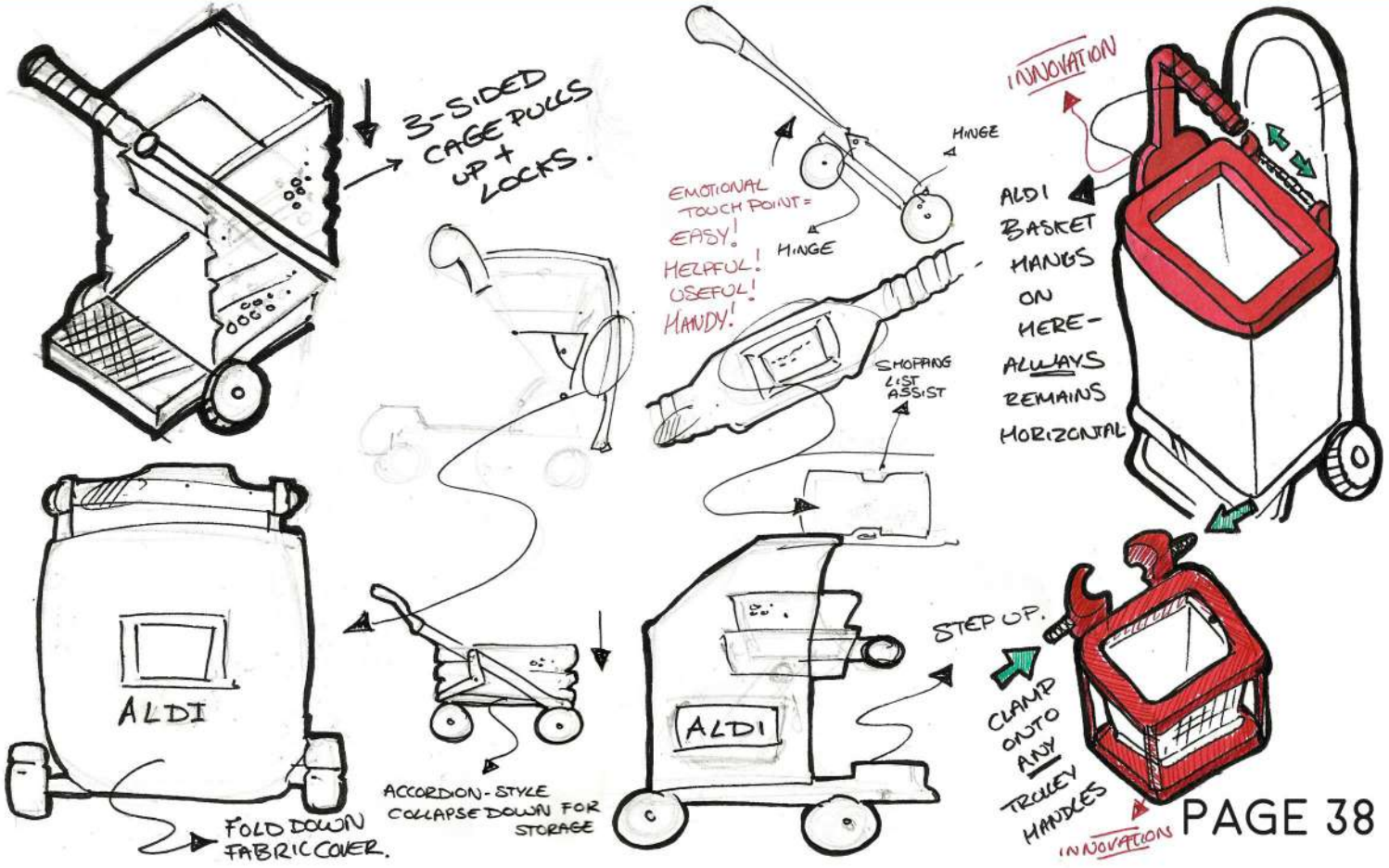
IDEATION


HOW?
GYROSCOPE BASKET STABILITY
OR
CAMERA RIGS SWING ON ARMS THEN STAY.
AIR / LIQUID
EMPTY
CLIPPED SHUT.
HOSE
EMPTY
AIR
COUNTER WEIGHT.
HUB.
EVERY AISLE HAS A RACK (BASKET HUB) TO HANG BASKETS OFF GROUND
LAZER SENSOR - OBSTRUCTION BY ANY PRODUCT (SHAPE) WILL ORER MECHANICAL LOWERING SYSTEM.
SAFE BET
BASKET CAN HOOK ONTO SHELVES AT ANY HEIGHT
- LESS LEVEL CHANGES + BENDING/RESPITE.
YO! SUSHI
LONG SHOT
CONVEYOR OR LEDGE AROUND SHELVES.
TAPERED SIDES + NON-FLAT BOTTOM SO ALL GOODS ROLL TO CENTRE
SAFE BET
WHEELS LOCK UNDER DOWNWARD FORCE.
2 HANDS FREE TO DO STUFF AND BASKET ISN'T TOO LOW.

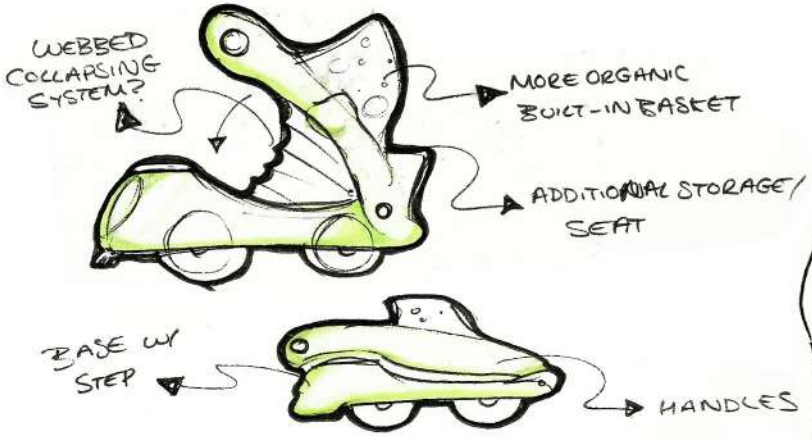

MOST MEANINGFUL
TOP SHELF.
BRING TROLLEY UP TO IDEAL HEIGHT
COMPRESSED GAS CYLINDER (LIKE OFFICE CHAIR).
MOST MEANINGFUL
HOOKS TO HANG ANY BASKET
SAFE BET
TROLLEY FOLLOWS SHOPPER AROUND.
BRING THE TOP SHELF TO THE USER.
BASKET HOOK.
HOOKS FOR BAGS BROUGHT IN / CARRIER BAGS
SAFE BET
WEARABLE TECH DEVICE - MAKES FOREARM STRONGER OR TAKES STRAIN OFF JOINTS.
GOODS.
LOCKING JOINTED FINGERS.
RAISE
RAISES LIKE A CAR JACK.
ANY EXISTING BASKET
STEP.
STEPPING UP ON HERE STABILISES THE 3 WHEELS.

IDEATION


BASKET IS STATIC AT IDEAL HEIGHT!
ADJUSTABLE HANDLES? FOR USER HEIGHT
SPACE FOR USER
CoG
INCLINE
FOOT PLATE, ROTATE OUT OF WAY OR STOMP DOWN
LOCK UNDER WEIGHT?
COLLAPSE?
SAVE SPACE?
STABILITY?
1ST STEP UP.
STEP FORWARD ONTO RAISED FOOTWELL
FIXED BASKET MOUNT
HANG B'SFL THEY CAME IN WITH
SPACE UNDER STEP
1 TROLLEYS ARE NUMBERED + CAN PAY WITHOUT UNPACKING
LIKE PETROL STATION PUMPS!
MOBILE BRANDING FOR STORE
ALDI
PUSH.
PULL.
BASKET PLATFORM CAN MOVE DOWN


3-SIDED CAGE PULLS UP + LOCKS.
HINGE
EMOTIONAL TOUCH POINT = EASY! HELPFUL! USEFUL! HANDY!
HINGE
INNOVATION
ALDI BASKET HANGS ON HERE- ALWAYS REMAINS HORIZONTAL
SHOPPING LIST ASSIST
ALDI
FOLD DOWN FABRIC COVER.
ACCORDION-STYLE COLLAPSE DOWN FOR STORAGE
ALDI
STEP UP.
CLAMP ONTO ANY TROLLEY HANDLES
INNOVATION

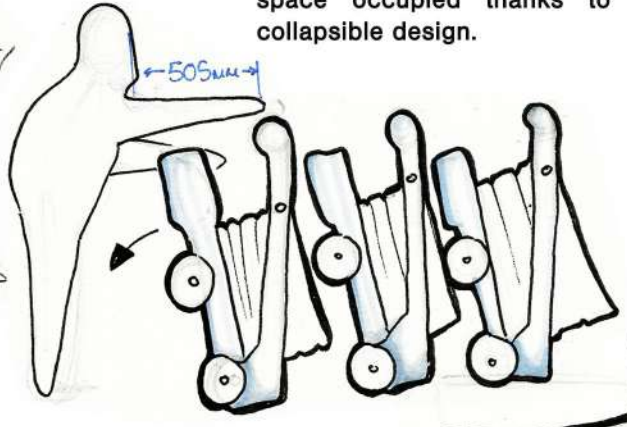
CONCEPT GENERATION 1



A standout concept emerging from design ideation is the development of a small wheeled trolley, like existing personal shopping trolleys, onto which handbaskets can be mounted. The branded adapter would be lightweight, collapsible and could have configurable extra features and USP's. The "basket" space could also be unique to the assistive device; becoming a new moulded form which changes current shopper behaviours.

(1)

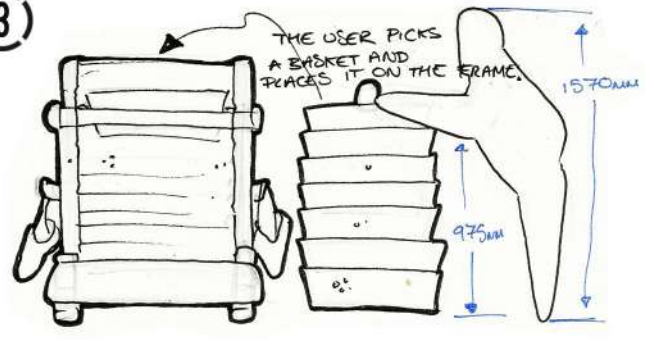
The "shopping assistant" basket carriers are stacked neatly at the entrance to the store; with minimal space occupied thanks to their collapsible design.



(2)

The user chooses an assistant and extends it to its full size. Any bags they entered the store with can be hooked onto the robust/lightweight aluminium frame.

3

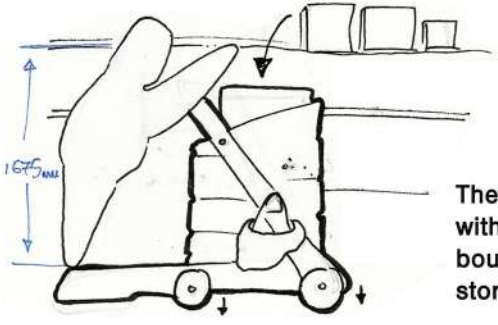


The user picks up a handbasket, which are stacked close-by, and places it on the frame. The frame is designed to accept most common plastic and steel wire handbaskets.

4

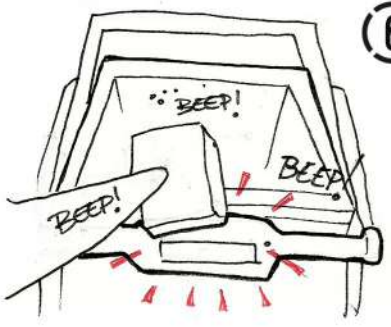
The user pushes the assistant along as they travel around the store; placing goods into the basket mounted at the most comfortable and central height to minimise user effort.

5



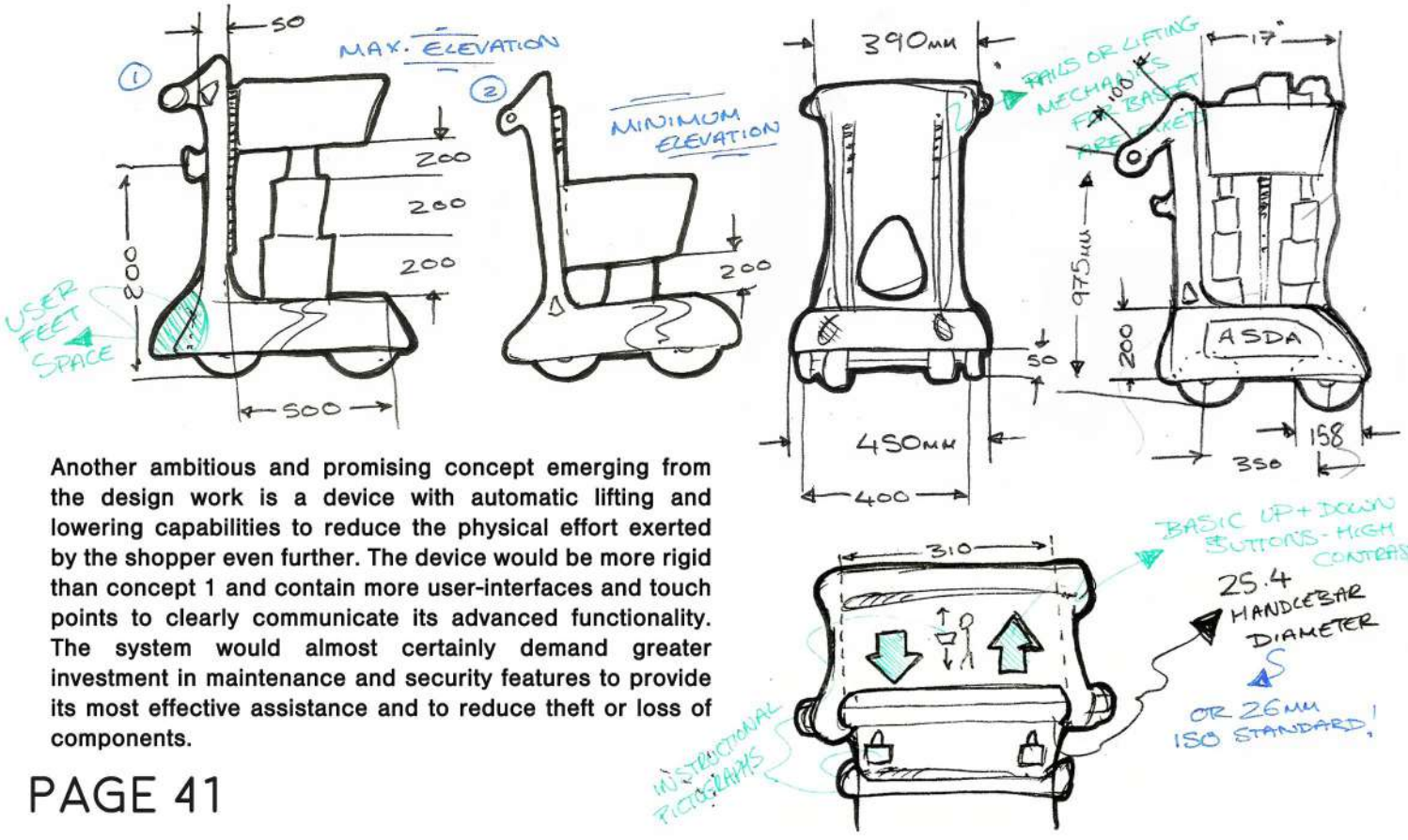
The shopper can easily view and reach top-shelf items by using the built-in step. The assistant is stabilised by an intelligent wheel-locking response to the increased load.

6



The assistant facilitates quick and easy checkout with a connected barcode scanner. The goods are bought and the device can be removed from the store or returned after bagging.

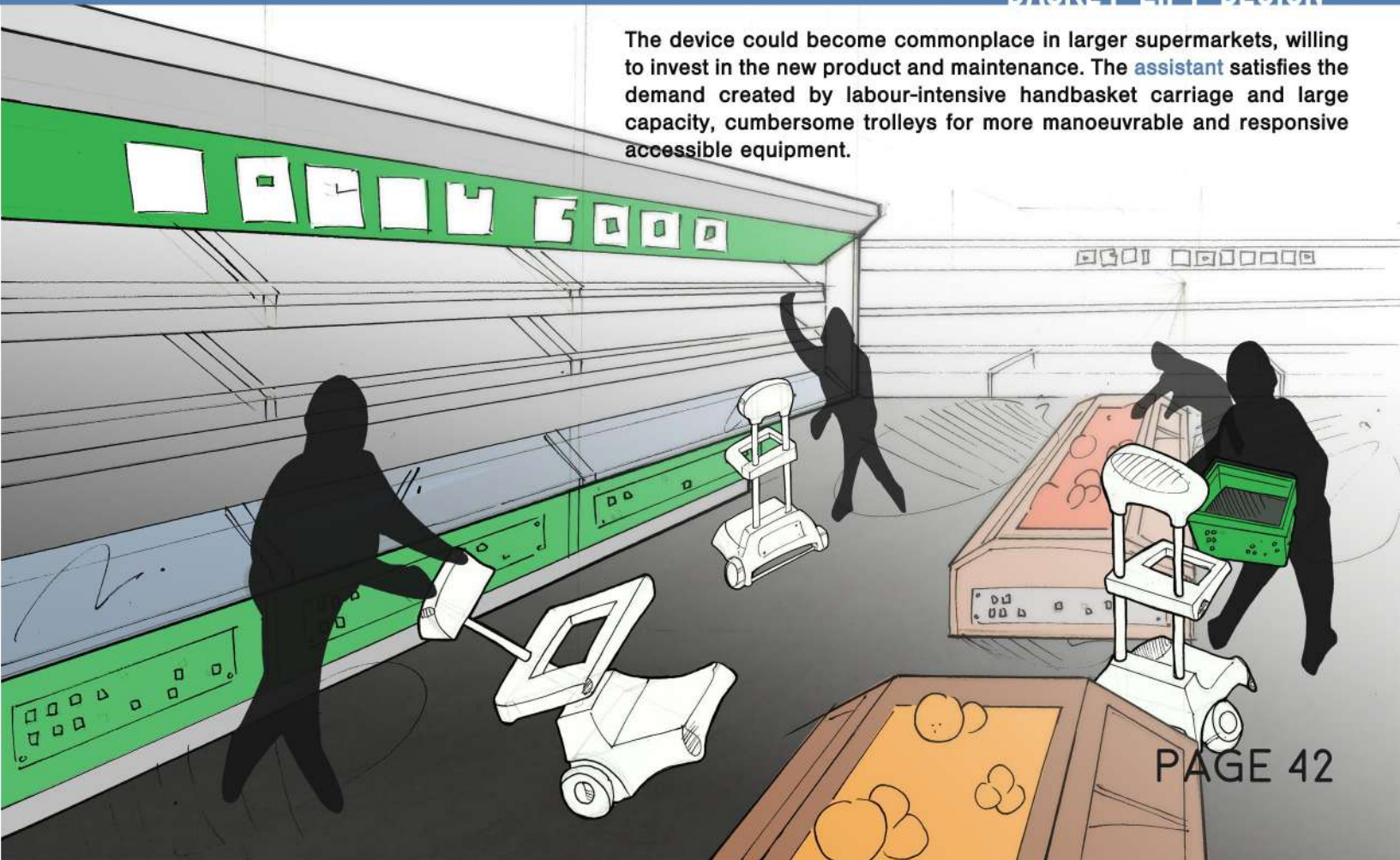
CONCEPT GENERATION 2



Another ambitious and promising concept emerging from the design work is a device with automatic lifting and lowering capabilities to reduce the physical effort exerted by the shopper even further. The device would be more rigid than concept 1 and contain more user-interfaces and touch points to clearly communicate its advanced functionality. The system would almost certainly demand greater investment in maintenance and security features to provide its most effective assistance and to reduce theft or loss of components.

BASKET LIFT DESIGN

The device could become commonplace in larger supermarkets, willing to invest in the new product and maintenance. The assistant satisfies the demand created by labour-intensive handbasket carriage and large capacity, cumbersome trolleys for more manoeuvrable and responsive accessible equipment.



5

DESIGN DEVELOPMENT

In order to critically compare the two most promising concepts emerging from the early stages of design work, an evaluation matrix was drawn up. The two concepts; a collapsible wheeled handbasket adaptor and a handbasket lifting aid, were each rated according to how effectively they satisfy the same 5 performance criteria. Manoeuvrability (around the store and under maximum load) was judged to be the most important design driver, while collapsibility was the least significant. Based on the results of a weighted rating comparison, concept (2) proved to be the design most worthy of further detailed development.

The design development stage sees the design transformed from a "blue-sky" concept into a well-rounded, functional and commercially viable product solution. The use of CAD software and 3D sketch modelling will aid realisation of the tangible product design in both a virtual and physical context.

CRITERIA	WEIGHTING	(1)	(2)
MANOEUVRABILITY	5	2(10)	3(15)
ASSISTANCE	4	1(4)	3(12)
MAINTENANCE	3	2(6)	2(6)
CAPACITY	2	2(4)	2(4)
COLLAPSIBILITY	1	3(3)	1(1)
TOTAL WEIGHTED RATING		27	38

DEVELOPMENT 1

This development further explores the concept of a folding handbasket carrier, to be picked up once the user steps inside the supermarket from a “hub” of neatly stored units.

The collapsibility of the unit would be in keeping with current trends surrounding the limited space occupation and easy storage and access of trolleys and baskets. Ensuring the product keeps a small footprint is also a better motivator for its adoption into smaller independent shops and grocery stores.

At this stage the “step” for reaching goods on high shelves remains but questions must be raised regarding the safety of such a feature...

(01) The foldable trolley concept was tested through the creation of a 1:1 scale cardboard sketch model. While the space reduction between the product's working and collapsed dimensions looked promising, concern was raised over the risk of finger entrapment injuries and the mechanism's ease-of-use.

(02) The proportions and form of a one-size-fits-all holding unit for existing handbaskets were tested. The basket must be held securely to avoid overbalance and tipping.

(03) The upright storage of a number of the units within a store may require a tailor-made and installed stacking unit or cage...

DEVELOPMENT 2

Development of the second concept, a useful vertical handbasket holding and lifting device, saw the form, required parts and functionality refined. The base (housing a number of electronic components for the lifting system), handlebar/control unit and basket holder are all designed with injection moulding for mass production in mind. The large rear wheels are off-the-shelf parts commonly found on existing personal shopping trolleys.

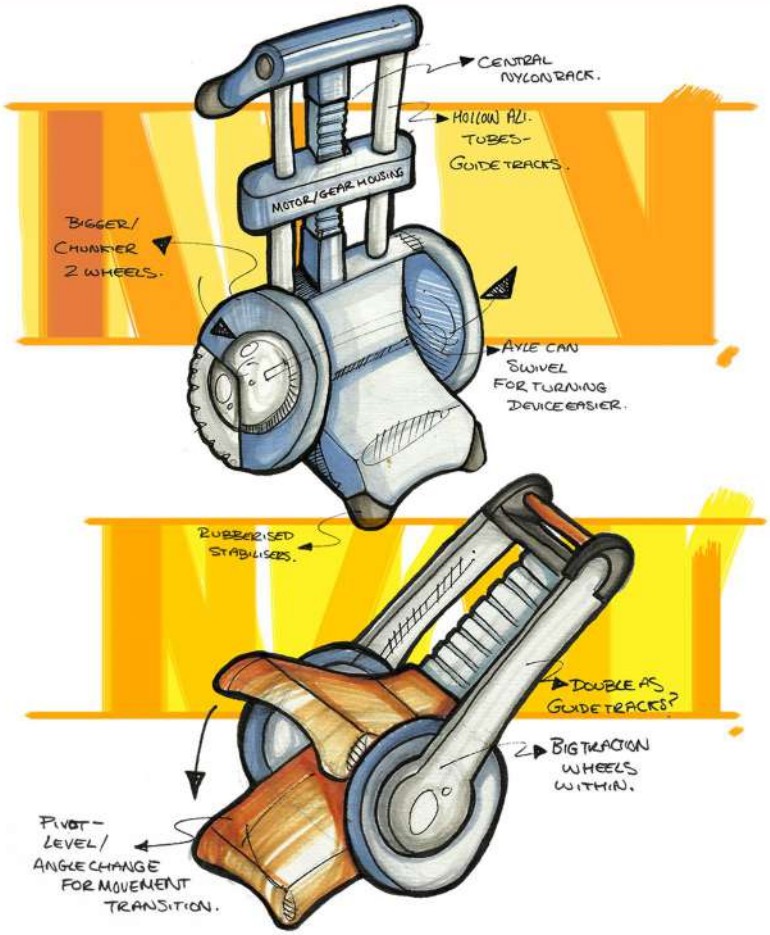
To further constrain and focus the development of a solution, the original intention to design a widely adaptable holding rig for multiple supermarket handbasket models has been changed to specify the 28L PP basket most commonly used in ASDA and ALDI stores. A simple holder with tapered sides has begun to develop, but a modular system whereby this component can be swapped for use in other stores would promote wider appeal.

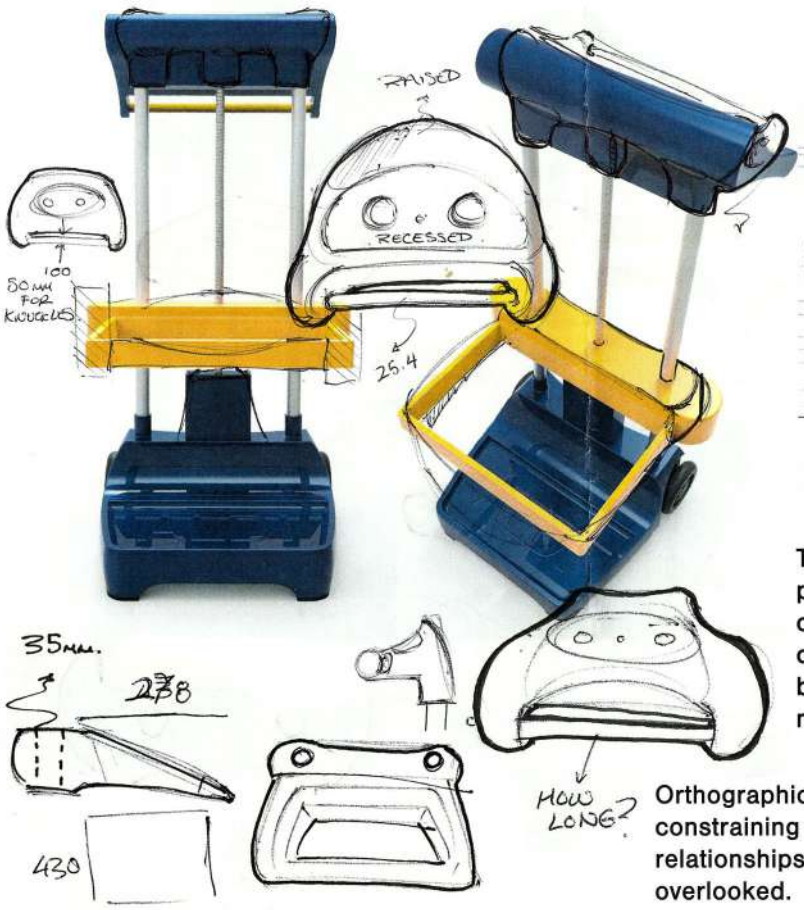
(01, 03 & 05) The form of the vertical lifting device was developed through 1:6 "playscale" and full scale 1:1 sketch models; using clay, papier mache, card and LEGO. Both organic and perhaps more lightweight and economic "skeletal" forms were explored.

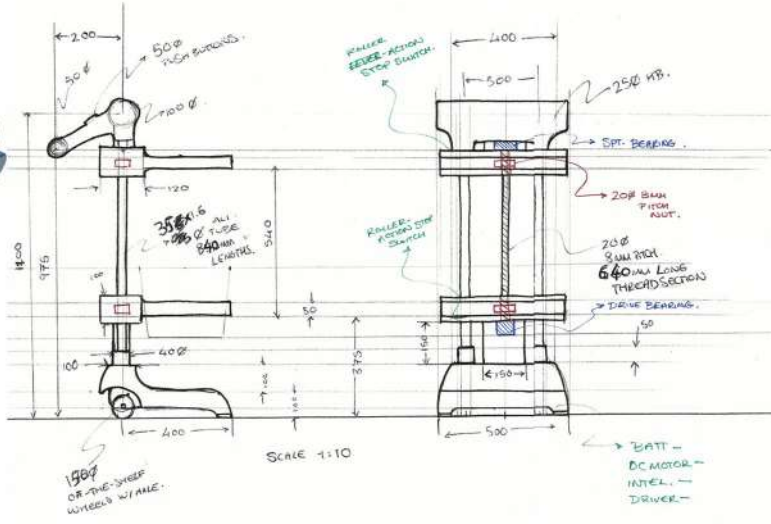
(02) The unit's "footprint" modelled in MDF. The form of the product's base was explored to confirm the best balance and wheel attachment options.

FORM REFINEMENT

Feedback suggested that some elements of the product's form were clashing visually and better juxtaposition of straight and curved lines may produce a more inviting and ergonomic aesthetic. Unnecessary material from the handlebar unit and basket holder can be removed; drawing the operator's attention to important points of interaction (such as the UP/DOWN buttons and key lock interface) more effectively.



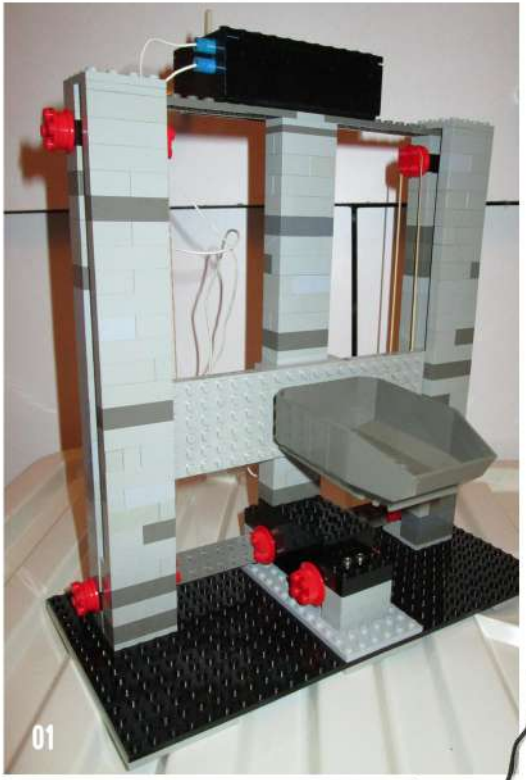




The primary point of interaction between the user and product is to be the handlebar and lift controls, so the form of this area has undergone multiple iterations. Flowing curves, more like modern car bodies, with a recessed button panel may prove a more inviting interface. Space must be created behind the panel for electronics.

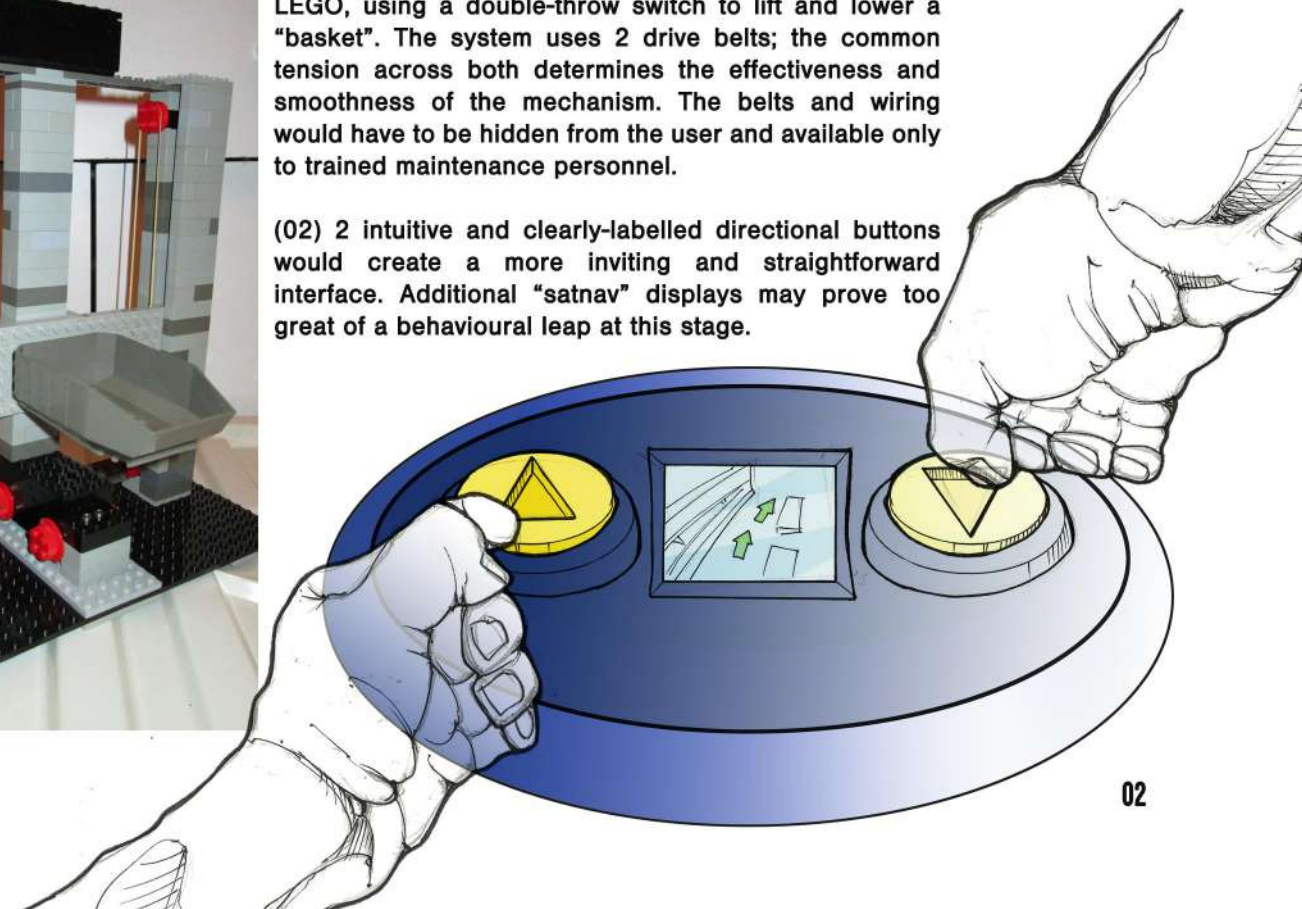
Orthographic drawings have been instrumental in constraining the solution's proportional relationships and ensuring no anthropometrics are overlooked.

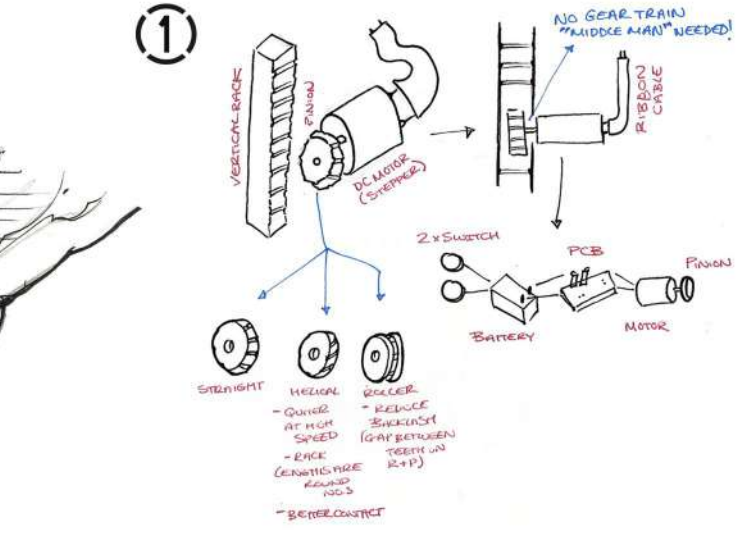
FUNCTION REFINEMENT

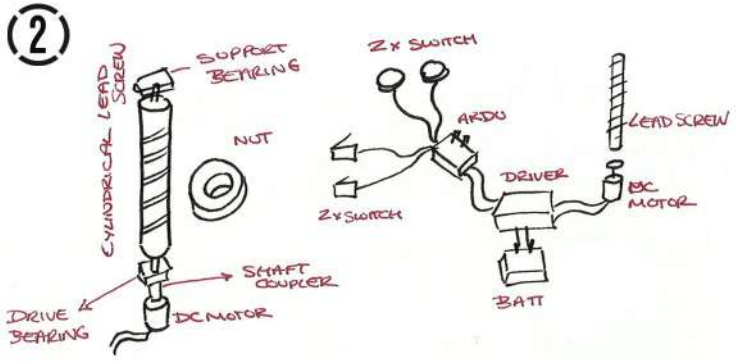


(01) A scale model proof of concept model was built from LEGO, using a double-throw switch to lift and lower a "basket". The system uses 2 drive belts; the common tension across both determines the effectiveness and smoothness of the mechanism. The belts and wiring would have to be hidden from the user and available only to trained maintenance personnel.

(02) 2 intuitive and clearly-labelled directional buttons would create a more inviting and straightforward interface. Additional "satnav" displays may prove too great of a behavioural leap at this stage.







The basket lifting system is central to the product's innovation and USP; providing the primary function as well as potentially the highest bearing on cost. A number of possible mechanisms have been considered including pneumatic or hydraulic pistons, inflation, counter-weight pulleys and drive belts.

The two most effective solutions are ① a rack and pinion system and ② a linear leadscrew actuator system; based on performance, accessibility and cost factors.

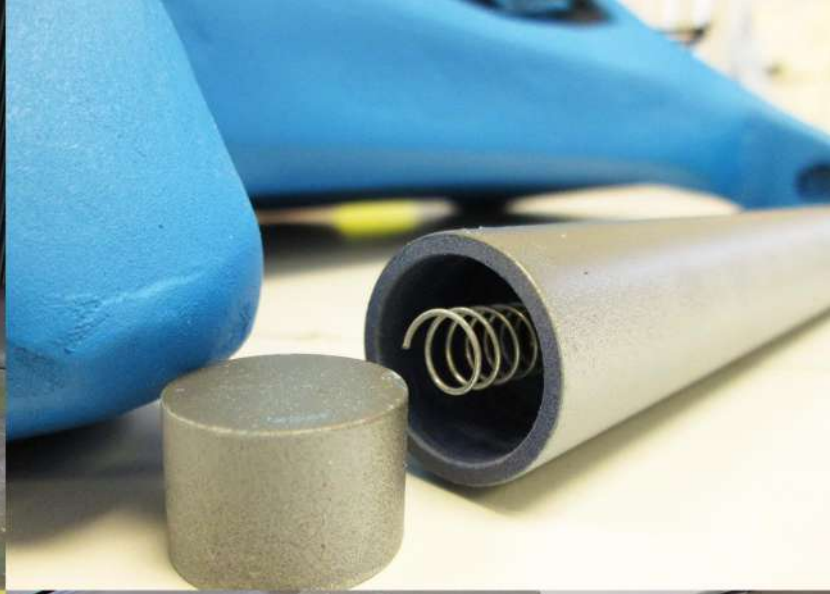
	①	②
WEIGHT	✓	✗
COST	✓	✗
PERFORMANCE	✗	✓
MAINTENANCE	✗	✓
OPERATIONAL NOISE	✗	✓
SAFETY	✗	✓
WORKING LIFE	✗	✓

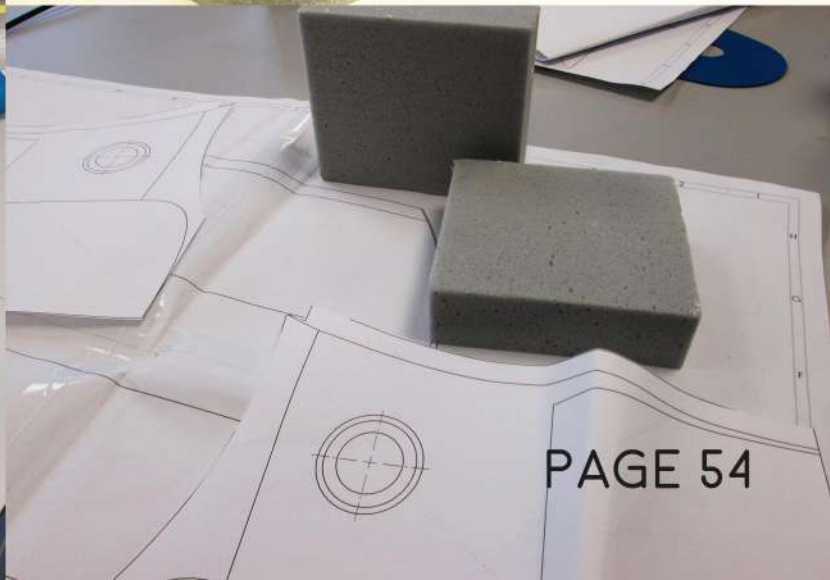
6

PROOF OF CONCEPT

As the product solution reaches its final iteration through accurate CAD modelling in SolidWorks, development of a working 1:1 scale prototype model begins. The proof of concept model is produced to demonstrate the principle functionality, characteristics and dimensions of the design in a real-world setting; allowing user-experience and interactions with the product to be assessed and improved upon.

The prototype was produced largely from the available 3D CAD data and 2D plans using a number of different rapid prototyping and manual methods including; FDM 3D printing in ABS, laser cutting, milling, turning, polyurethane foam modelling and electronic coding. The prototype is representative of the product's finished proportions, interfaces and basic functions and not necessarily the final DFMA intent. The modelled parts can be described as effective "plugs" for future mould-making or vacuum casting. The final product would ultimately be mass produced with more lightweight, uniform and thin-walled parts to reduce cost and optimise manufacturability.





COLOUR SELECTION

FAVOURITE COLOUR (51 - 69 Y.O. FEMALES)

FAVOURITE COLOUR (70+ Y.O. FEMALES)

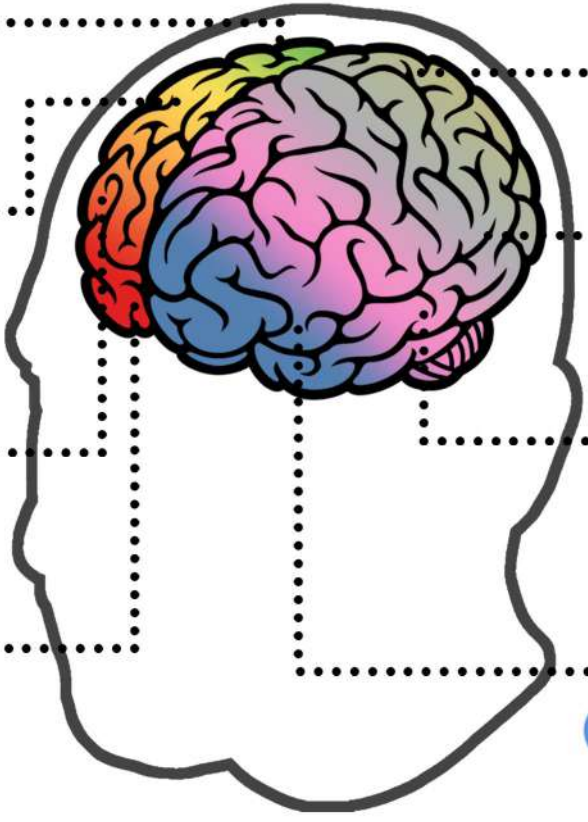
LEAST FAVOURITE COLOUR (51 - 69 Y.O. FEMALES)

LEAST FAVOURITE COLOUR (70+ Y.O. FEMALES)

Colours can have deep psychological and emotional connotations which determine their appropriateness within different environments and contexts. The predominant colour featuring in the neutral, unbranded shopping aid should appeal to the senses of the target user above all else; to help them engage with and enjoy using the product (Rob Curedale, 2017).

The final product colour could be dictated by the branding culture already adopted by the store the units are installed within. In this case, minimum colours should be used and the design must be simple enough to serve as a "blank canvas" for vast potential branding combinations.

PSYCHOLOGY OF COLOUR



GREENS

nature - balance - wealth

YELLOWS

energy - happiness - attention

ORANGES

social - reassurance - warmth

REDS

passion - optimism - adventure

NEUTRALS

simplicity - sophistication - calm

GREYS

protection - formality - strength

PINKS

calm - sweetness - love

BLUES

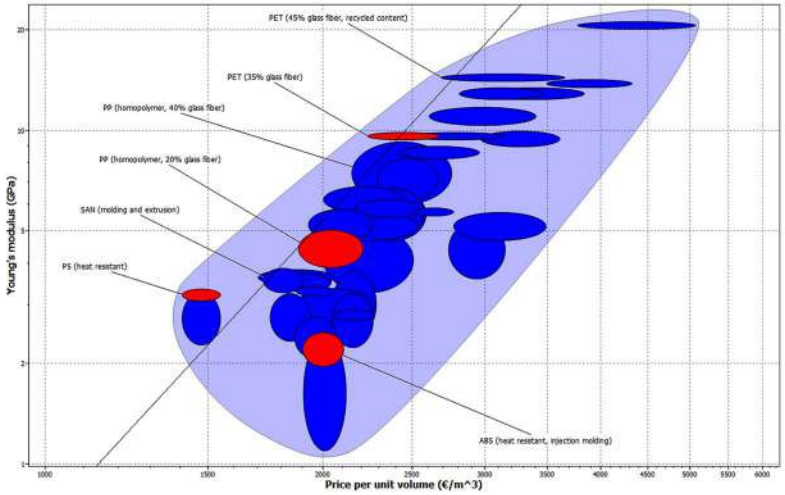
serenity - rescue - intelligence

(Vanessa Arbuthnott, 2016)

MATERIAL SELECTION

	Cheap	Strong	Light
Steel	●	●	
Aluminum	●		●
Titanium		●	●
Carbon fibre		●	●

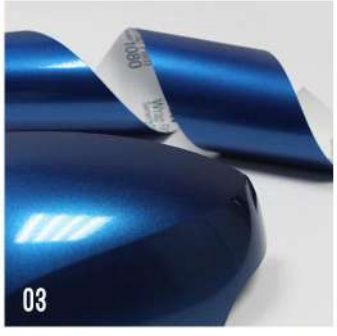
(Rick Hansen Foundation, 2015)



(Granta Material Intelligence, 2017)

The upright guide rails for the lifting system take the form of cylindrical hollow tubes. The strength and friction of the underlying material are critical to the mechanism's smooth function, while the stock price and weight are equally important factors. Aluminium displays perhaps the most effective trade-off for use in the final product.

Market research found that the majority of competetive products already produced and used within stores share the same small number of common materials; polypropylene (PP), glass-reinforced plastic (GRP) or polycarbonate (PC). PC can be ruled out as opaque material will be the most appropriate for concealing the device's mechanics. Material data shows that PP has the most appropriate and cost effective stength and weight characteristics for the potentially mass produced new product, as well as the best injection moulding suitability.



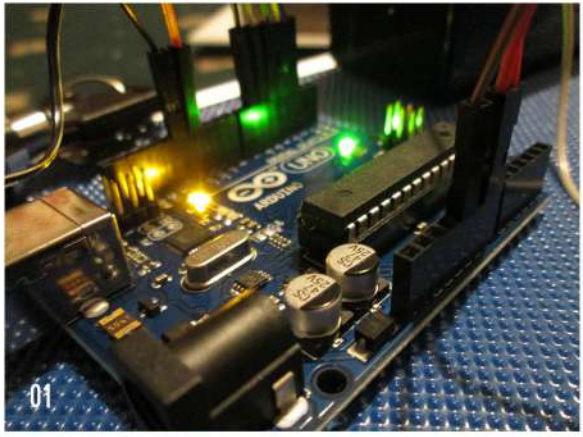
A high gloss PP moulding (01) would provide the modern and high quality surface finish sought after by users. A similar finish with a rougher texture (02) may help to disguise scratches and scuffs developed over the product's working life. Car body vinyl wrap (03) is another option, although the production labour implications and durability are drawbacks.

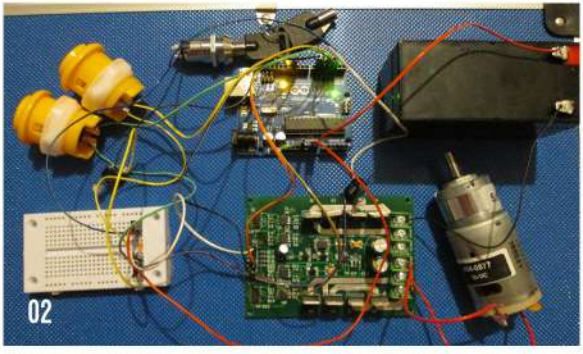
(04) Brushed aluminium would prove more hard-wearing than a highly polished finish.

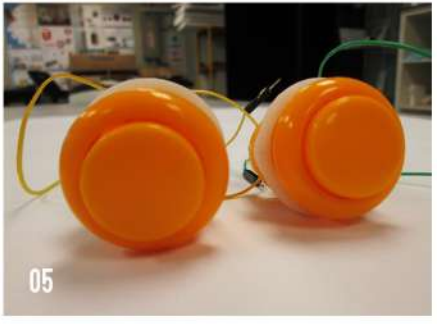
(05) Moulded LDPE rubber feet should provide long life and prevent damage to supermarket floors.

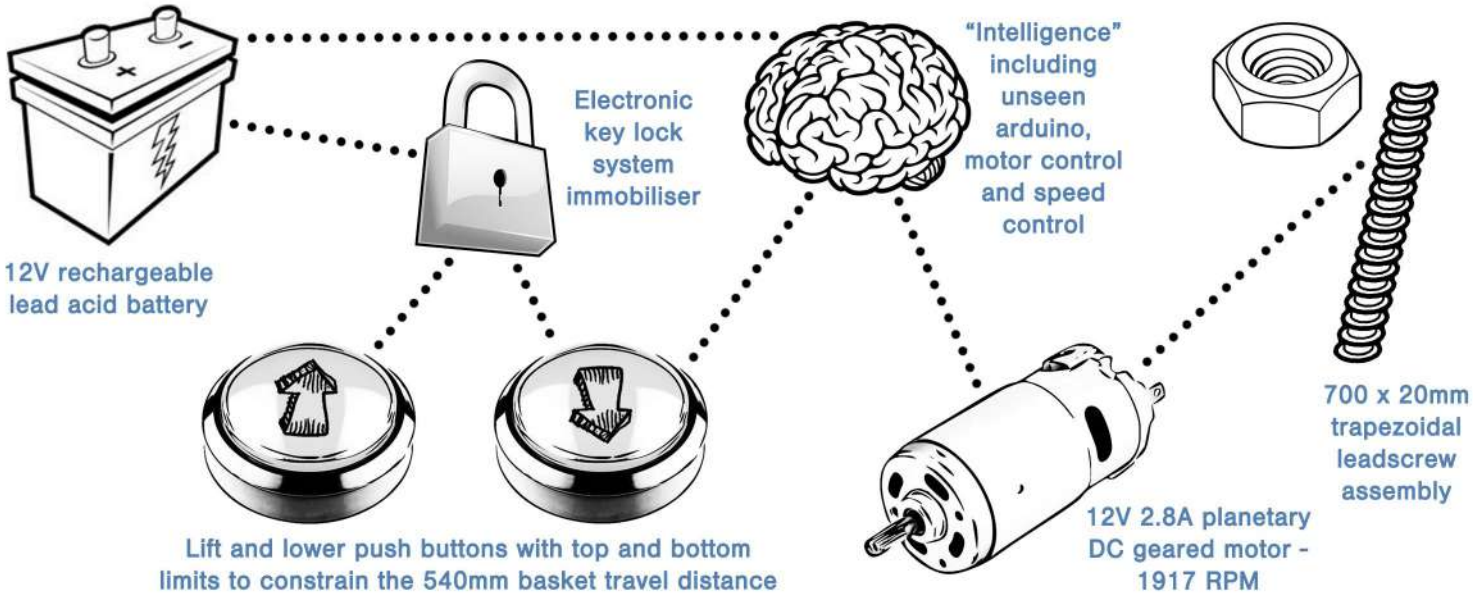
(06) Reverse engineering of existing shopping trolleys exposes the strong triple-layer composition of their handlebars.

ELECTRONICS



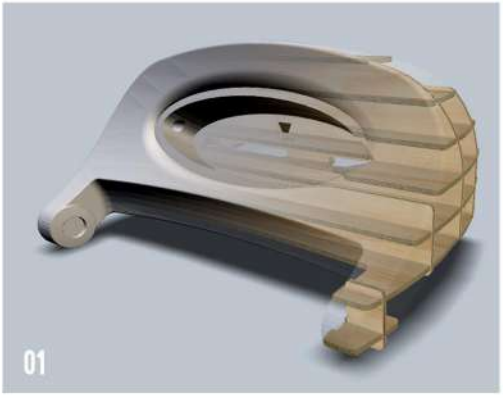






Development of the final electronic system and assembly for the basket lift control, to be used within the prototype, is more bespoke and unrefined than the version which would be adopted within the final product. Components like the arduino board (01) and leadscrew would be replaced by more cost effective, energy efficient and standard parts which can be more easily replaced and maintained. The system is designed to raise and lower a 12kg load (the average weight of shopping plus a factor of safety of 2) a distance of 540mm in a comfortable 4s. An electronic key lock (03) is included in the system as a theft and misuse-prevention feature; the key can be issued only to shoppers who register with the store to use the device. The prototype switches (05) are hard wearing "arcade-style" push buttons, but embossed aluminium or responsive, illuminated LED buttons would provide better intrinsic motivation and instruction in the final design.

PART PRODUCTION

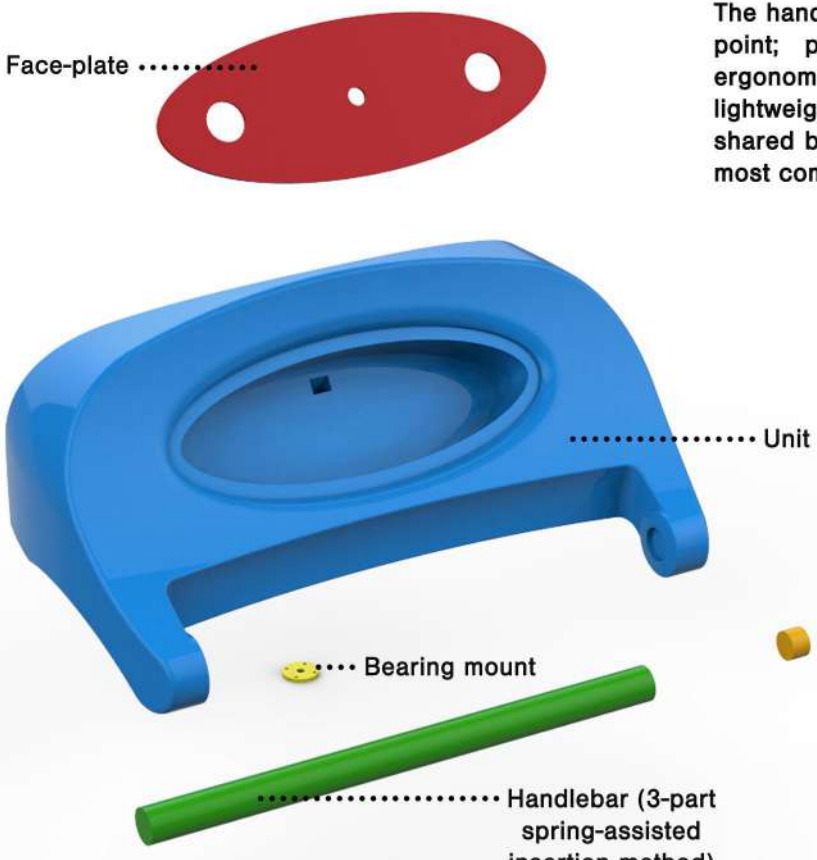


(01) The 3D CAD model of the handlebar unit was imported into Autodesk's 123D Make software, where the solid model was split into composite sections to be cut from sheet material.

(02) The individual sections were laser cut from 5mm plywood and assembled carefully. The skeletal structure was filled with blocks of modelling foam, which help to bring the form closer to the final design intent.

(03 & 04) The part is refined further through developing stages of sanding, filling and applying pattern coat primer to provide a smooth and symmetrical surface finish; ready for final spraying.

HANDLEBAR UNIT

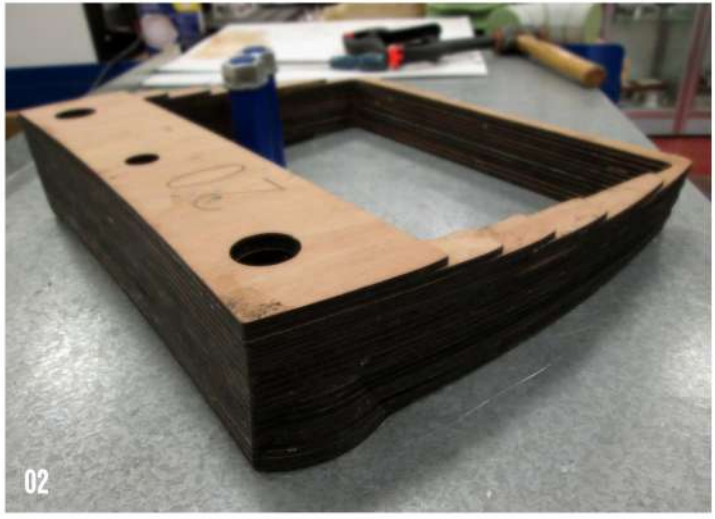


The handlebar unit serves as the product's principle touch point; providing the most significant functional and ergonomic interfaces. The handlebar itself was turned from lightweight POM plastic, to represent the 25.4mm diameter shared by common supermarket trolleys, and provides the most comfortable grip according to anthropometric data.

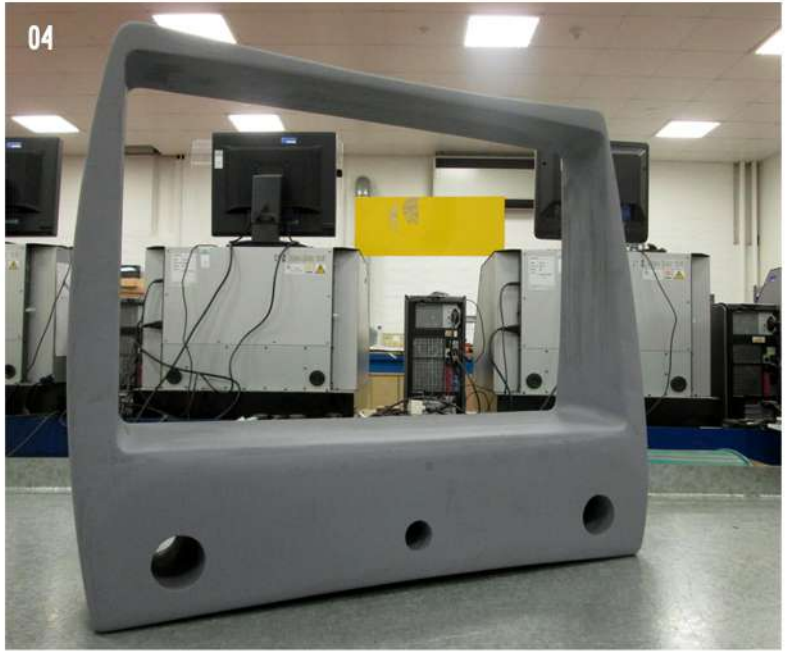
The angle of the face-plate, containing the three user interface switches, is positioned for greatest visibility and clarity. The face-plate and other screw mounting points (the stable motor and bearing mounting plates) were laser cut from 5mm plywood and HIPS plastic (04).

PART PRODUCTION

(01) The solid CAD model was divided into 20 5mm layers of material which, when stacked together, produce an accurate profile of the formed basket mount/lift. Some of the small details and radii from the final design are lost this way and must be created by hand to provide a smoother entry for the user's placement of the existing handbasket.

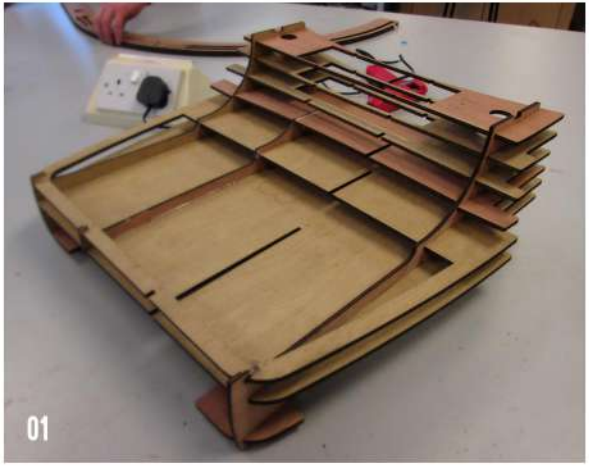


(02) The 20 layers of plywood were glued and stacked. To keep the component's mass down (and more accurately represent the physics of the real-world moulded plastic product) a strategic internal honeycomb structure was used to remove material from most of the layers. The though holes provide stable guides for the part's vertical travel.



(03 & 04) After finishing by a process of sanding, flattening back and filling in any imperfections with body filler; the lift should be suitably smooth and accurate for accepting the shopping basket comfortably. The wooden part could also provide an a adequate former or plug for vacuum forming or creation of a 2-part mould. Either of these processes would more likely be adopted for the shopping aid's cheap and lightweight final mass production.

PART PRODUCTION

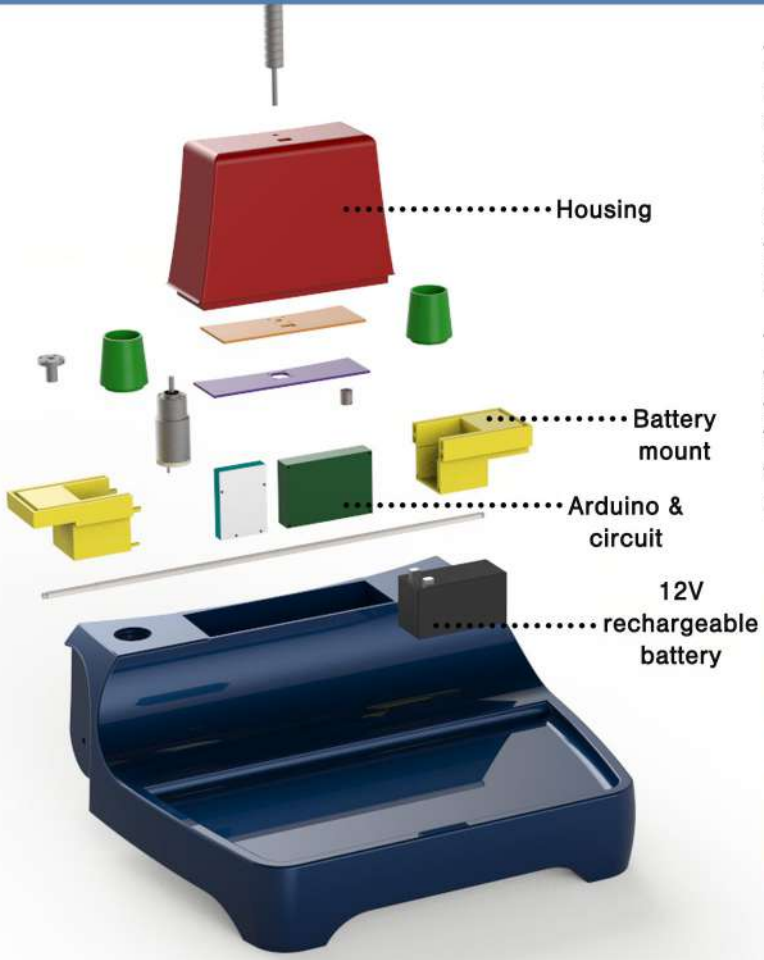


(01) The method of assembling laser cut layers posed greater difficulties for the bigger and more complex base part; but did prove that the dimensions of the part provided an adequate footprint for balance and stability.

(02) The part was instead handmade in six pieces from PU modelling foam, which were glued together and continuously sanded to a smooth finish.

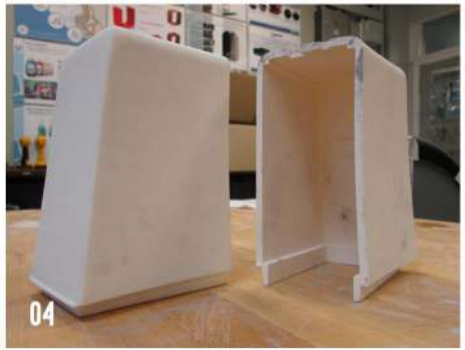
(03) Nylon tube holders were drawn and turned.

BASE, HOUSING & WHEELS



The base part serves as a hub for all of the lifting mechanism components; including the 12V battery, motor and circuitry. The base must also dictate the device's centre of gravity and stability while static, under the maximum load, and while in transit. The space within the housing is critical and 3D printing was the chosen process to ensure that the hollow form was suitable for mounting a number of plates, wires and components (04).

The final product would have strategic removable panels within the base unit to provide access to every component for battery charging, installation and general maintenance. The prototype wheels and axle system are off-the-shelf but the final design may include bespoke wheels to avoid the risk of tampering by store-goers.



PROTOTYPE

01

```
/*
 * File: basket_lift_v2_slight_edit.ino
 * Author: Jamie Kneale
 * Date created:
 * Date modified: 22nd April 2017
 * Description:
 */

// Names for the pins
const int keySwitch = 2;
const int up = 3;
const int down = 4;
const int topLimit = 6;
const int bottomLimit = 5;
const int PWM1 = 11;
const int DIRP1 = 12;

// Used to determine whether the motor is running and its dir, respectively.
int enable = 0; // Zero is off. One is on.
int dir = 0; // Zero is down. One is up.

// Used to determine whether the keySwitch is active. Negative logic due to pullup resitor method.
// TRY CHANGING TO TRUE IF CODE DOESN'T WORK!
const boolean active = true;

// Change for max run speed
const int PWMVAL = 255;
```

(01) After several iterations and testing with different component configurations, the arduino code and electronic system; featuring a compact 3-relay module, were proven to be functional. The use of arduino offers the potential to build further intelligence and functionality into the product; including the capability of the store personnel to optimise and monitor battery usage and track the assistant's performance remotely.

(02 & 03) The prototype stands 1.1m tall and 0.5m wide; representing the critical dimensions of the final design. The tapered basket holder is strong enough to suspend existing hand baskets as intended.

(04) The contrasting control interfaces offer instrinsic motivation; with multiple test users commenting on the inviting nature of the push buttons. The UP/DOWN instructional symbols are raised for clear defintion.

(05) The 2 straightforward trolley wheels are removable for ease of maintenance and exchange at the end of their functional life.

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FINAL DESIGN

- Effortless shopping with dedicated assistance

- Excellent stability
- Superior manoeuvrability

- Simple 2-button lift operation
- Registered electronic key lock security

The Personal Shopping Assistant, measuring 1.2m tall and 0.5m wide, is the ideal companion on shopping trips for the “essentials”; with a tailored carrying capacity, using most common supermarket handbasket models. Its compact size and stability, while unmanned and while transported around the store, make the Assistants the most ambitious and practical modern equipment solution to be installed within both small grocery stores and major supermarkets.

FINAL DESIGN

OPERATION

Lift the basket to remove the need for continuous bending and lifting or lower the goods to pull the Assistant effortlessly around the store.

MAINTENANCE

The safe basket lift mechanism is almost maintenance-free; delivering smooth, consistent and silent performance with minimal lubrication to combat friction.

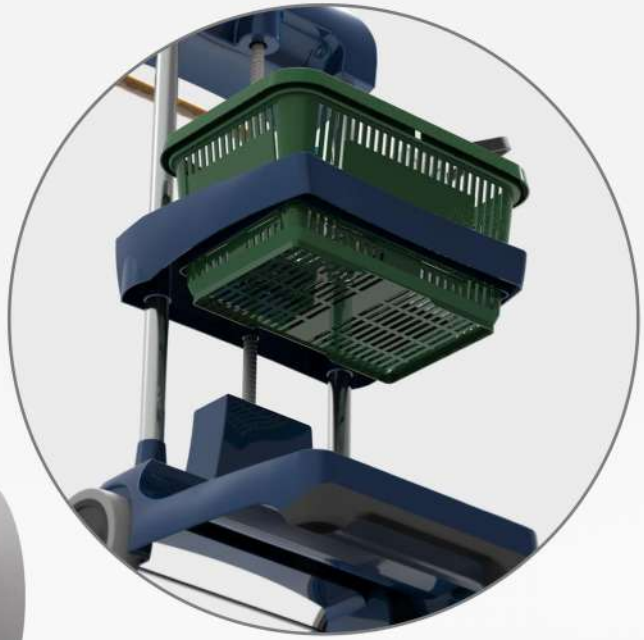
FUNCTIONALITY

Shoppers no longer need to balance their basket precariously while stretching to locate goods in deep freezers or on shelves.

Theft and misuse prevention are paramount. The issue-and-return key lock security system has been developed to maintain the longevity of the device for those most in need.

FINAL DESIGN

4 x tamper-resistant security Torx bolts



PERFORMANCE

Large 15cm PU/rubber wheels provide the smoothest portability, whether pushed or pulled along, and perfect stability while unattended with the help of hard-wearing rubberised feet.

The high-performance/low-cost battery, inaccessible to shoppers, is capable of supplying at least 5 hours of continuous use before requiring a recharge at a dedicated in-store docking and storage facility.

USER INTERFACE

Simple and responsive 2-button operation offers the most intuitive user experience and control possible. The aluminium push buttons are engraved to add a touch of quality and accessibility for visually-impared users.

FINAL DESIGN

SECURITY

The Assistant is immobilised with the use of a dedicated key, which can be easily monitored and tracked by in-store security personnel.

BRANDING

Lightweight injection moulded PP components are designed for ease of manufacture and versatile branding capabilities; with almost limitless possible colour combinations.

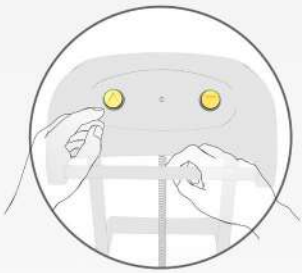
1. lower 2. raise 3. shop

Compatible with most common handbaskets, the ASSISTANT eliminates physical demand & leaves 2 hands free; granting shoppers the freedom to conduct essential shopping tasks comfortably & easily.

The ASSISTANT is a modern supermarket equipment solution designed to help the older shopper complete their in-store tasks more effectively, independently & safely. The lightweight & compact device boasts greater manoeuvrability than alternative shopping trolleys; requiring less maintenance to ensure consistent performance & deliver almost silent operation.

ASSISTANT

PERSONAL SHOPPING AID



Intuitive UP/DOWN interface with 2 hard-wearing engraved aluminium buttons

Secure, trackable key lock immobilisation prevents theft & misuse

Lightweight, hollow PP base houses the rechargeable battery for ease of maintenance

Large 15cm PU wheels offer excellent mobility in transit & rubberised feet provide stability while unattended

Jamie Kneale - BSc Product Design Engineering - 6003PDE Design Project III

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