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Uuele generatsioonile mõeldud kohvermööbli disaini arendus.

Design development of deployable luggage for a new generation.

Author applies for degree of Master of Technical Sciences (M.Sc.)

Speciality: Design

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Author's Declaration

I have written the Master’s thesis independently. All works and major viewpoints of the other authors, data from other sources of literature and elsewhere used for writing this paper have been referenced. Master's thesis is completed under the supervision of Martin Pärn.

Date: Author signature:

Master's thesis is in accordance with terms and requirements.

Date: Supervisor signature:

Accepted for defence by chairman of defence commission.

Date: Chairman name:

Chairman signature:

Master thesis objectives and tasks

2014/2015 academic year, 4th semester

Student: Patrick Mallon, A131195

Field of study: Design & Engineering

Supervisor: Visiting Professor, acting head chair of Design, Martin Pärn

Consultant: Engineer, Sulev Saar, 609 0437

Master's Thesis topic:
Uuele generatsioonile mõeldud kohvermööbli disaini arendus.
Design development of deployable luggage for a new generation.

Tasks and timeframe for their completion:

NR	TASK DESCRIPTION	COMPLETION DATE
Task 1	Establish methodology	25.05.2015
Task 2	Find user group	25.05.2015
Task 3	Write brief	25.05.2015
Task 4	Develop design	25.05.2015

Design and Engineering problems to be solved:
An identification of the user types that would benefit from a synthesis product of luggage and furniture, followed by design development.

Defence application submitted to deanery not later than …..…. Deadline …….........

Student ……………………………. /signature/ ………………..…………. date …......…………

Supervisor………………………… /signature/ …………………………….…. date …......…………

ABSTRACT

This thesis explores possibilities of a synthesis between luggage, and specific functionalities of household furniture. Specifically the integration of compartmentalisation, frontal access and a clothes rail.

Design methodology was utilised to structure an investigation into potential new markets, citing societal level trends in economics and technology, as well as primary sourced research. Following this process, a new luggage morphology was developed, documented and evaluated.

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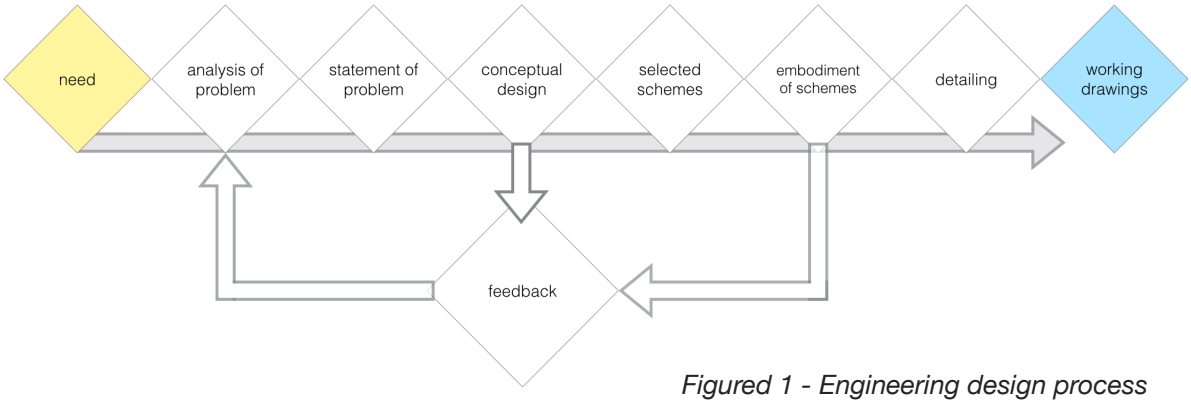
1. Introduction

The aim of this thesis is to develop an existing concept through a better understanding of users. The existing concept blends the features and functionality of bedroom furniture with that of rolling luggage. Knowledge of the users is currently broad and unrefined, resting on assumptions that users will be urban, young and on the move. Investigations into macro-trends is important for this research, to ensure the primary user groups will still exist if and when the product released to the market.The scope of the inquiry will cover research and design, but few considerations of final product manufacturing cost.

Note, the name 'Ronin' refers to the conceptual design developed in a previous semester, it provides much of the groundwork for design investigations and is referenced to throughout.

2. Methodology

The sheer abundance and variance of methodological models that are available for use by designers and engineers can in and of itself create a problem, see (Kumar 2012). The problem, of how to select, from many options, the most effective model for the circumstances. For the previous design iteration the engineering design process (figure 1) was the chosen and used as the most suitable methodological model. It was selected, and considered useful, due to its step by step approach coupled with its requirement for multiple schemes.



Figured 1 - Engineering design process

It guided the development process to the selection of the upright luggage model, with frontal access and hanging rail functionality. One limitation of this model became apparent on reaching the final stages, that is the lack of a feedback mechanism to revise and improve on previously made decisions.

On commencement of writing of this thesis, development had already reached the final stage of the engineering design process, the working drawing phase, with yet more development and testing of assumptions required to produce a satisfactory design. To address shortcomings in the engineering design process, preferences were compiled to act as a filter to narrow down design model candidates.

Three preferences included: use and improvements on definitions of the overall problem; use and improvements of concept, and finally to work on these two

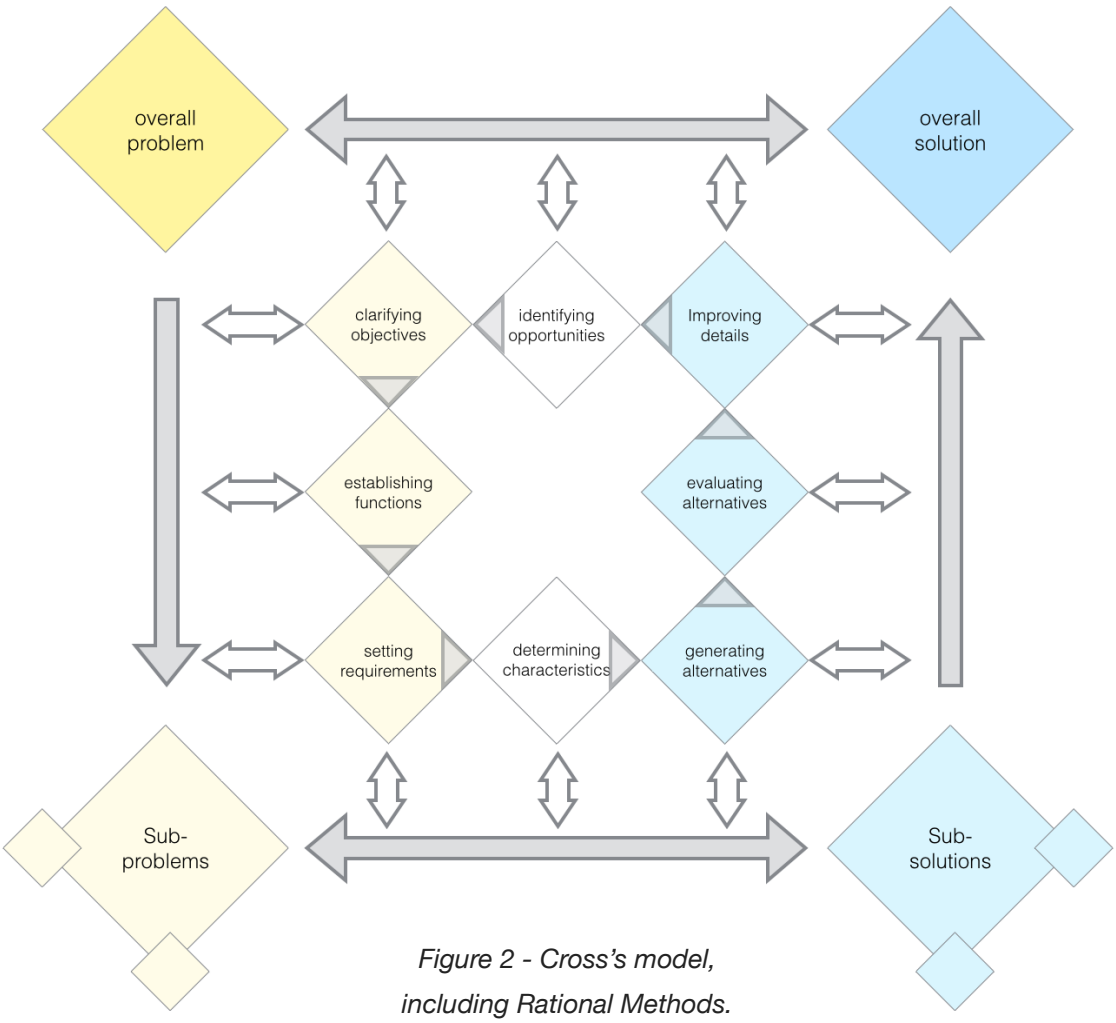


Figure 2 - Cross's model, including Rational Methods.

elements in tandem. In looking for a methodological model which best reflected these criteria, it was apparent that models, like the 'engineering design process', that emphasise a linear progression to a final solution, were not ideally compatible. Instead, models that promote parallel but influencing work streams were considered more preferential and Cross's model was selected as the most suitable candidate. The model, pictured in figure 2, 'assumes that designers develop the co-evolution of problem and solution together, as well as analysing overall problem into sub-problems and synthesising sub-solutions into an overall solution' (Nigel Cross, 2008).

Cross goes on to detail individual exercises (the inner elements in figure 2) which compound and constitute developmental flows in what he terms 'Rational methods'. Working through these exercises the overall problem and solution will steadily become concretised. The implication for this thesis being that any of the individual development stages have the potential to change characteristics in both the overall problem and solution.

The thesis will begin with general analysis of overall problem and solution, outlining a brief history of the developments in problem definitions and design development. Below is a breakdown of the internal processes outlined in Cross's model, the bulk of the thesis, including design exercises, will fall into these categories.

(A) Clarifying objectives
Clarifying overall design objectives plus sub-objectives, and the relationships between them.

(B) Establishing functions
This stage establishes the functions and sub-functions necessary to achieve the listed design objectives.

(C) Setting requirements
This stage is primarily concerned with setting and understanding constraints on design. This thesis will reference restrictions placed by airlines and human physical capabilities. This stage is also intended the stage to set performance targets for the design. i.e. storage capacity.

(D) Determining characteristics.
This is the first of the sub-stages to begin to form solutions that meets all of the criteria set in previous stages. The character of the solution will become apparent and will later enable comparisons between other viable solutions.

(E) Generating alternatives.
Like the Engineering Design Process, this development model also calls for generation of alternative solutions. Greater authority emanates from designs selected from amongst many, than solutions that lack comparative options and stand in isolation. This thesis explores alternative design solutions where possible, but limits of time and resources have constrained the range of explorations.

(F) Evaluating alternatives.
Weighted matrixes and positioning charts were utilised to gauge levels of achievement in categories set in the earlier problem definition stages for both sub-solutions and overall solutions.

(G) Improving details.
Cross recommends use of the Engineering Design Process on a detail specific scale to aid development and reduce costs. This stage in this thesis relates to the specification of connection details, hinges, locks and production methods.

(H) Identifying opportunities.
This section relates directly to defining what users require, it achieve this by using various user centred design exercises such as, user profiles, scenarios, interviews, user testing, analysis of macro data and questionnaires.

3. Identifying opportunities & clarifying objectives

3.1 Overall problem and overall solution

In the previous semester on the Design & Engineering course students were given a general brief to isolate and explore an aspect of public nuisance. The particular starting problem for the project (that is relevant to this thesis) was:

How to reduce the excessive space consumed in the home by common luggage items.

In response, a solution was proposed:

To remove the redundancies in traditional luggage by designing luggage for use on a day to day basis.

This proposed solution, to a well known problem, is by no means the sole approach, or even the most direct. Searches of the patent archives of luggage retail giants Samsonite reveal patents for folding luggage (Samsonite, 2015), a much more direct response to the problem; and folding luggage is also championed as a space saving saviour of design in the recent Kickstarter success 'Barracuda' (Kickstarter, 2015).

Day-to-day use was selected as a development angle over others due to a desire to address human issues of globalisation, specifically increasing liquidity of labour markets, or the increasing pace of modern life. International integration of labour markets is one of three crucial factors of globalisation (World trade report 2008) and for the purpose of this research, emphasis was placed on the increased integration experienced, not just by labour, but also two self determined categories: consumers of travel, and education.

3.2 User journey mapping

User journey mapping was utilised to understand the actions taken by a typical luggage user. It maps a journey, beginning in the home and ending in the car. Actions defined in the early stages of the journey provide examples where Ronin could offer efficiency gains. The following actions were identified as superfluous for a luggage system that remains packed and accessible all of the time.

- Locating or/and fetching luggage (some users store their luggage outside)
- Finding, sorting and folding/rolling clothes
- Packing personal items into luggage

These points were important in building the value proposition, and led the research in the direction of time savings through convenience.

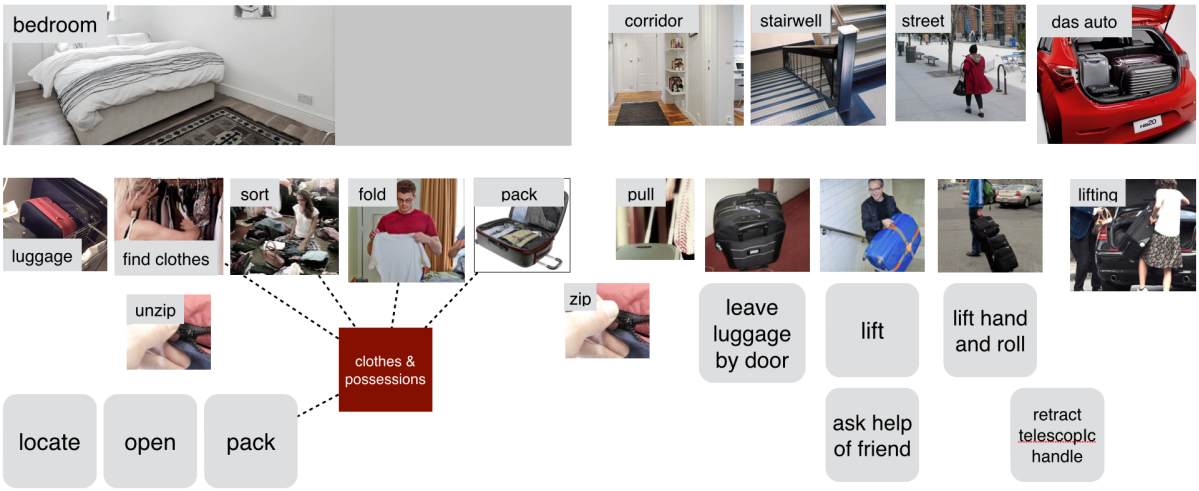


Figure 3 - User journey map

Another point that emerged through mapping, was the importance of traversing luggage up and down obstacles such as stairs; street side curbs and into the back of cars. Designing for these actions is paramount to the creation of a functional design. Additionally, zips were identified as a mechanical element, present on the majority of traditional luggage, but not recommended for Ronin. Zipping up is a symbol of readying for movement, but their drawbacks include: jamming, they are

noisy, they can catch on skin and they have a poor aesthetic. Excluding zips from the final specification would help differential Ronin from other luggage as a system more suited to home life.

3.3 Identifying opportunities - broad user definitions

Original attempts at finding the target user group are depicted in figure 4. It shows a broad spectrum of nomadic types; moving from users closer to nature on the left, through urbanity and finally financial elites. This graphical spread helped to identify the users existing in urban lifestyles with mid range income as likely users of a day-to-day luggage system, however its usefulness ended there, and more sophistication probing methods were required to find more defined user types.

Figure 4 - Nomad mapping

The creation of three broad demarcations; ‘labour force’, ‘consumers of travel’ and ‘consumers of education’ was done to separate differing user motives and values. With this understanding, a strategy for either specialisation or mass market appeal could be formulated. All of the above categories are similar in that they have issues connected to the effects of globalisation. This consideration, coupled with the core requirement to design for day-to-day use, provided the theoretical basis for inquiry.

Emphasis was also placed on the young (roughly ages 16 to 30), as the young are the least geographically settled demographic. The three categories are not exclusively independent as demonstrated by the example of a foreign student who also works. Such a broad user search was required because Ronin at this stage was more alike to a technology push product. That is to say it had clearly defined features, but poorly defined values. Beginning user type analysis with such broad definitions was done to avoid missing any critical user groups e.g. early adopters.

3.3.1 Labour force

For confirmation of an assumed mobility in the labour force and affects, statistics garnered from renters in the United Kingdom were consulted, to reveal that roughly 50% young renters from 2008 to 2013 had been renting their property for less than a year, and 30% had rented from between one and three years (Department for Communities and Local Government, 2014). So, four of five young renters had occupied their accommodation for three years or less. These figures support a generally understood trend, that the young are on the move. Within six months of renting they are more likely to move property, than to stay. However data regarding the levels of stress when moving residence and its effects is more scarce, with the most promising studies, also from the UK, only confirming that relocating for a job is stressful (BBC, 2015).

Thus one implication for Ronin is that the link between moving house and elevated levels of stress is not established in literature and the effects, if real, may not be strong enough to cause consumers to act, with a new purchase and/or a change in lifestyle, to diminish said affects. Recommendations included: avoid, in marketing and design, emphasising the benefits of Ronin as a device for the minimisation stress when moving between permanent residences.

3.3.2 Consumers of travel

Advances in technology, amongst other changes, have had effects on young travellers behaviour (Tourism Research and marketing, 2013). Todays' travellers utilise a wide spectrum of sources to organise their travels more effectively than

previously possible, travelling further, with more frequency and for longer durations. Travel has evolved from being an exclusively leisurely activity to an “essential part of personal development”. A nurturing habit which often extends into travellers’ thirties and beyond, a trend which is redefining the young traveller status from an age dependent tag to a lifestyle choice.

Some of these changes have spawned new categories of travellers with their own nomenclature. ‘Flashpackers’ are commonly differentiated from backpackers and regular tourists by their higher budgets, higher than backpackers, and staying times per trip. The group are considered travel veterans who opt for higher comfort, more authentic experiences and often bring laptops and other cumbersome technology along for the journey. Changes in the character and behaviour of travellers has also spurred industry change, which is “becoming more professional as the demands of young travellers with higher levels of travel experience become greater” (Tourism Research and marketing, 2013).

The emergence of new traveller types is a strong sign of unaddressed need, and new markets. Like the rest of the tourism industry, luggage may need to adapt to stay relevant to new user types. The question then becomes, which traveller types will be represented in the future, and which groups in particular should become the focus of this research. ‘Flashpackers' are clearly a strong contender, due to their preferences for comfort and professionalism, characteristics compatible with the first Ronin’s design aesthetic and features.

Subsequently ‘Flashpackers’ were selected as a likely primary user group.

3.3.3 Consumers of education

Students, as a group, were chosen to investigate because they exhibit many characteristics that are compatible with a luggage/ furniture product. As a group they are often young, geographically mobile, open to new ideas and lifestyle

changes, and many suffer from lack of storage and living space. Many of them can be considered travellers, moving beyond their national borders for education.

One subcategory of students is Erasmus students, a user type considered interesting due to their pronounced blending of leisurely travelling and studying. Inside Europe, 1.7 million students, since 2006, have participated in the Erasmus exchange program and the program is growing. The average stay of erasmus student is six months, and the average age 23. (Erasmus 2015). The relatively short stay time of these students raised concerns of their suitability as core influencers to the brand and design direction. As one six month trip does not define a user characteristic for life, but rather is symptomatic of pre-existing lifestyle choices.

Additionally outside of, and including Europe, numbers of international students are more than 3.7 million, and is “increasing by about 12% each year” (BBC travel, 2015). Evidence for increasing numbers of mobile students is abundant, however there is scant evidence that these same students struggle with the issues posed previously as the ‘overall problem’. Namely: lack of storage space and dissatisfaction with current luggage morphologies. Any inconveniences, on those subjects, these students face, appear to be eclipsed by the many benefits and rewards they receive from travelling to study.

Some implications: catering for students would be wise, to capitalise on their apparent nomadic characteristics and growing size, however primary research is required to test personal assumptions of dissatisfaction within the student community. This recommendation moved focus from common home owners, which was the intention of the original overall problem.

3.3.4 Summary and conclusions

Examinations into the nature of possible users types, through the use of broad definitions, was deemed to be successful, with some specific user groups testing as a positive match for primary users (flashpackers) and others testing negative e.g. a Erasmus students. More research is needed to further pinpoint the exact motives and values of specific user groups.

3.4 Primary research

This section uses primary research to refine assumptions about users by and tighten definitions of that target group. Methods include online questionnaires and examinations of users home environments.

3.4.1 Questionnaire

A questionnaire of twenty-nine open and closed questions was formulated to test assumptions about user groups. Twenty-eight respondents answered about their behaviours and preferences regarding luggage via an online form. The questionnaire was generated in google forms and promoted via Facebook. See annex 2 for more detailed responses.

Goals

Key information to find out was how users perceive and use their luggage; and what they consider an ideal lifestyle.

Sample questions:

Question 1:	Where do you keep your luggage when not travelling?
Available answers:	In a hidden place In a visible place
Question 2:	Generally on a journey would you prefer to…
Available answers:	Take more personal things Take less personal things Don't know

Results

Older respondents - above age 34, were satisfied with current level of travel while nearly all younger respondents said they wanted to travel more. Durability and flexibility were important characteristics in luggage, no respondents considered style an important factor in selecting personal luggage. Most respondents keep their luggage hidden away while it is in the home, and half of those use it as

storage. But only two thirds of respondents use their larger capacity luggage item on a yearly basis. Most respondents cited current luggage breakage as a core reason for changing their luggage. Only twenty percent of respondents said they keep their luggage around the house. Over half of respondent agreed that they do not have enough storage space. Most respondent listed losing their luggage as a troubling thought on a long journey, closely followed by extra weight fees. All respondents owned luggage.

Conclusions

Some conclusions drawn from this research, indicate that fashion was not a determinate factor for respondents, however most respondents were (self reported) on the medium to low disposable income level.

Recommendations

Ronin would be best marketed through its features than style if it is to appeal to the young traveller demographic who are often price sensitive. But as these respondent hide their luggage away, there is no need for it to be fashionable.

3.4.2 Investigations into the home

Reconnaissance into the homes of luggage users was conducted to witness first hand existing user behaviours and environments. How clothes were stored and how luggage was used in the house were chosen as focal points. Friends and family dwellings made up the sample. Some examples of findings were:

- Items placed in the corner of rooms.
- Clothes, especially shirts hung on budget telescopic rails.
- Clothes stored in three levels: shirts on top hung on a rail, next folded clothes on a shelf and lastly on the bottom shelf miscellaneous small clothing items stored in a rectilinear plastic tub.
- Luggage on its back open acting as a clothes basket for dirty clothes

Local halls of residence for students were also investigated (Siidisaba 7, Tallinn) to find any evidence of mismanagement of space. Interestingly, what was found was contrary the original assumption; that students living in halls would be prime candidates for an item offering extra storage space, lacking space themselves as

indicated by the survey. However what was found, were well thought out spaces

Figure 5 - Investigations into the home

with just the right amount of space required for students' belonging.

No extra corners in the room were available for storage, and ample cupboard space was provided. The likely reason being that students residing in halls are a well defined user category, and can therefore be designed for accordingly by competent architects. In another light, it is obvious that those lacking space, also lack the space for a new furniture item.

Conclusions and recommendations

Luggage owners with extra floor space, but not adequate storage space, would be likely users of the storage features Ronin.

Students living in halls may struggle to use Ronin's storage features from lack of floor space. However, they will likely benefit from those features when moving and settling in rented private apartments or houses, especially when those apartments are unfurnished. Therefore, if choosing to design for students that are destined for halls, Ronin's size must be constrained to fit within the storage space of the average resident student. This particular student group is important, with the individuals transitioning from a state of dependancy at the family home, a time when they may not own luggage, to a state where they require luggage and will seek out a product which meets their needs.

Additionally, the three tier clothes access (figure 5, right) is a logical and familiar way to live, and is recommended as a quality to emulate.

3.4.3 Queries about personal items.

A categorisation map (figure 6) of common personal possessions was created after consulting both male and female student work colleagues about the kind of things they take travelling. The symbols used in the map contains some clues about the rigidity of items, with squares representing more solid items like laptops, and circles generally represent more flexible ones. The laptop is the largest, most delicate, expensive and rigid item. Through this map was learned the need to provide adequate storage and protection for the laptop, as well as smaller compartments for more fiddly item such as sicks or soap.

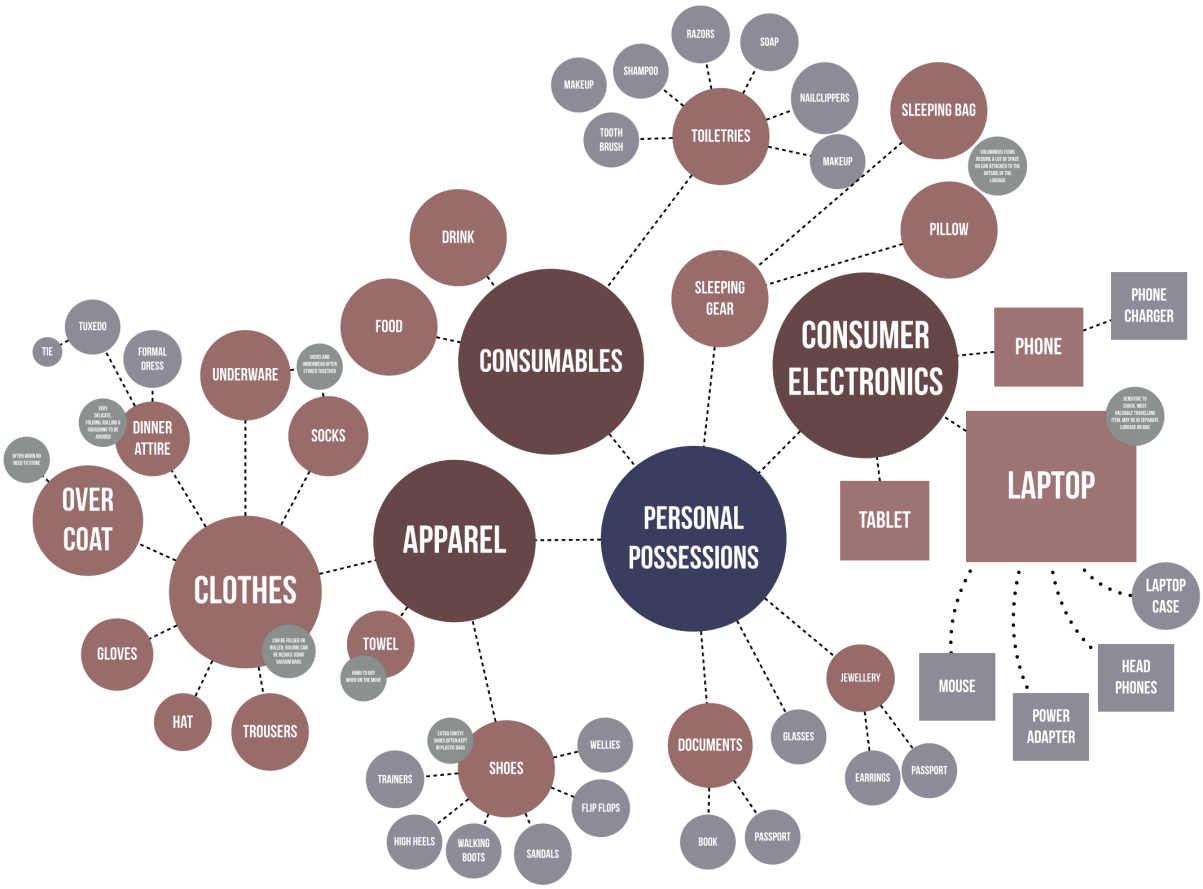


Figure 6 - Personal possession mapping

3.5 Persona development

Personas were developed to illuminate motives and desires for all three of the user segments. ‘Consumers of travel’, consumer of education and the labour force. As a research tool, personas development correlates to the identifying opportunity stage in Cross’ development model and subsequently help to clarify objectives.

Robin is a student and serves to represent consumers of education. He moved from student halls and now rents a small room in an apartment with other students. He has issues when furnishing/personalising his space as the distance from his family home coupled with his upcoming graduation discourage any purchases of physically bulky items.

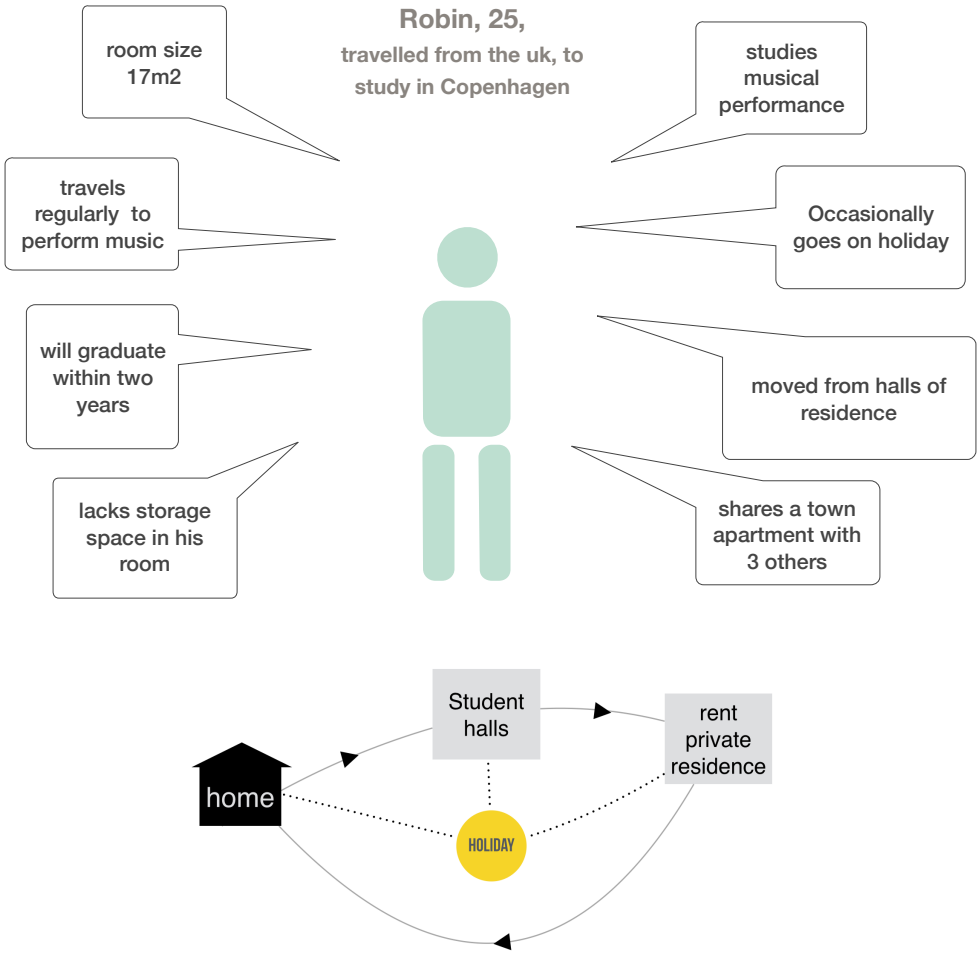


Figure 7 - Persona Robin

Mary, as a regular commuter, represents labour force, Mary resides in London as a means to advance her career and save money to buy a house. Any large purchases like expensive furniture or artwork are considered liabilities and detract from her dream of moving away. She looks forward to the weekend when she can relax out of the capital, but requires a certain level of comfort when managing her items to reduce the stress of the journey.

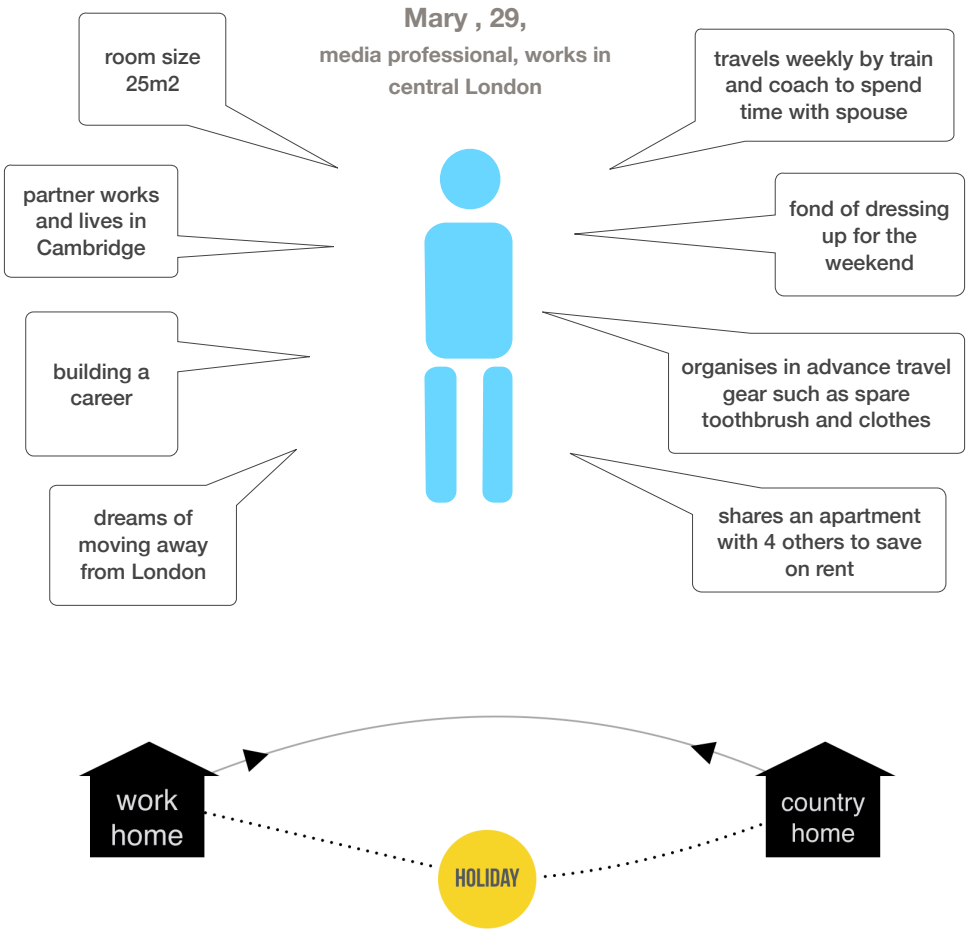


Figure 8 - Persona Mary

Harry represents 'consumer of travel'. He has a need for quick access to belongings to get out and enjoy the day, however unpacking all of his belongings on arrival is not an ideal solution as it waste his time. Style has more importance for Harry, as first impressions count for a good deal when on the move and looking to meet new interesting people.

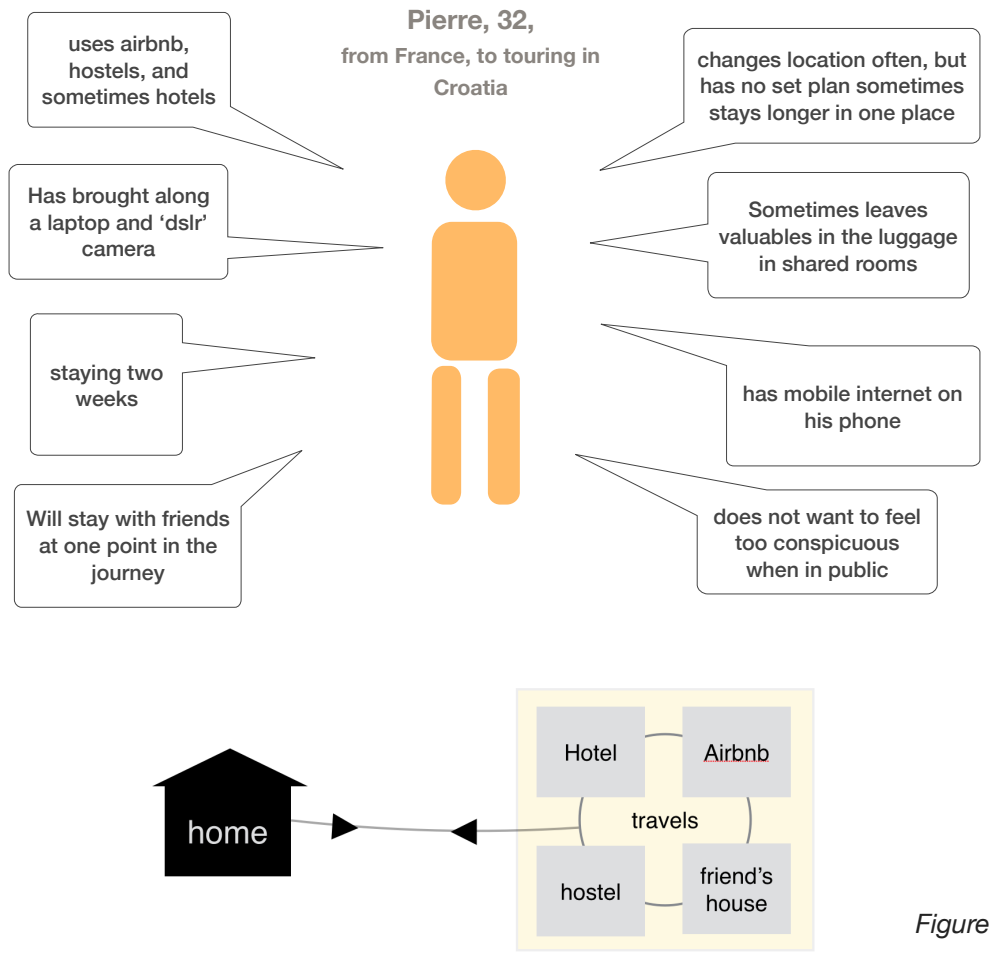


Figure 9 - Persona Pierre

Opportunities for development have been identified in this section:

-Allow users to add a touch of personality to their private space in the home.

-Provide user the ability to add storage space to their home.

-Allow users to create a 'private' space using a luggage system.

-Offer design which will be discrete in the home, hostel and on the street.

-Allow users to access what they need without needing to fully unpack

-Provide the ability to lock compartments.

-Ensure that it is rugged enough to take on a train, boat, coach or check in when flying.

To compare findings across user types, ‘consumers of travel’ would benefit most from time saved or in others words convenience. ‘Consumers of education’ with ‘labour force’ both place precedence on extra comfort as a means to civilise ‘existing in somebody else space’. Combined, the two angles equate to two strong core values that a majority can rally behind: comfort and convenience.

Through this process a strong example of a specific user who share these requirements emerged. That of the ‘au pair’, an “unmarried young adult aged 18 to 30 years, who… travels to a foreign country for a defined period of time to live with a host family”. (au pair world 2015). An ‘au pair’ would have advanced knowledge that they would be living in somebody else's space, and would plan according to ensure a comfortable stay. The ‘au pair’ makes for a good example because, as a category, it combines youth,travel,work and education.

3.4 Digital nomad

An additional user category was found through social media sites. The Facebook group Nomads has (XXX1982918 users), users share travel tips and stories in a global community. Awareness of the term digital nomad arose from usage on this popular forum. It is a term which is growing in usage across the internet. Below is example post from Facebook, it provides useful insights into user requirements. It is also fascinating that the term Digital Nomad is self applied, implying a certain value in imbuing a product with this movement.

“(THAILAND - DIGITAL NOMAD RESEARCHER)

Hey guys, Me and my girl are structuring our business in order to put it on road later April next year, we are located in Europe, but want to hit southeast Asia for two motives; Cheaper and great culture shock.

Our company is based in culture research and for that we want to travel through SEA starting in Thailand. The hard question is where to start, since we would like to stay at least 3 months in the same place and also live in different regions, in order to get in touch with locals and learn / explore as much as we can of the Thai culture.

Must:

Good internet access (our business runs online);

Less touristic areas;

Being on / close to the beach is preferable, but not mandatory;

We also would love living with local people as guest family or culture exchange houses…2”

(Facebook 2015)

It is clear, that with the digital nomad all three user categories are combined. As they researchers, setting up a business and travelling. Digital Nomads therefore are a strong match as primary users, and individual who consider themselves as Digital Nomads can provide useful feedback in the creation of a travel product which suits their needs.

3.4 Macro trends - luggage market

An understanding of trends was deemed important for this research, and indeed any research that aims to provide solutions, as any realised design proposal will exist, and should attempt to cater for, the future world. A world which, depending on the length of time to market, may differ considerably from the present one. This section uses published statistics and primary sourced survey results to explores trends and changes in the luggage market as well as wider social, economic and technological changes. The aim to help identify a user group which may qualify as a new market.

'By 2015, the global luggage market is forecasted to generate about 31.62 billion U.S. dollars' (Statista 2015) a truly sizeable market. Ronin, as a luggage item, must contend for a share of this market.

Analysing the global growth trends in the luggage retail sector per region reveal the largest growth sectors, by far, are in China followed by India (see annex table 1). The following section will use China as a case study to help reveal information about why this may be the case, and the implications for this research.

Growth in China's domestic luggage retail parallels the steady and rapid growth in China's GDP beginning the early nineties (world bank 2015). GDP as a measure of countrywide economic success may not necessarily reflect wide income distribution, but the fact that China 'cut its poverty rate from 84% in 1980 to about 10% now' (The economist 2013) is evidence of wealth trickling down.

The figures tell a narrative of wide spread social strata in Asia, formerly too poor to travel (in the manner of the west), and to purchase travel accessories such as

luggage. This emerging consumer class are now purchasing luggage, and their purchases serve as a symbol of recently attained geographical and economic freedom.

Conversely the relatively slow, but steady, growth of luggage retail sales in the western nations serves to indicate a certain level of market saturation. Additionally according to the results of the primary sourced study four fifths of respondents, all of which reside in the west, said they would only acquire new luggage if their existing system broke down (see annex 2)

Figure 10 - "Building bridges with fashion @ Opening Fashion Show of the Eurovision Song Contest Village"

(Facebook samsonite official 2015)

Luggage, as a low technology, does not follow the rapid rate of redundancy present in other sector like information technology. Larger luggage retailers operating in the west, act in manner suggestive of an awareness of this fact. Such retailers are pushing fashion, style and features to sway consumers into purchases they might not otherwise make (see figure 10).

Further analysis of the luggage market reveals a fragmented spread of market share (see annex 1, figure 2). The largest company Samsonite/Tourister generating 9.6%, but interestingly 82% of the global market generated by mysterious 'others'. This is further evidence of the low barriers to entry in the luggage market and a positive sign for prospective entrants to the market.

3.5 Stakeholder and product lifecycle mapping

The product life cycle was mapped in order to identify various stakeholders that exist at different stages of the luggage life span. Through mapping in this method the distribution stage was highlighted as a point of interest. This observation arose through an understanding of multinational group 'IKEA' and what differentiates them from their competitors. IKEA specialise in the design and sale of ready-to-assemble furniture, offsetting the costs of assembly to the consumer. One of the major costs minimised is associated with physical space. Flat packs reduce transportation costs and enabling retailers to stock more products with less shelf space. An additional offset cost is labour costs: this is due to consumers self assembling products at home saving IKEA both money and time. The consumer is often happy with the trade off as they can save twice. Firstly from lower prices at the cash register from IKEA's minimisation of costs; and secondly on delivery costs: by fitting furniture into their own vehicles and through the door of their houses. Luggage is also, comparable to furniture, a bulking item and could reap many of the benefits IKEA did if designed in such a way to sell the final product in flat pack form. Other opportunities identified through mapping centred around the eco-friendliness of the product. To give an example: carbon fibre were considered for use in the luggage due to its high strength to weight ratio but through an understanding of stakeholders

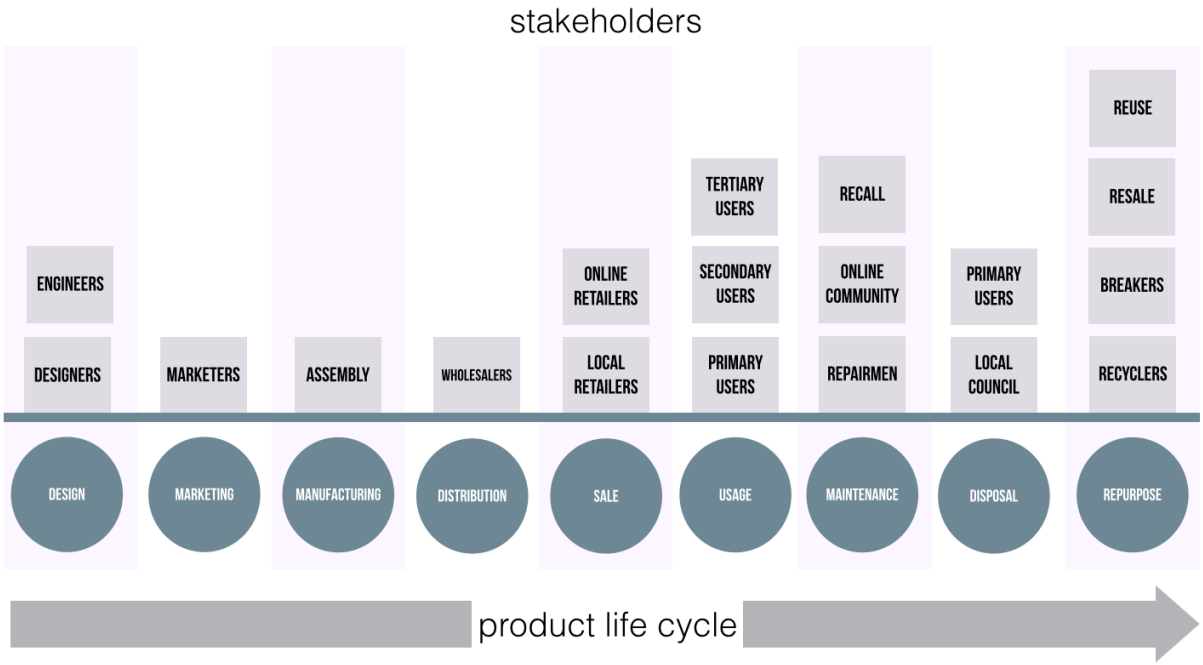


Figure 11 - Stakeholders & product life cycle

Figure 12 - exploded isometric, original Ronin

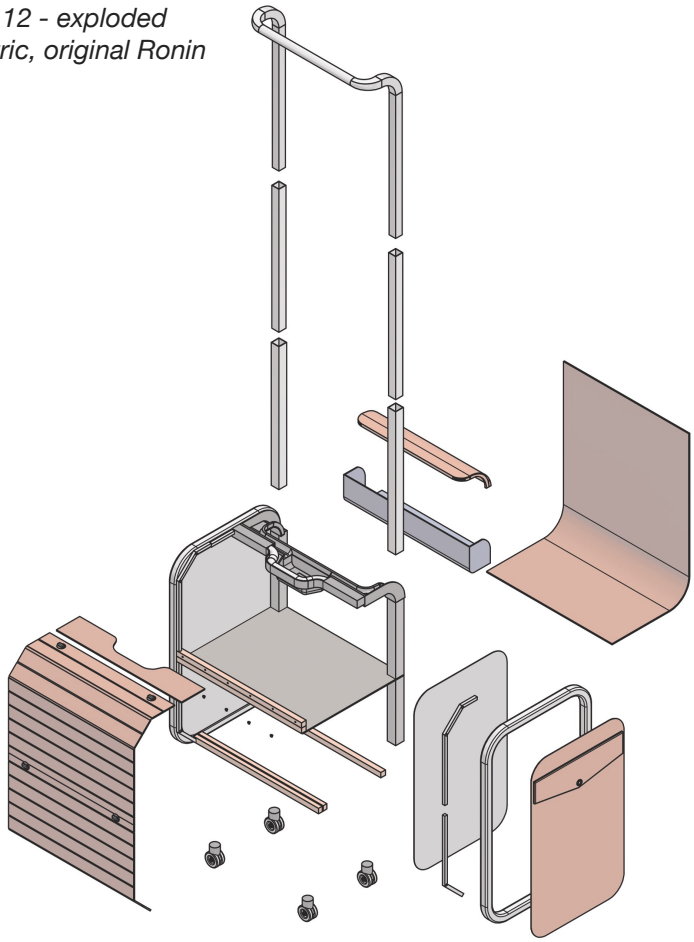


Figure 13 - Perspective view, original Ronin

in lifecycle its poor recyclability was made apparent.

3.6 Conclusions

Through research the following points were concluded, and have implications for future development:

User groups

User types exist that exhibit many ideal characteristics required of a primary users group for a deployable luggage system, examples include, Erasmus students and Au pairs; however, on their own, these groups lack the size and longevity to mark them out as focal primary users. Instead a more broad user group was targeted. The target user group contain sub-categorisations including:

- **Flashpackers**: Experienced, tech savvy, on tour, with a budget.

- **Commuters**: Regularly travel between two or more places they would call home.

- **Digital nomads**: Using modern tech to work on the go, and call no place home.

- **Students**: Have left home, uncertain of their future location and circumstances.

4. Previous design

4.1 Previous progress

This section will outline in detail the many design elements which made up the previous iteration of deployable luggage, evaluation of the design is a later section. The design structure centred around two bended filleted profiles that provide structural support to enable frontal access and bare a mid-height shelf. A plastic moulded glove compartment, accessible from the top of the luggage, resolved the negative space left by a sweeping rail cantilever. This cantilever was designed to bring the mass of the clothes closer to the centre and limit the likelihood of an extended and loaded rail tipping the luggage rearwards.

The two front compartments were secured by a set of coverings/doors that were inspired by apple iPad smart cover. (see figure 14) Like the iPad cover the design

Figure 14 - Apple Ipad cover

attempted to capitalise on the benefits of a composite material. A composite that utilised the flexibility of Fabric (alleviating the need for mechanical hinge details), and the solid sheets for shock resistance and form. The luggage door function was also similar to the iPad cover, with the door folding/rolling into triangle formations to limit the door interference when open.

Castor wheels were chosen for mobility, and were fastened to square profiles visible in figure 12. Side compartments for wider items (a4 documents/ laptops) were positioned in the space inside the bended support frames. A bended circular profile aluminium handle was designed for close quarter lifting and moulded plastic was formed around it, to provide a recess for hand access. Telescopic rail function

allowed for an extension of 80cm above the luggage height, to provide ample space for the hanging of medium to short length garments.

The luggage central compartment was divide into two spaces. The top space was designed to provide easy access and sight lines into the luggage. This was achieved by wrapping the top door over three planes across the top corner facing the user. Access to bottom compartment was a achieved with the addition of a sliding box, which would function in a way similar to traditional drawer. Lateral stability was achieved with a moulded plastic shell (visible in figure 12), that most likely would have been glued to the bended profiles, this sheet would act as the floor and rear wall of the luggage. The flexible front panels were permanently fastened with rivets at the lower end and fastened temporarily with rotating knobs (pictured in figure 16). The flexible covers rested upon an inner metal rail visible in (figure 17)

4.2 Brief evaluation

Technically speaking the lower compartment contains the most apparent design inefficiencies. Inefficiencies that detract from the usability of the object. The font lower door requires two separate clips for tensioning and a locking mechanism, adding to total weight and user actions required to lock the entire luggage system. Furthermore if a user were to open this panel and attempt to access their items by sliding the tidy box outwards, two more issues become apparent. One: The weight of the tidy box would not be supported as extends outwards and therefore the tidy box would fall to the ground and two: The flexible panel would droop to the floor, an unaesthetic solution. Both scenarios are exacerbated when attempting to open the bottom compartment in a public space - the panel would trail on the floor, and the tidy box would slump in plain view. Note that the spinner wheels are not visible in figure 16 and 17.

Figure 15 - Perspective view in context, Ronin

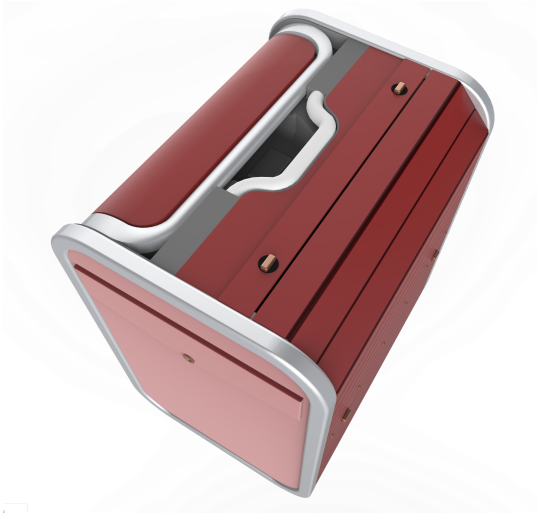


Figure 16 - Perspective view top, Ronin

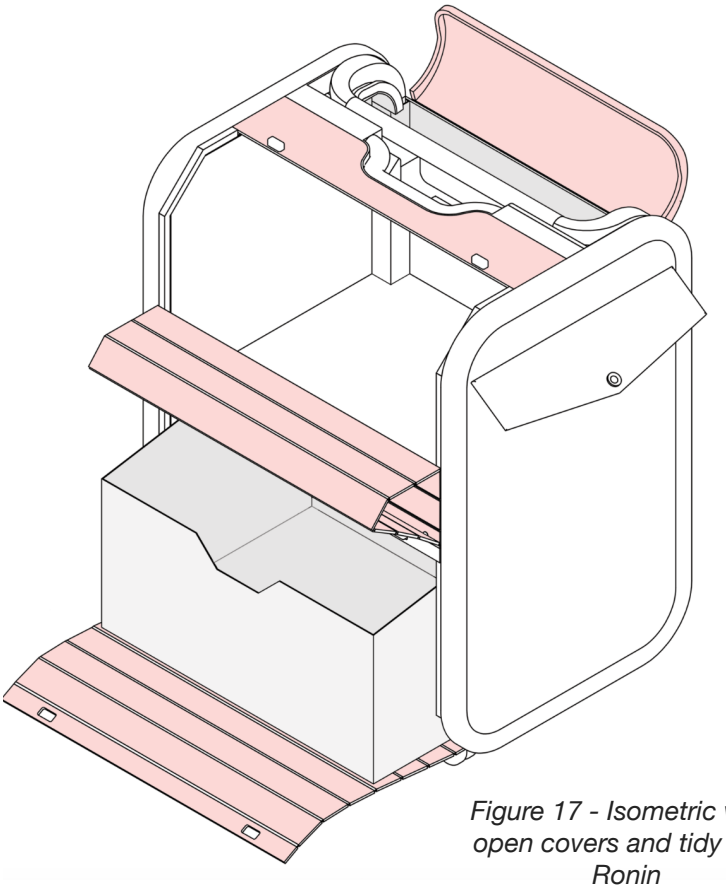


Figure 17 - Isometric view, open covers and tidy box, Ronin

5. Marketing and development strategy

Marketing theory was used in this section as a means to broaden understanding of development goals in the context to existing market realities. the section uses the theories of Nigel Cross to help correctly position developmental efforts

5.1 Overview of development

Following precedents of the evolution of luggage, ‘incremental innovation’ was selected in favour over ‘radical innovation’ as the developmental goal. The development history of luggage is incremental in nature, as luggage as a category, is a low-to-medium technology industry; ’an industry generally characterised by incremental innovation and adoption’ (The innovation policy platform, 2013).

A quick scan of the development of luggage in modern history reveals perpetual technological progression (Annex 2). Subtle changes such as the addition wheels; telescopic handles and adoption of new materials like polycarbonate, have all steadily but permanently changed the morphology of luggage.

Contemporary attempts at incremental development in luggage can be witnessed on crowd sourcing platform ‘Kickstarter’. The submissions, uploaded by independent designers, are further evidence of the low barriers to entry in the luggage market. These designs provide useful insights to current values and offer a glimpse of a potential future luggage morphology. On Kickstarter, and other similar platforms, independent designers are actively incorporating ‘disruptive technologies’ into luggage. Disruptive technologies such as lithium Ion batteries and smart phones are integrated to offer new features to luggage users. Some examples include luggage with GPS tracking to minimise the likelihood of luggage loss/theft. Another addition, self weighing luggage, is a direct response to restrictive weight requirements on luggage imposed by airlines. These inventions, will only be considered a success if adopted by consumers on a mass scale, which is by no means a certainty.

So far, large-scale luggage manufacturers/retailers have been slow to develop their own luggage brands in this ‘smart’ direction; but will no doubt respond if ‘smart’ luggage proves popular with consumers or risk diminished market share. This thesis takes a similar stance, and forgoes inquiry into the exciting prospects digitisation, focusing instead on providing users with new experiences with their luggage. However, usage of digital technology is a defining characteristic of modern user types; but to what extent technology must be incorporated to all aspects of design and life, is a matter for public debate.

5.2 Market positioning theory

Insights learned in previous sections regarding user groups and macro trends, provide the foundation to mount a search into Ronin’s position within axes of varying development types. This was undertaken as a means to contextualise any developmental efforts, and fully comprehend the forces which enable successful adoption of new products in the market place. This was considered important due to the nature of the thesis proposition, which is an attempt to fuse two traditionally separate product categories into one new category. The very real danger being, the new product fails to cater for users needs, by performing poorly in both categories.

The previous iteration of Ronin was used in conjunction with other designs that display similar cross-pollination of furniture and luggage, to evaluate success or shortcomings in defined categories and subsequently plot position as either product renewal, product development or product innovation.

Product innovation/ radical innovation occurs with combination of high levels of two forces: market pull and technology push (see figure x)(Nigel Cross 2008). Product development however occurs under two differing sets of conditions. One set of conditions: either mid to low level market pull forces combined with strong technology push. A second set of conditions: high levels of market pull combined with a low to mid range technology push. If both market pull an technology push forces are weak, product renewal occurs.

Ronin aims to achieve the second set of conditions necessary for product development, through identifying strong market pull forces combined with a moderate technology push, most likely a reconfiguration of existing technology.

New markets can be said to exist with the identification of a new user group. A user group, for the purpose of this thesis, is defined as a set of individuals that share meaningful commonalities. For the user group to be considered a new market the group must either be newly identified, or identified but yet to have their common needs & desires catered for.

5.3 Ronin evaluation and positioning

Design objectives were created as a measure of success and comparison. Categories were generated through a combination of common consumer requirements i.e. low weight, and characteristics considered strategically important for Ronin i.e. ability to act as a wardrobe.

The full list of categories is as follows:
Low weight; projection of the brand through aesthetics and function; low manufacturing costs; robustness during travel; mobility and function as a wardrobe.

To meaningfully evaluate the success of this iteration it must compared it to its competitors. To identify market competitors, the market position of Ronin must be identified. As illustrated in (Annex 3) the target market position lies under transformative/ multiple use; and more specifically luggage with wardrobe functionality. Thus in order to evaluate success Ronin must be weighed against competitor designs which, exhibit a combination of luggage and wardrobe functionality. Searches of existing and unrealised products yielded the following designs (see figure 20) which meet the two required criteria. The sample also include archaic and luxury niches examples.

Figure 18 is calculated according to Weighted objectives model (Nigel Cross, 2000). The weighted objectives model was used to add sophistication and customisation to the comparison by allowing weight to be added to strategically important characteristics.

To explain the numbering system, number four grade represents top mark in any category i.e. the number four in the low weight section represents that the luggage has a low mass, a desirable attribute of luggage. Zero is the lowest mark and this scored in any category represents a failure to add value to that category.

Extra weighting was given to four of the six categories. Fifty percent extra weighting was given to three categories. Note that figures are estimations due to the conceptual nature of many of the systems.

Low weight: To reflect the affects on mobility and potential increases in cost when flying.
Aesthetic relating to brand: To reflect the importance of create brand loyalty with the niche market.
Mobility: The ability to conveniently move the luggage is paramount to overall function, moreover if mobility is clumsy or malfunctioning it will be advertised to the public, eroding brand value.
Wardrobe function was weighted with an additional one hundred and fifty percent, this is due to the fact that, if successful, these luggage items will be used in the home as a 'wardrobe' for a much longer time period compared to their time used as luggage. It is also the only differentiating factor between this particular product category and the countless others, and if performance is poor in this category then consumers will be deterred from adopting.

Results and conclusions

Results of the matrix (figure 20) show that the Ronin iteration barely distinguishes itself from the competitors reaching 72% of compatibility with design objectives. Luckily the two nearest contenders, both at 71%, exist only in conceptual form with no detectable signs of future manufacture. In third place comes the traditional luggage with spinner wheels coupled with frontal access which performs well in all categories but that of wardrobe functionality. In this regard number six serves to represent the majority of luggage which are often put to use performing auxiliary duties around the house, i.e. storage for shoes or dirty laundry.

figure 18 - Weighted matrix calculations

NO.	LOW WEIGHT (KG) (X 1.5)	AESTHETIC RELATING TO BRAND (X 1.5)	LOW COST TO MANUFACTURE	ROBUSTNESS DURING TRAVEL	MOBILITY (X 1.5)	WARDROBE FUNCTION (X 2.5)
1	3	3	3	3	2	3
2	4	1	4	0	4	1
3	2	3	3	3	3	3
4	0	0	0	4	1	4
5	1	1	1	4	2	4
6	3	2	3	3	4	1
7	2	4	2	3	3	3

figure 19 - Product innovation, development & renewale

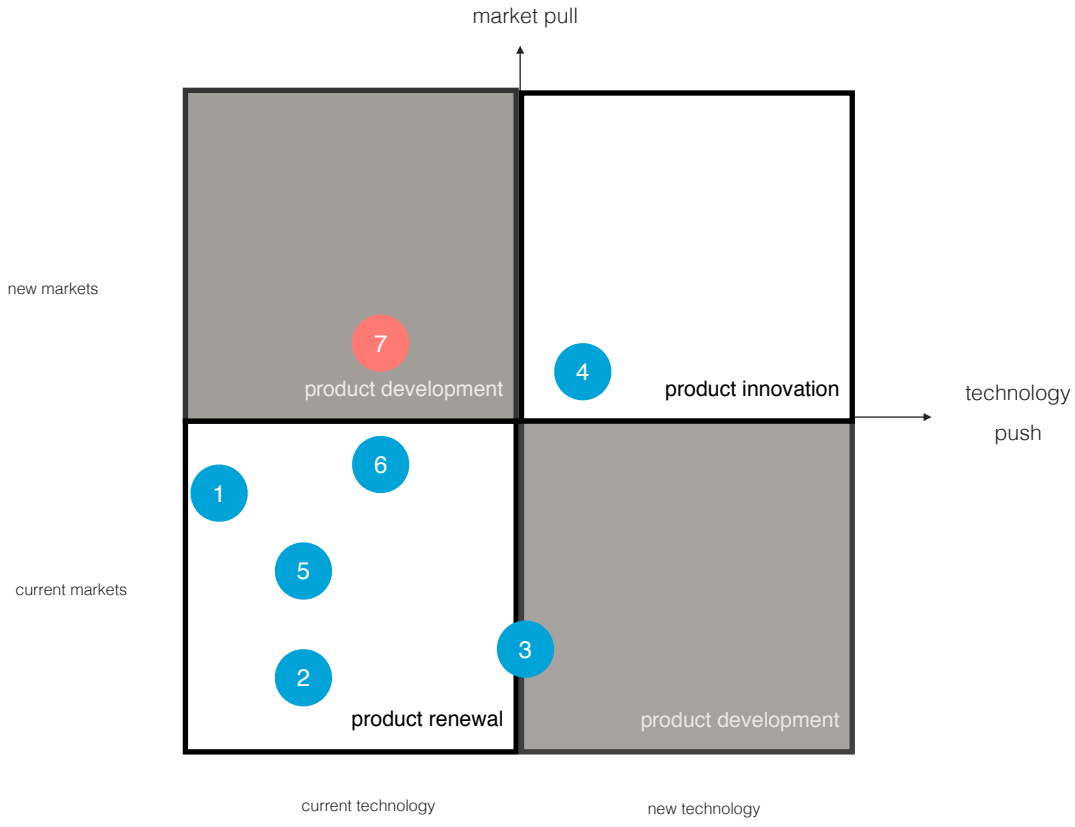


figure 20 - Weighted matrix featuring first iteration of luggage

NO.	TITLE	IMAGE	DESCRIPION	WEIGHTED RESULT (% OF OPTIMAL)
1	Living bag		Concept design only. A folding wheeled suitcase that when leaned on to a wall provides a soft interior and hanging area for suits and other longer garments.	71%
2	Rise and hang duffle bag		This travel bag sports a hanging shelf but requires a horizontal bar on location at a certain height to allow for hanging and easy access for the user.	56%
3	Travelling Closet		Concept design only. A low profile set of drawers on wheels. No indication of locking mechanisms or the resolution of the corner detail where the two wheels are present. Limited storage capacity with the division of space into three.	71%
4	Luis Vuitton		Vintage travel trunk with vanity area, clothes hanging area and plentiful drawer space.	43%
5	Method studio		A modern interpretation on the Vuitton trunk. Pine construction, latches. swivelling miniature compartments and an extendable table make for a vanity area. tensioned flexible strings create a storage area for smaller garments.	58%
6	Upright luggage case		Traditional luggage, with limited frontal access pouches.	61%
7	Ronin 1st iteration		Ronin - design emulates modern standards of luggage but with the addition of frontal access. Mobility provided by a set of four spinner wheels.	72%

The results indicate the scarcity of affordable systems that provide quality ‘wardrobe’ functionality coupled with light weight enclosure & mobility. The results also reveal opportunities for improvement to distinguish ‘Ronin’ above its competitors through improvements in all of the design objective categories (excluding adherence to brand). The largest gains are to be had reducing the weight, improving mobility and a strong push to be the clear cut market leader in wardrobe functionality for a luggage item.

5.4 Competitor positioning, product renewal, development and innovation.

It is the intention for Ronin to forgo attempts at, the difficult to achieve, radical innovation, and aim to lie within the bounds of incremental development.

The term incremental development is synonymous with product development. In referring to figure 19. Two quadrants on the graph are titled ‘product development’, this is case as there exist two routes to achieve product development, either through a technology push or through catering to new markets.

Ronin, listed as number 7, is positioned in the product development category on the market pull side. This is the case because Ronin aims to respond to a perceived market gap, with only a moderate reconfiguration of existing technology. If Ronin was to synthesise emerging technologies into the design, such as GPS, its position would move to the right. That outcome is desired, but is a long term strategic ambition.

In mentioning the positions of competing designs, most fall within the category of product renewal, due to their lack of technological prowess and lack interest from the market. Number four however, constitutes innovation, or at least of the time of its sale. Catering for new markets, passengers on time consuming boat trips across the ocean, with new levels of craftsmanship and features.

5.5 Market categorisation & consumer preferences

Market research of luggage categorisation within retail was conducted, in order to find how, both retailers and consumers, view luggage in terms of defining features and functionalities. Online retailer 'luggagepros' online web shop was used as a typical example of categorisations in the market (luggagepros 2015). The following headlines are categories of luggage present within a drop down menu available from the homepage of the website:

- Carry-on-luggage
- Designer Luggage
- Garment bag
- Hardside luggage
- Leather Luggage
- Lightweight luggage
- Spinner Luggage
- Travel Tote
- Rolling Luggage

The categorisations reveal which features are important for consumers to differentiate between luggage. They can be broadly understood as offering either distinctive functionality or appearance. The particular categorisation garment bag was considered interesting as it may reveal insights about familiar methods of storing and accessing garments, a key focus of this thesis. The website describes a garment bag as "used to keep clothing flat, clean and wrinkle-free during travel" insinuating a travel accessory for those needing to look smart for example, business travellers. Other intriguing points are the distinctive preference for Spinner wheels and case of solid material (Hardside, usually referring to polycarbonate).

The logical question was, which, if any, of these product categories would Ronin belong to. Clearly Ronin fits among rolling luggage, which is the broadest of categories. But no others. Some suggestion titles include: furniture luggage, deployable luggage and luggage for living.

To establish consumer trends a search was conducted of best sellers in the luggage department of online retailers Amazon. The results: All top five sellers were spinners and carry-on-luggage. Four of the top five were polycarbonate (hardside luggage). The combination of polyester casing (soft) and inline wheels, technology popularised in the nineties, resulted in prices less than half of Hardside Spinner models. (Amazon 2015)

This would suggest the most popular morphology is carry-on, polycarbonate with spinner wheels. That said the requirement for the majority of travellers differs from the focus niche segments outlined in the research stage. These findings can help contextualise any design choices regarding functionality, material selection and mechanical elements, even if choices are made contrary to popular tastes.

5.6 Branding progress

Ronin was the name selected for the luggage in the previous iteration. A name inspired by a particular group medieval samurai renown for their masterless status and roaming lifestyle. The intention of the name being to ascribe noble qualities to the nomadic lifestyle more usually synonymous with more impoverished circumstances.

5.7 Conclusions

Many indicators learned from this marketing section, point to China and India as the best locations to sell luggage, if bulk selling is the aim. The market also reveals a lack of a suitable category of luggage, which Ronin could occupy, meaning Ronin may have to exist as a niche offering. There has never been a better time to offer niche product, with global distribution networks and the Internet connecting buyers and seller with ever greater efficiency. Findings in the marketing section elude to a possible problem in future product distribution, where a non-standard sales model may have to be adopted to reach consumers e.g. webshop selling direct to consumers.

6. Setting requirements

6.1 Re-evaluation of overall problem and solution.

The user group is made of: Flashpackers, Commuters, Digital nomads & Students which hence form will be termed ‘Urban Roamers’. For a more detailed description of what constitutes these individual sub-groups consults section 3.6.

Overall problem:
Urban roamers do not have access to luggage which caters to their needs.

> **Sub - problem**
> Urban Roamers waste unnecessary time packing and unpacking their luggage.
> **Sub - problem**
> Urban Roamers sometime operate/live out of luggage, and currently it is an undignified and clumsy experience.

Overall solution: A luggage item that caters for needs of Urban Roamers.

> **Sub - solution:**
> A luggage item which remains packed and accessible.
> **Sub - solution:**
> A luggage improves access to personal belongings.
> **Sub - solution:**
> A luggage item which performs well as a travel item.

6.2 Additional constraints

-According to ‘britishairways.com’ A checked bag can be up to 90cm x 75cm x 43cm

6.3 Project brief

The following brief outlines requirements and aims of Ronin and is a product of all previous design exercises. The primary concern of the brief is to design a luggage item which caters for the needs of Urban Roamers by demonstrating the following:

- **Designed to remained packed and accessible**.
    - Compartmentalisation of internal storage.
    - “Feels’ more comfortable amongst household decor.
        - Will fit in a bedroom/corridor/living corner.
        - Use of homely materials and technology.
            - Access mechanism suitable for home use.

- **Improves access to personal belongings.**
    - Allows users to store, view and access their items without straining.
        - Has three tiered access.
        - Provides a method of hanging clothes.
        - Has space and provides good access to a laptop.
    - Generous quantity of storage space.
- **Performs well as a travel item.**
    - Design aesthetic suitable for public view.
        - Discretion regarding revealing wardrobe/closet functionality.
    - Can navigate difficult terrain (curbs, cobbles and stairs etc).
    - Can be hoisted into vehicle or on to high shelves.
    - Will pass airport security screenings.
    - Can easily be locked and unlocked.
    - Total weight is not overly burdensome.
    - Has a long life span
        - Can withstand shock (being dropped).
        - Can be repaired
    - A certain level of water resistance.
    - Is compact.

7. Value proposition

Below are the four user types of Urban Roamers and their corresponding value propositions.

Digital Nomad

- Feel a sense of home, and organisation, which are lacking as they are always on the on the move.
-Provide a house for precious gear

Commuter

- Always feel ready to switch houses
- Saves time through increase convenience
- Provides a short term fix to a long term problem.

Student

- To add furniture where there was none.
- Add a level of security

Flash packer

-To travel in style and comfort

8. Design development

The design development stage documents the processes taken to improve on the first iteration Ronin, which scored 71% satisfaction of design objects (objectives set in the marketing section). This section aims to improve the design by using the more refined definitions of user types and by adhering to requirements set in the brief. This section includes matrixes, comparisons of viable solutions and graphical material documenting the evolution of design.

8.1 Elemental break down

To simplify design development, design tasks were divided into three broad categories. Two of the chosen categories correlate to the two main functional requirements of traditional luggage, which are: to contain and to transport. The third relates to Ronin's requirement to increase levels of access and convenience to user in the home. Aesthetic considerations permeate all categories.

Note, the three categories overlap in some instances and are interdependent, for example, in selecting the optimum material for strength (enclosure), it may raise total weight and in turn negatively affect transportation.

The divisions are:

A) Transportation :Includes user experience whilst travelling with the item. Major considerations include wheel design, handles and telescopic function.

B) Enclosure: Includes the ability of Ronin to withstand external shocks and to adequately contain forces from stored items as well as user access.

C) Stationary functionality: How to use Ronin day to day whilst it is deployed in the home.

*Resolving the hand rail/clothes rail mechanics (Locking, lifting, load bearing capabilities and balancing).

8.2 Transportation

Design development of the elements which are necessary for transportation are outlined in this section.

8.2.1 Transportation physical usage tests

A physical model was used to test steps that were outlined in the user mapping section, such navigating stairs and carrying. Previously unforeseen methods of lifting were were revealed during this exercise. One example as seen in (figure 22) was carrying the luggage two handed at chest height supporting the weight from below. A second example was the possibility of using existing side rails as a set of symmetrical handles, using the strength of the rails and supporting the weight from above (figure 23). Figure 24 also demonstrates the feasibility of a rail that curves toward the centre of the luggage also functioning in its ability as a handle to with the luggage tilted forty five degree towards the user.

Figure 21 - stair pull, physical model

Figure 22 - two hands, physical model

Figure 23 - two hands, physical model

Figure 24 - tilt, physical model

Stress points were noted where luggage owners may attempt to roll the luggage up a step (figure 21), suggestions to avoid damaging the area included a scape proof

cover either localised or even covering the entire rail. The scenario pictured in (figure 21), that is elevating the luggage over obstacles through use of the telescopic handle, is never recommended in traditional luggage. However unbeknownst users continue to use the telescopic handle for lifting forces it is not equipped for.

An additional idea which emerged through testing was the possibility of designing the side rails to encourage sliding. Carpeted stairs, present in many homes, provide a soft surface which aluminium rails could possibly glide over. Snowy conditions may present similar low friction conditions, possibly hindering the use of wheels and forcing users to improvise by turning their luggage into a temporary sledge. The creation of a versatile product rests on understanding as many of these conditions possible and designing for them ahead of user mishaps.

8.2.2 Wheel type selection

There are two competing wheel designs utilised by the majority of modern luggage. The two systems can be observed at any luggage retailer. Firstly there is the inline wheel type, which gained popularity in the early nineties (figure 26),, which uses similar components to inline roller blades (appendix 2). Secondly there are the spinner models, four or eight castor wheels at the luggage corners (figure 2).

Figure 25 - Spinner wheel type

Figure 26 - Inline wheel type

The two different designs offer their own distinct benefits and drawbacks, with no one design trumping the other in all categories, however as noted in the market research section, modern preference is for spinners. Below is listed the general benefits & drawbacks of both types, which was important to consider when

designing the wheels. Observations are gathered from personal interaction with the two luggage types.

General benefits of spinner wheels

Multidirectional movement	Castor wheels placed on the corners of the luggage provide unparalleled manoeuvrability on even surfaces.
Less physical effort required for movement	With wheels placed in the four corners, the luggage can stand upright and move simultaneously. The wheels bear all the luggage weight leaving the user to steer unburdened of the load.

General drawbacks of spinners wheels

Vulnerability to damage	Protruding exposed wheels can often bare the brunt of a external shock and depending on build quality, are prone to breakage.
Terrain limitations	The often small wheel diameter render traversing rough uneven terrain a difficult task. Obstacles such as high curbs can present problems.
Instability	As the wheels operate in all directions, a sufficient slope in terrain will result in an unrequested moving luggage item.
Lower travel speed	Smaller wheel diameter also limits travelling speed, as the wheels must rotate at a higher rpm.

General benefits of inline wheels

Concealed appearance	In most models of luggage the wheel is largely concealed in the wheel housing providing a clean aesthetic.
All terrain	This wheel configuration is more robust at handling environmental obstacles: pebble, snow, curbs, cobbles etc
Speed	A combination of large wheel diameters and that they are pulled whilst tilted results in higher attainable speeds.

General drawbacks of inline wheels

Inflexible manoeuvrability	They have a larger turning circle, plus you cannot push these luggage items and they can only be moved in a forward direction.
Physical strength required	As the luggage has to be tilted to allow for movement, some of the weight has to be borne by the user. If the luggage is heavy, it can be a considerable load.

Ronin is a synthesis of two usually separate functions, luggage and wardrobe. The selection of a wheel type must consider both sides and the relevant requirements as set in the brief. Below are the brief recommendations that relate to the wheel design:

- **Can navigate difficult terrain (curbs, cobbles and stairs etc).**
  Inline wheel though they lack the manoeuvrability of spinner wheels are the clear winners in this category. Inline wheel often have an armoured area above the wheel, pictured in (figure 26), this allow use to pull the luggage up stairs or curbs. The rail design used in Ronin if made from the correct materials can act in this fashion. The larger diameter wheels present in the inline variants can also be hidden inside, allowing the luggage to roll over small stones etc.

- **Total weight is not overly burdensome.**
  Current design has two supporting rails on both sides. If opting for spinner wheels, some ingenious way of incorporating four wheel units into the bent profile will be required or wheel will have to placed more centrally as in the first iteration. More centrally located wheels will also require more structure to screw into, adding to total weight with aesthetic gain.

- **A certain level of water resistance.**
  Both wheel designs will have to exhibit the ability to withstand water and dirt. Spinners have an advantage in that the luggage is raised above the ground away from contaminants. if opting for the inline type, an internal mud guard may

be required.

- **Provides a method of hanging clothes.**

  The stability of system when loading the rail is highly determined by the selection of wheels and wheel housing design. Selecting spinner wheels would result in a less stable system as any weight differentials in the luggage would be exacerbated by the fact there is no grounding. One potential solution could be to opt for spinners and to apply brakes to add stability.

- **Use of homely materials and technology.**

  A wheel design which is discrete is a benefit in this scenario, as it will allow the luggage to blend more easily with the surroundings of the house. Inline have the clear benefit in this category, as a large proportion of the wheel and housing can be hidden inside the luggage.

- **Be compact**

  Inline wheels protrude less, and make for a neater overall finish, something important for storing the luggage and travelling with it.

  - Can with stand shock (bring dropped)

  Both spinners and inline wheel types suffer from damage, how ever less wheels equates to less vulnerable corners to hit.

  - Can be repaired

  The ability to remove the wheel and replace is the most important consideration to ensure that the wheel unit can be repaired in the event of failure, which could include issues with bearings, foreign objects jamming the wheels and wheel breakage.

Conclusions

Inline was selected over spinner as it won out in more categories, the most

influencing factors being suitability and superior performance regarding clothes rail functionality, homely aesthetic and compactness.

8.2.3 Product availability

Searches of manufactured wheel units was conducted to gauge levels of compatibility of a standard wheel with Ronin. ‘saddler.co.uk’ was consulted as they specialised in replacement parts for existing luggage. This provided details into industry standards and opened the possibility of buying off-the-shelf parts and reducing overall cost. Individual designs were used for a more detailed analysis.

Looking at figure 27, the wheel is completely exposed, one benefit is the reduction in the chance of small items jamming. One draw back of this design is that the wheel is visible and may detract from the clean aesthetic required in the home. The finish is also low grade, with a black polypropylene as material for both wheel and chassis.

Figure 27 - Delsey Seascape Suitcase Wheel

Figure 28 - Delsey Seascape Suitcase Wheel unit

The second design features a more contained wheel, with an internally located mud guard. An elongate domed arch, positioned above the wheel, creates a reinforced protective shell against the hard knocks of curbs etc. This design exhibits desirably imitable qualities, but it lacks the fines in the connection details, and materiality may detract from the luggage overall aesthetic as a homey Item.

Following these searches it was decided to design a bespoke wheel utilising many of the qualities demonstrated in figure 28. All concerns outlined in the brief are still relevant to the design of this wheel unit. It was decided to design the wheel chassis according to the constraints of a selected wheel.

8.2.3 Wheel selection

In wanting to increase the ability of Ronin to tackle environmental obstacles, wheels were sought out with a large diameter. Searches conducted on 'saddler.co.uk' reveal the largest diameter arouund 60mm. As the technology is the same as inline roller blades, a trip to the local sports store yielded a wheel with 90mm diameter and 24mm thickness. Bearings and two type of axel design were acquired. The intention being to hide the large diameter of the wheel in the side rail area. Thinner wheels were requested, but it was later learned that 24mm is industry standard for inline wheels. A wheel with diameter 18mm was found, with a large radius. Under the brand name AM Wing, but they manufactured in the far east and distribution relied on bulk buying of the product.

Figure 29 - Wheel hunting, roller blade wheel 90mm

3.4.1.2 axel selection

Two options of wheel axle were presented in the specialist shop, one that threaded directly into the assembly, and another which had a nut and bolt type configuration. The second option was selected due to superior strength.

3.4.1.3 Wheel arch

In additional to brief requirements that concern wheel design are the following technical considerations:

- Wheel dimensions
- Connection details to: handle telescope and supporting rails
- Internal space interference.
- Materiality.
- Manufacturability.
- Functionality, mastery of obstacles
- Maintain ‘flow’ of the rail

Some considerations only emerged through successive iterations of design. Figure 30 shows the initial concept as a large wheel hidden within the thickness of the rails. Over time the wheel thickness became larger and attempts to keep the thickness of chassis the same as the rail were abandoned, opting instead for a widening chassis. This development can be seen on figure x, with early iterations starting at A and progressing forward.

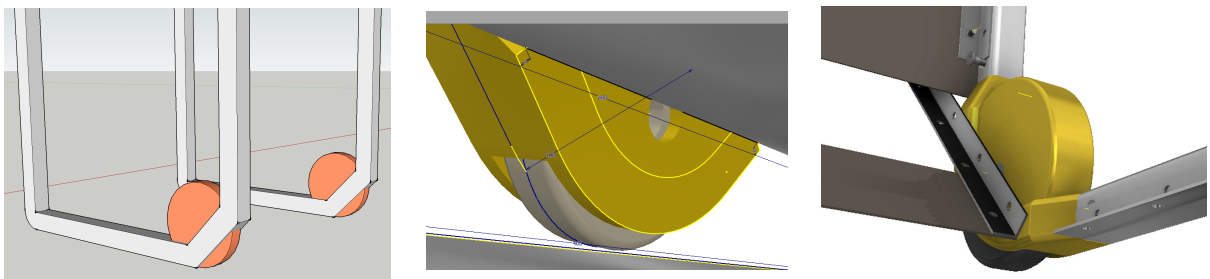


Figure 30 - Wheel unit concept and development, rendered

The 45 degree angle visible in figure 30, was required to provide clearance between the luggage bottom and the floor, something that was discovered experimenting with the physical model. Further changes include positioning of the rotation axis, which was moved from its position inside the luggage to outside. This was done to simplify the process of changing/ assembling the wheel. Note figure 28, has a rotation axis inside the luggage.

Another design consideration that emerged through this process was the need to fit the wheel within the radius of chassis. In some iterations, iteration D, the wheel would have to be inserted on the mud guard side, see also figure 30, middle. This in turn would require a detachable mud guard, an thought to be an additional unnecessary component. The benefit of this solution was an extremely tight finish, with hardly any wheel visible. Flanges were incorporated to provide a surface to fix on to the rear plate. The finally iteration features no holes for rivets or bolts. As the fixing method is yet undecided.

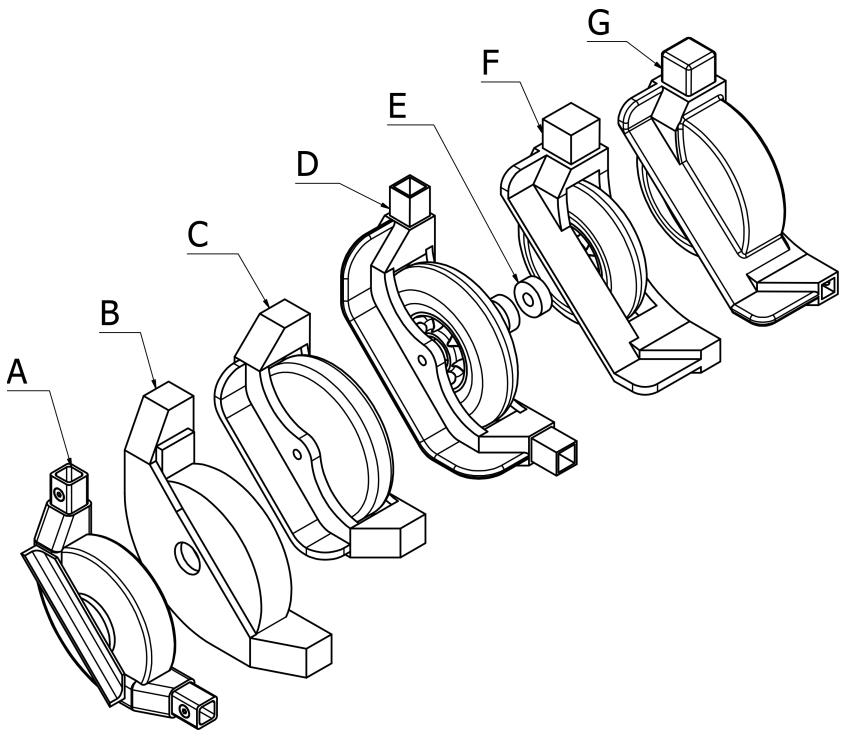


Figure 31 - Wheel unit concept and development

8.2 Enclosure

This section documents the design development of Ronin components which relate to the topic of enclosure. Elements that are discussed include the frame, the front access panel and the side compartments.

8.2.1 Perimetral frame

One of the earliest and lasting conceptual designs is pictured in figure 1. The concept features two rectilinear structural elements with curved edges. A load bearing shelf a mid level, cross elements for lateral stability and a telescopic handle/rail. The benefit of this concept was the abundance of unhindered access to the core void which caters to the core brief requirement: **to improve access to personal belongings**. The division of the elongated storage void into two separately accessible areas, is novel and would require novel sub-solutions.

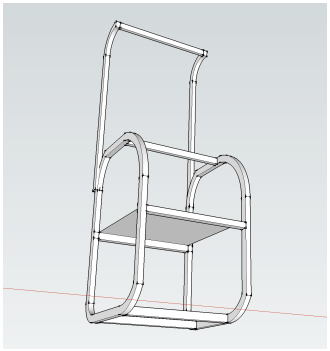


Figure 32 - Early frame concept

Figure 33 - Hard clam shell design

Figure 34 - soft, inline wheels with lid type door

This design is a nonstandard solution to luggage. The two dominant forms being the clam shell design (figure 33) and the zipped lid (figure 34). The zipped lid morphology was considered not suitable, due to the lack of control when prohibiting items falling out. Further more, the lid, which would function as a door when the luggage stand upright, and the door would either have a hinge on the left or right, biasing usage patterns. It was decided to keep things symmetrical to allow users maximum flexibility in the home and elsewhere.

The question of materiality is important, which materials allow for such a shape? Which materials will not falter with shock damage or scraping.

Consultation

Advice on the feasibility of aluminium was sought from veteran mechanical engineer Sulev Saar, who is managing director and owner of a local Engineering firm which specialises in solutions for pellet manufacturing. He was consulted for his wide knowledge of materials and manufacturing. When shown the proposal which included bent aluminium square profiles, he advised against the selection of aluminium, mentioning the difficulty in bending and high probability of an unaesthetic finish. Sulev suggested plasticised wood as a more manageable material to achieve both the form and finish required.

Bending tests

However, despite the warning, aluminium square profiles measuring 15mm squared and 1,5mm thick was chosen to test the bending capabilities. Of the ninety degrees desired the bending machine could only achieve forty degrees (see figure 35). The resident machinist said that the large diameter of the wheels limited the possible radius of the bend to a figure much larger than called for by the design. On bending, the aluminium also showed signs of stress on the inner radius, where compressive forces created a series of cracks (see figure 36).

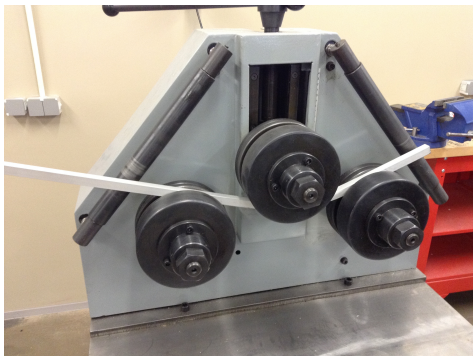


Figure 35 - bending

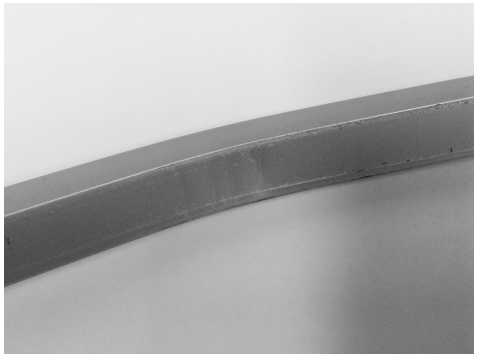


Figure 36 - cracks

Conclusions, aluminium demonstrated its many limitations to act as an exposed support including its propensity to crack on bending, delicate overall surface

appearance and low localised resistance to denting. Recommendations include the using the strength of metal contained within a more elastic rubbery material, or to fashion the rail completely out of a plastic such as polypropylene.

8.2.2 Access hatch

The top access hatch was designed in such a way to allow users to look down into the compartment, reducing strain by clear sight lines and increasing accessibility. The multiple slatted design (figure 37), as mentioned previously was inspired by the Apple iPad covers. Investigation into the construction of iPad covers was done, by cutting open a cover. Inside was a strong fibre glass, with felt on one side, for cushioning and a more water resistant polymer fabric on the other. The result, a composite sandwich held together with adhesive. This design exhibited good qualities of strength and appearance. Also noted was the appreciation for internal qualities: warm soft and dry. Verses external qualities: sleek and resistant. These qualities were considered favourable to creating a new design aesthetic which related to the Urban Roamers, but the question remained of the suitability of such a design and mechanism in the context of luggage.

Figure 37 - multiple slats

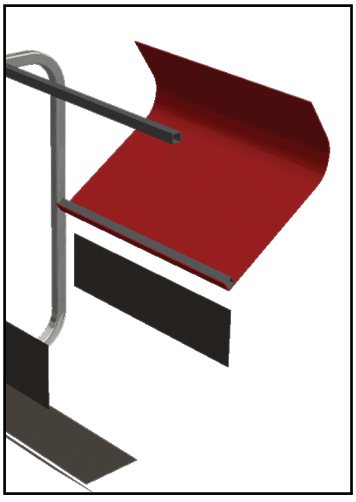


Figure 38 - single door

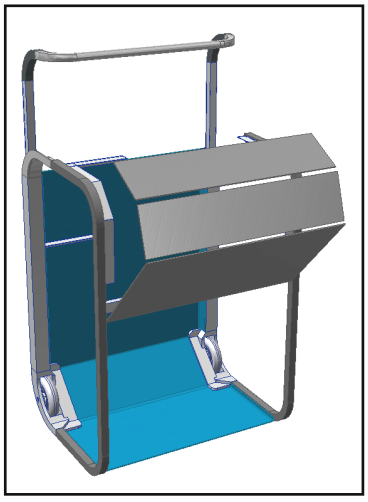


Figure 39 - compromise

The use of such a quantity of multiple slats was questioned, original concepts of usage imagined users rolling the slats downwards and with the aid of magnets forming triangles in the process, similar to Apple designs. After attempts to recreate this process in physical models, it was decided that rolling was a unnecessary time

consuming clumsy and a detriment to user accessibility. Subsequently design concepts swayed to the other extreme exploring a single door shape. The single door (figure 38) allowed for greater speed, but again through modelling shortcomings were revealed, in this instance the bend in the door, and rigidity of the hinge mechanism creating a barriers to access, the opposite of the intention of the design. Attempts at a compromise between the two options are present in figure 39, where larger slats replace smaller ones to enable fast handling and a tidy finish.

This design met problems in attempting to resolve the internal supporting flanges. The flanges which provide a landing area of support for the access panel were increased in width, from the meagre dimensions of the first iteration. A 'L-shaped' profile was also selected as more efficient than squares. Problems with this iteration emerge at the filleted corners of the rails, which sweep in a curve for maximum strength and shock resistance. Reconciling these two shapes, plus the new number of flanges required flagged this iteration as non-optimal.

All of these mentioned insights provided the reasoning behind the most current design for the access hatch, which is illustrated and explained in the design outcomes section.

8.3 Stationary functionality

This section documents design choices made regarding components that influence functionality of the luggage while it is stationary i.e. features used in the home. The two major components that will be discussed are the the telescopic rail and the lower storage compartment.

8.3.1 Simultaneous development.

The follow section explains how the location of the telescopic rail impacted on other components.

The position of the telescopic rail in the first iteration of Ronin Figure 40, lies inside (not touching), the two rectangular frames. This position was chosen to maximise

overall strength of the luggage structure, as more centrally positioned telescopes, would not impede the path of the structural side rails, resulting in greater strength.

This positioning created two major problems. Firstly how to secure telescopes to a load bearing entity in the luggage, and secondly the negative impact on internal spatial integrity. The first problem could be solved with the application of an adhesive; not ideal, but a workable solution. The second problem however had affects for the top hatch space as well as the shape of the lower retractable storage compartment that could not be so easily resolved.

Figure 40 - previous iteration, Ronin

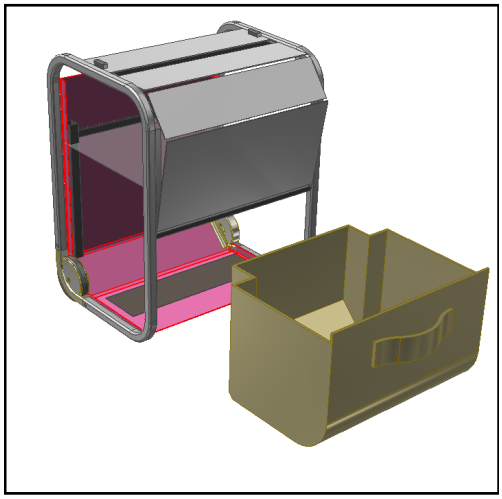


Figure 41 - lower compartment

8.3.2 Lower retractable storage compartment.

The lower compartment cover was first developed through a desire to offer a unified frontal appearance for a strong design aesthetic, the tidy box, figure 41, was added later after it became apparent users would not be able to access their belongings in the lower area.

Overall aesthetic considerations resulted in cover solution, on the bottom compartment, that was similar to the top hatch, featuring a slatted cover. However, unlike the top compartment cover, on opening this cover, it would lie on the floor as demonstrated in figure 40, an inefficient and ugly prospect.

Recent re-evaluation of work methodology, led to refined brief requirements such as providing users with superior levels of access and generous storage space. Considering these requirements, combined with common design sense, it was clear to see that the slatted cover was a redundant item, and added from personal taste. A redesigning of the tidy box to withstand environmental conditions, would solve the issue of a redundant cover, but then the new challenge became how to ensure design consistency between the top hatch and bottom compartment. One method suggested could be materials, to apply a waterproof and texture skin to both areas. Brief explorations into handle design were also explored.

The problem remained that the large square profiles of the telescope, in the rear of the luggage, were forcing unideal geometry in the lower compartment.

8.3.2 Reposition of telescope.

The solution to the irregular internal geometry, as well as how to support the telescope were resolved with the repositioning of the telescopes.

To solve said issues, telescopes were repositioned above the rear wheel housings. The largest telescopic profile are now exposed to the elements on two sides, and a re-specification of material of those two exposed members is suggested, from aluminium to plastic. See detail B on the technical drawings page.

Wheel housings were also redesigned to accept the large telescope dimensions and now provide direct support for the previously unspecified fixing detail of the previous iteration.

9. Design outcomes, overall solutions.

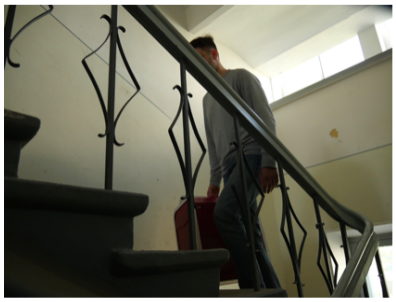
The section demonstrates features and functionalities of the most recent iteration of Ronin.

9.1 User journey - Ronin.

In reference to the journey map formulated in the research section, Ronin, in its most recent form, demonstrates its similarities and differences with traditional luggage morphologies with the aid of journey map.



Some similarities include Ronin's adherence to the design brief in producing an item which travels well. The luggage can be seen as a compact item, which fits in the rear of hatchback car. The new wheel position allow user to walk forward and comfortably pull the luggage behind them. The design remains discrete, leaving little clues of the luggage dual capabilities as a bedroom closet.


A reconfiguration of the side support, changing aluminium for more elastic materials allows the luggage to navigate through urban environments and deal with obstacles such as street curbs without damaging the luggage. The top mounted handle comes in handy when climbing stairs.



Once positioned in the bedroom, Ronin blends in with the other surroundings. Users wanting to feel more at home can lift the rail up, unlock the luggage and proceed to unpack.



The top compartment will likely be used for a users' cleaner/ more delicate items. In this instance the user has also packed clothes hangers and is seen hanging his shirts on the rail for more convenience of access. This also frees up space in the compartment for other items.



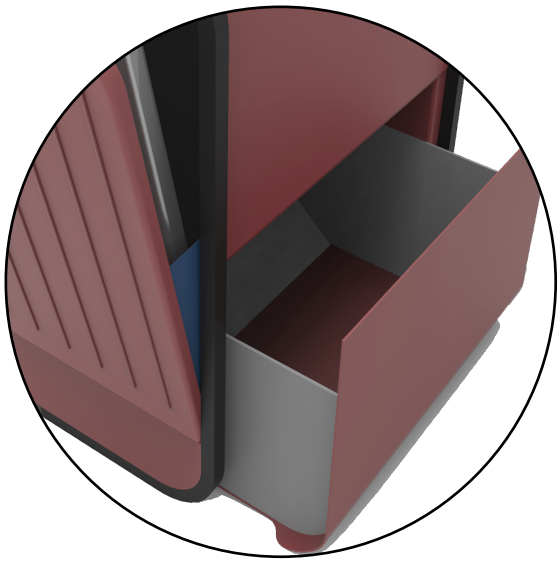
The lower compartment can be seen in action, the user has store more rugged items in this compartment, like shoes and dirty laundry. The user demonstrates the flexibility of the compartment by removing it and taking it to the washing machine in the bathroom.

9.1 Improvements - Ronin.

This iteration of Ronin exhibits a more harmonious internal spatial organisation than the previous iteration, mainly due to the positioning of the telescopic elements over the wheel chassis. One of the most exciting development is a direct response to information learned about Urban Roamers in the research stage. That is, that a large proportion of them travel with laptops and other expensive electronics. This point, coupled with the fact that Amazon customers strongly prefer hard polycarbonate cases, led to the specification for a hard polycarbonate side pouch. A hinged door provides users a direct look into the pouch, where they can store their valuables such as laptops, power cables as well a smaller items such as socks ties etc. Further improvements include, a more spacious lower compartment. Users can push the telescopic handle all the way down to maintain a flush finish and a reduced likelihood of handle damage whilst in transit. Oversized inline wheels allow users to better navigate through urban environments.

Figure 40 - Ronin, with new wheel chassis and laptop storage

Figure 41 - Ronin, with new spacious lower compartment



One of the largest changes from the previous iteration is the improvement of the inner rail/flange detail, which provides the support for the access hatch. Now moulded in plastic, this new seal provides the side pouches the environmental isolation they require as storage for delicate equipment such as laptops. The internal storage space in the side pouch is approximately 3 cm wide.

Previous iterations featured a 45° angle at the top facing corner of the luggage, this variant is curved to match the curve of the outer rail. This curve has also led to changes in design in the access hatch, which now has smaller slats where it meets the curve and larger flat panels elsewhere. The access hatch material is fibreglass sandwich between a layer of synthetic waterproof material (external) and a synthetic felt (internal).

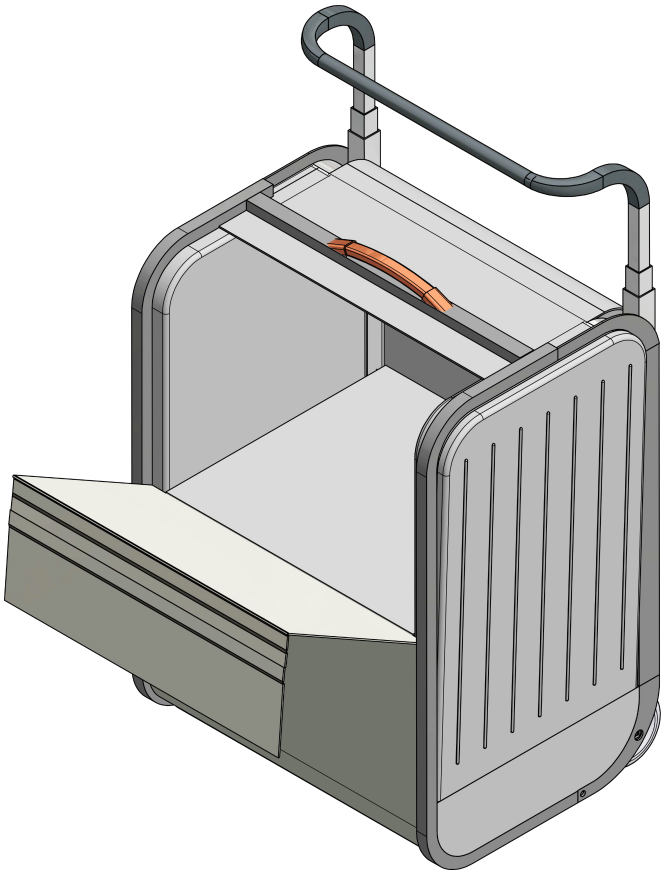


Figure 42 - Ronin, Redesign of inner rails and access hatch

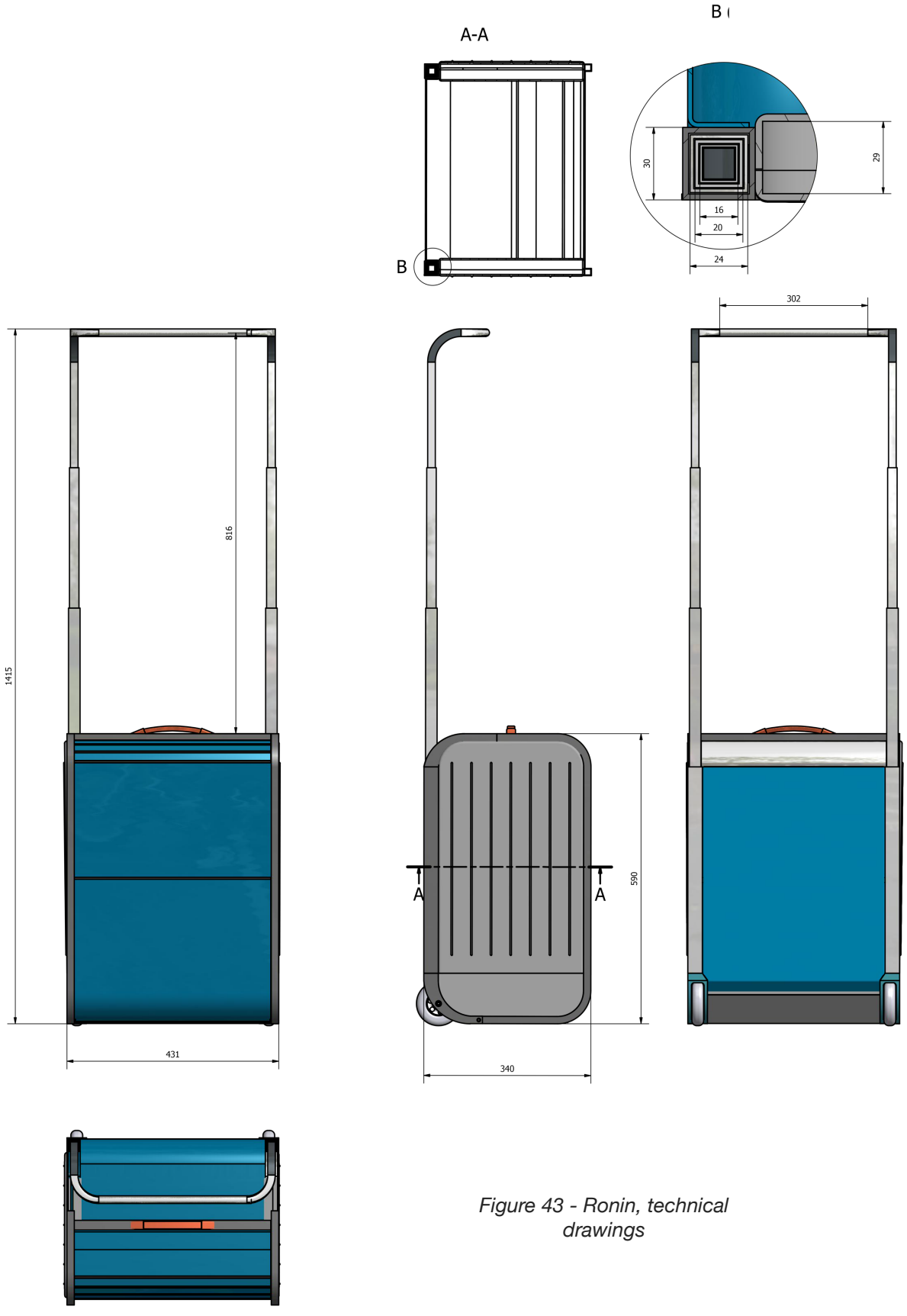


Figure 43 - Ronin, technical drawings

10.Summary

In summary, this research began with a formed design concept as inspiration to mount an investigation into the user types who may best benefit from the features and functionality offered by a fusing furniture and luggage. Learning this may then in turn inform choices about the future direction and design of the luggage system.

Design methodology was selected and used to help define overall problems and overall solutions, and laid out a path and process for research and development.

Problem definitions were steadily refined with the use of design exercises, such as personas and questionnaires. Exercises revealed information about user behaviour and values. Broad categorisations of users were established, which were steadily refined through examination of statistics and primary research. Global economic forces were analysed to better contextualise any efforts to add value to existing markets. This research revealed China and India as major growth markets in luggage, and also indicated increasing preferences to cater for fashion markets within luggage.

Previous iterations of Ronin were examined and evaluated against likely competitors, using a weighted matrix model. Product development was selected as the most suitable market strategy.

This process highlighted areas for improvement for future iterations. Through these efforts four groups of users were identified as the target, these four are: digital nomads, Flashpackers, commuters and students. The name Urban Roamers was created to describe these four user groups.

Using information about user groups combined with an understanding of where improvements could be made, a brief was outlined. In the design development stage, the brief, as well as progress made from previous iterations, was used to develop designs. Areas for development were categorised and broken down into some problems. Improvements in Ronin's design were demonstrated in the design outcome, overall solution phase utilising physical models, 3-D renderings and technical drawings.

11. Conclusion

This thesis was undertaken to develop an existing concept through a better understanding of users. Therefore firstly, to measure it's success, the levels of understanding of users must be measured before and after the study.

In the research, much progress was made in refining the identity of Ronin's primary user group. Before the study all that was known about the user group was that they were young, urban and on the move. After research and design exercises specific user types were identified, such as Digital Nomads and Flashpackers, that offer real insights into the minds of likely users. Use of macro-trends also help pinpoint the growth in these user types. The formulation of the brief help define characteristics of the subsequent design of Ronin.

The second measure the success for this study relies on pinpointing whether development has occurred in the Ronin concept, and whether those development are a response to user insights learned during the research phase. One key finding and response stands out. The finding was: the prevalence of reliance on digital technologies in the user groups. This fact, coupled with the learned preference for hard polycarbonate cases, led to the development of a laptop safe compartment.

Many other improvements of details was achieved in the design development stage, but the degree to which findings from the user research, influenced the development of these details, is more vague. Many of the problems existing in the previous iteration around then, could have been resolved through use of the engineering process methodology. However, this research was also designed to confirm market interest for such a product, and if the research concluded there was no interest, all subsequent detailing would be stopped. Research did confirm market demand, and therefore details were improved upon using engineering methodologies.

Regarding research: having identified primary users, there is now a strong incentive to build a fully functioning prototype to collect insights from any or all of the identified users.

Regarding development: many improvements in details are clearly still required, and will emerge with the reconciliation of differing constraints, with solutions of ever increasing simplicity . Reflecting on the current iteration, it has difficult manufacturing specifications, an excess of unique parts, resulting in a difficult assembly process and high cost. Hopefully design complexity can be reduced to a more manageable level without losing functionality; utilising the technology of today at a competitive price.

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Annex 1

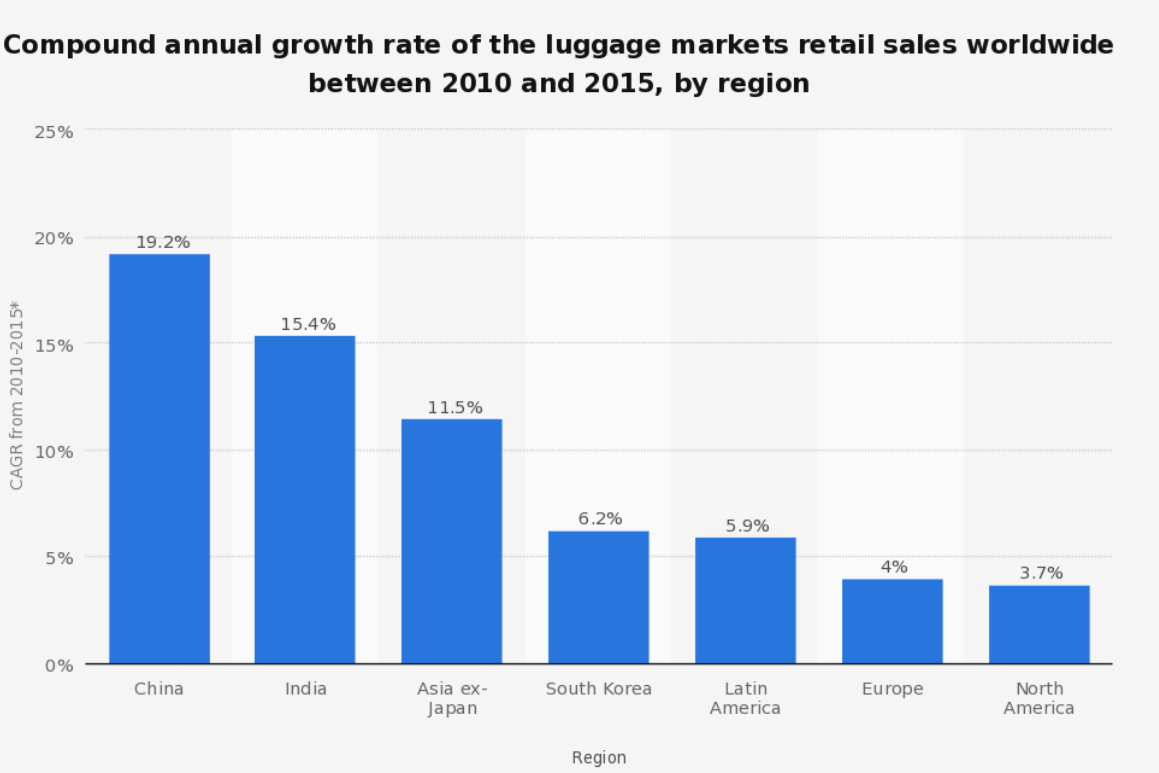


Figure 1 -

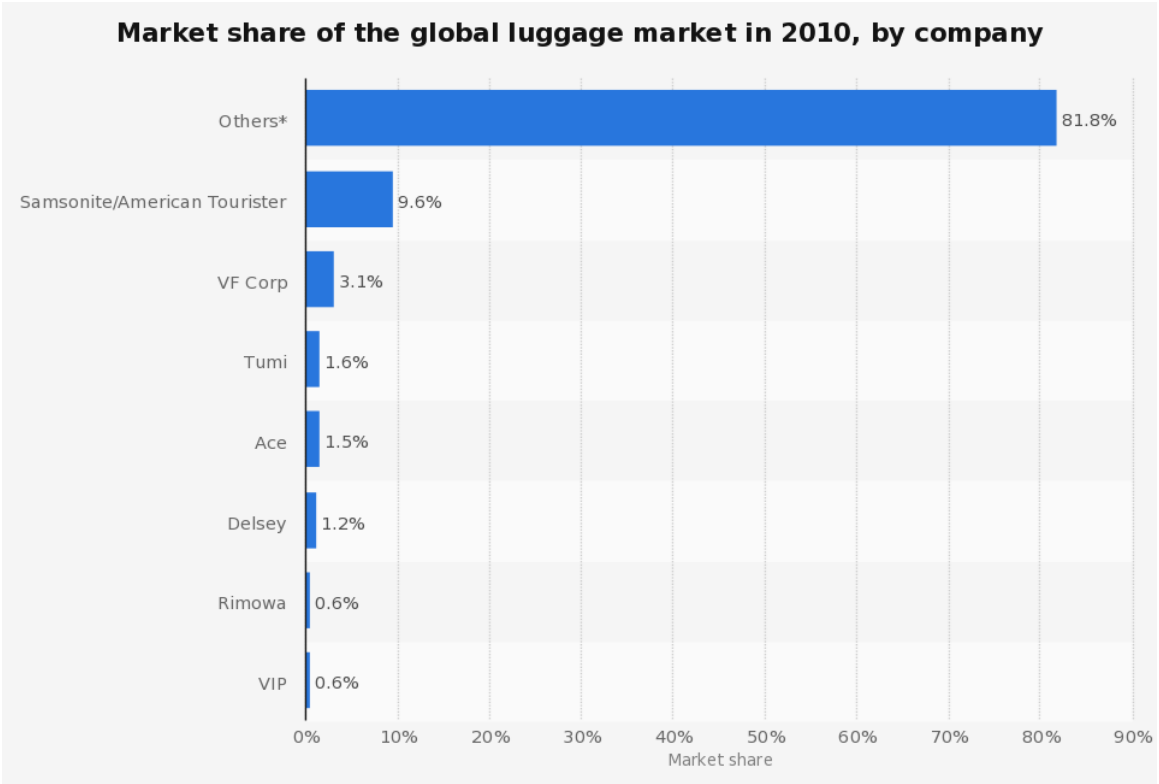
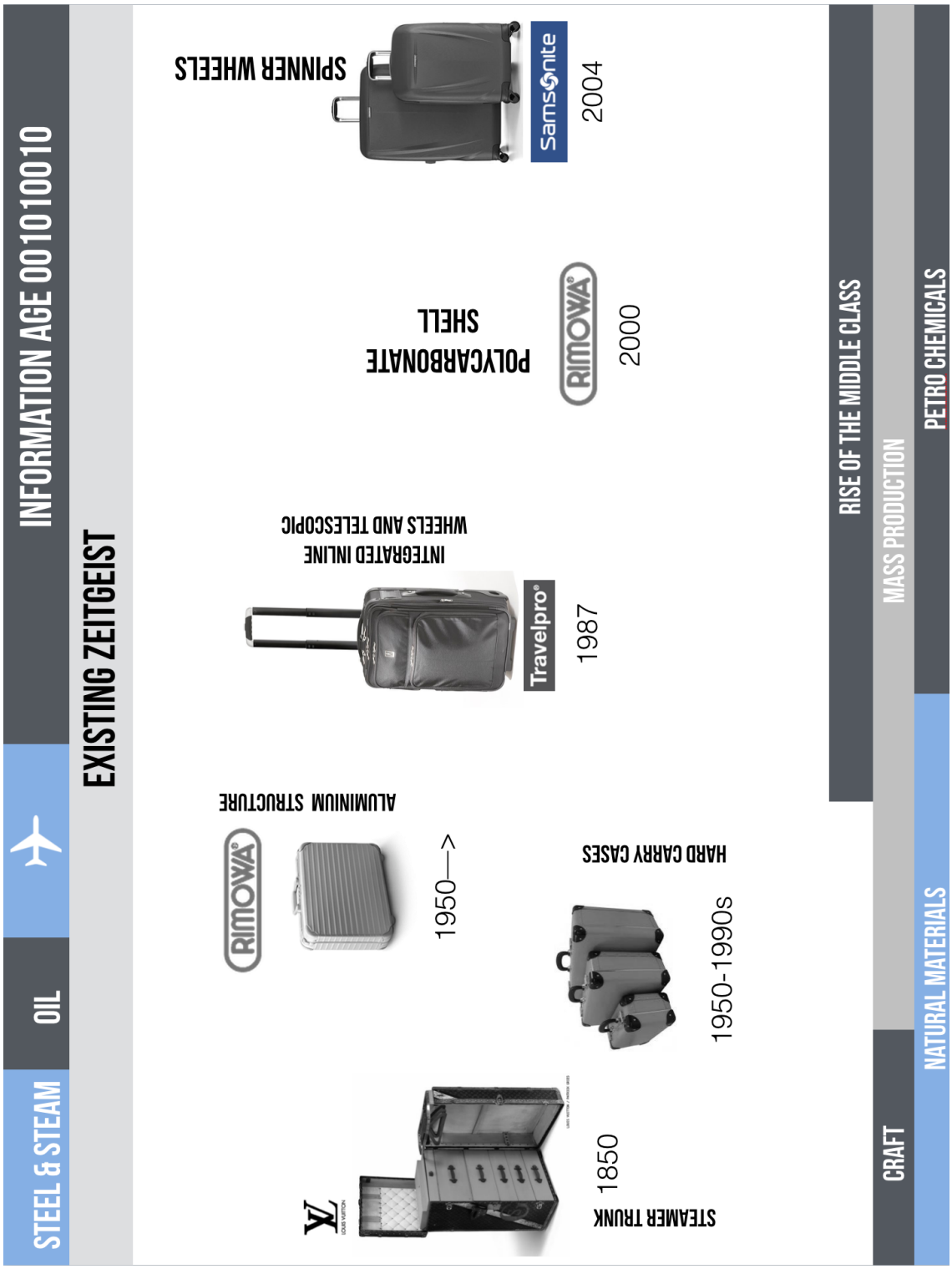


Figure 2 -

Annex 2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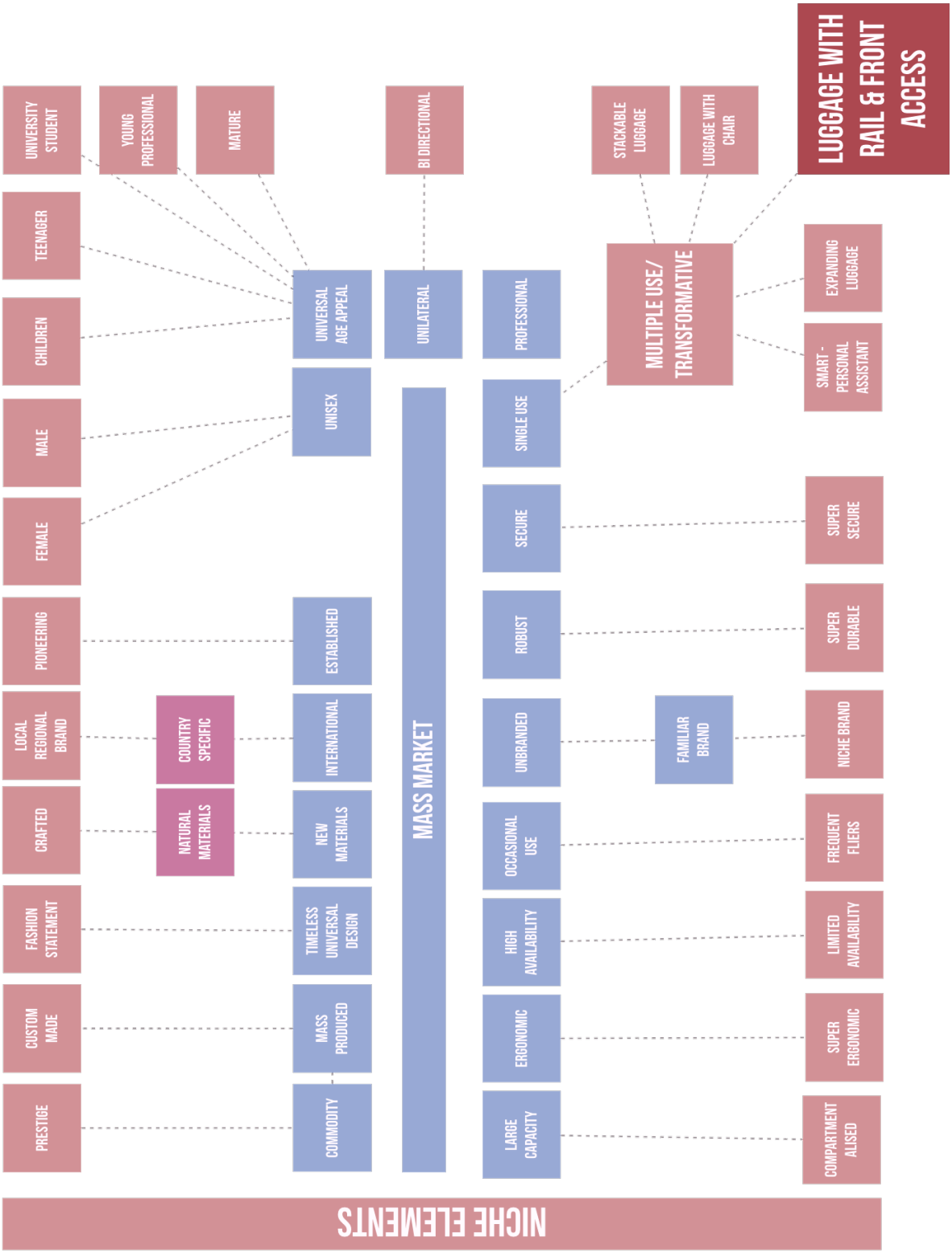
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LUGGAGE WITH CHAIR
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FEMALE
UNIVERSAL AGE APPEAL
UNILATERAL
PROFESSIONAL
MULTIPLE USE/ TRANSFORMATIVE
EXPANDING LUGGAGE
SMART - PERSONAL ASSISTANT
UNISEX
SINGLE USE
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NEW MATERIALS
TIMELESS UNIVERSAL DESIGN
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