MÄLARDALENS HÖGSKOLA
ESKILSTUNA VÄSTERÅS
School of Innovation, Design and Engineering

DESIGN OF A SHOPPING CART

BACHELOR THESIS WORK

15 credits, C- level

Product and process development, Concurrent Engineering

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Abstract

This report will consist on the developing of a “shopping cart”, adapted to some requirements that our client has, those requirements are special because she has the disability of reuma. It will be a big challenge, because it must be a competitive shopping cart but it also has to carry out the specific needs of our client.

We need to follow these steps in order to obtain a successful product:

- First of all we need to study the shopping carts market. We must analyze all the products involved in that market and discover the best qualities of each one.
- Of course, we need to know the illness of our client, it will be very important to understand what she need and what we have to improve, so that it will be good to work together, to know her common days, and so on.
- Afterwards, we start the real work. We are going to analyze and develop characteristics such as use, functions, parts of the shopping cart, how to fix the problem of the movement, reducing unnecessary movements,…

Finally, we will obtain a competitive shopping cart in the market, to be able to use by a big range of people, especially by people with difficulties in their common days and with an ergonomic adapted to the requirements and of course, with a well design.

Acknowledgements

We would like to thank Mälardalens University for giving the chance to study and do our report here in Sweden and also for all of the facilities that they have given us.

Thank our teachers Ragnar Tengstrand and Henrik Leykryd who have helped us always and of course thank to Monica who has been always available for us.

Thanks to our home university “Universidad de Zaragoza” for giving the chance to came here and because of their support.

Thanks too to our family because of their support.

Wordlist

CONVEYOR BELT: consists of two or more pulleys, with a continuous loop of material that rotates about them.

CRANKSHAFT: Mechanism that changes rectilinear motion into rotation or rotation into rectilinear motion.

FLANGES: It is an external or internal rib that is used to transmit movement between different elements.

GEAR ASSEMBLY: System of wheels connected between them by some kind of tooth.

GUIDES: It is a mechanism that only allows movement in one direction.

HINGES: Union points of the structure axels that allow 90º turning.

SHAFT: A long thing object or part, in this case it is the main structure of the fourth idea.

SHELVES: Each level of the cart to put the products on it.

TOWING HOOD: Union point of the bag with the structure. It permits 360º rotation.

Contents

1. Introduction

This report is going to be a result of our thesis work, here at Mälardalens Högskola, Västerås. It would be the final work of our degree, Technical engineering in Industrial Design.

1.1 Background

The way to carry things has evolved for years. Design is a tool which has helped to evolution, especially the evolution of carry things. From the most rudimentary or basic way like carrying things in the back with a piece of cloth to the most moderns shopping carts with which you can carry a lot of things without too much effort.

Our society has evolved too, and we try to achieve more and more comfortable lives, so that we try to do everything adapted to all people. We cannot forget that there is also a lot of people with diseases and with all this development we can make them to have a much easier day by day.

That is why we are going to do this project, to develop a new shopping cart adapted to the needs of people with problems in their movements.

1.2 Content and structure

The report is going to be composed of twelve chapters.

The first one is the introduction in which we talk about what is going to be our report.

In the Aim of the project we will explain, specifically, the purpose of our project.

The third one is about the project directives where the reader can find everything about the prerequisites and conditions to do our thesis.

Problem statement is the fourth one. Here we will be solving the problem.

The fifth point is project limitations in which we clarify what kind of limitations we have had during the execution of the project.

Theoretical background & solutions methods, is the next one. We will explain our theories and our work methods to solve the problem.

Seventh is Applied solution procedures in which we will talk about what we have done, the application of our theories and methods to the problem and what kind of types of problems have we had and how we have solved them.

Eighth is Results. Finally, we have found the final solution that will explain our conclusions later on.

We continue with next one, Analysis. Here we analyze our solution having in mind the problem that we must solve.

After that we will have the conclusions and recommendations where we explain with a short summary our problem and the conclusions. Achievements, results, recommendations for the future, implications, improvements and implications in our work, are going to be talked about here.

Every work need to have references, where we have get the information and this information should be gained from scientific references, internet, other reports or papers.

In the end, we put some information that it is really relevant during the course of our project, it is the appendix.

2. Aim of the project

The aim of the project is to design a product that helps you to move heavy things. It consists of a cart that usually helps people to carry on shopping from the supermarket to one place, but in this case we want to carry whatever from some place to other one. So that we have to take into account that no all kind of heavy things has the same shape, so the product must adapt to all possible different shapes and environments.

3. Project directives

This Project is going to be developed during one semester and it is going to be 15 ECTS, so the product cannot be really complicated, namely, we will try to use as much commercial elements as we can and try not to complicate much with the new ones.

First of all, we are going to be based on actual shopping carts. We will try to develop a new one, finding some errors in the actual one and correct them and of course, try to adapt to our specifications, the restriction of several movements. So, it should be very important to start to develop new things adapted to that kind of illness and it should be a better way to improve their lives.

After that, we can start to think about how to improve the way to carry things for that kind of people. We have to do an ergonomic study, ask to our client how is the best way for her to carry things, which movements she can do and not, which are her preferences, etc.

We must think about functional aspects, shape and design. The product is designed to be used, to carry out the main function and the secondary ones. Uses and environments determine the main function of our product. The shape and function are related each other by the content and the user. Shape affects function, function affects use, and use affects users.

4. Problem Statements

The main problem in this project is to make comfortable for the user the action of carrying anything.

To solve the problem in a complete way our product must work outside some place (street, garden) and inside the place (home, supermarket, shopping center), it must carry out the requirements of the client which are going to be adaptable to the needs of her illness, reduce the unnecessary movements, help to carry all kind of things and not to be difficult to use.

To find the best solution to solve the problem we are going to do some studies about:

- Analyze the actual market about shopping carts, how many kinds of shopping carts exist actually? What functions could they do? Is it possible, with the actual shopping carts, help to the problem and how? Which ones?
- What is arthritis? We will search information about it and we ask to our client, Monica how her common days are, we will go with her to a supermarket to know “in situ” the main problem.
- Connection between shopping carts and users. They do carry out their requirements? How?
- We need to know everything about shopping carts. We need to do analysis about:
    - The parts which compose a shopping cart. Shape Analyze.
    - Functions analysis to find the main function and secondary ones.
    - Use analysis. How is it used?
    - Scenario analysis. How it works in a supermarket?
    - Ergonomic analysis.
    - Demands specifications
- Possible problems that can happen during the use of the shopping carts.

5. Project limitations

We should find a concept product that helps to a person who has an illness and it should be competitive in the actual market.

Our concept product must be able to be developed in the future for a manufacturing process.

We have four months to do this project.

6. Theoretical background and solution methods

To achieve the objective of the project is necessary to follow a work method, so that you can make sure every time that you are following the correct way for the final solution. The method that is usually followed is the next;

1.-**Define the problem**

It is very important to make the correct definition of the problem in order to obtain the right solution.

2.- **Collect information**.

A lot of information must be collected about the subject. In this collect it must look forward to the products in the market that can be competitors and also different products from the same “family”.

Inside this step we also looked up for different technical solutions that could be useful to achieve our aim.

3.- Function analysis

It must be analyzed the functions that have to carry out the product, it usually have one main function and many secondary functions. This analysis is done in order not to lose the aim of the project and so that at the end of the project compare the result and look if all the functions are well satisfied.

4.- Demands analysis

Based on the function analysis a chart of customer´s demands have to be done. There are reflected the needs of the user so probably it is one of the most important sections to get a successful project.

5.- Customer analysis

This step consists of analyzing the different user the product can have. It helps the designer to specify all details of the product because the product changes a lot depending on who is going to be the final user.

6.- Use analysis

The verb use means to make work or employ for a particular purpose or for its inherent or natural purpose so the use analysis consist of a kind of scenario where the designer can see how the product is used in order to make it easier or more comfortable.

7.- Ergonomic analysis

Ergonomics can be defined as "the science of obtaining a correct match between the human body, work related tasks and work tools". That one is a very important aspect to take into account because if a product is not ergonomic nobody will use it.

8.- Environment analysis

It is highly important to know the different environments where the product is going to be used.

9.- Creative sketching

It consist of drawing lots of ideas that comes to the designers mind based in all the research that have been done before, from all those ideas after the best ones will be selected in order to create a concept.

10.- Selection of ideas

In this step each idea is evaluated and the aim is to choose the best ones in order to create a good concept based on them.

To do this work in an easier way there are different methods that can be used like for example the Pugh method that is based on the demands that carries out each idea to select the best one. It consists on giving different punctuation (for example from 1 to 5) to each demand depending of the importance level that it has for the user. After that each idea is punctuated looking if it carries out with the demand or not. Finally some operations are done with those numbers in order to know which idea fits better the users demands.

11.- Develop the concept

The developing of the idea means that the idea has to became concept so that we must focus on the details and mechanisms of the product.

In this step a 3d model must be built with the correct dimensions, materials, mechanism...

Before making a 3d model, some experiments in the workshop also must be done so that the designer makes sure that his idea will work.

12:- Final scale model

This is the last step, that consist on building an scale model

7. Applied solution procedures

7.1 General description

We started with this project because Monica Johansson asked for it. Monica is a woman who has some mobility problems that is why she cannot use normal carts that are nowadays in the market. The first step was to have a meeting with Monica in order to know exactly which were her needs so that we could define the problem (the problem is defined in the fourth point problem statement).

Speaking with Monica was not enough to understand properly her needs so we thought that it was better to go to the environment were the problem occurred. So we went to the supermarket with her. There we got more idea of the different problems she had and we did a scenario with the obtained information.

1.- **Take the cart**. It is easier for the user to push it instead of taking the handle and push.

2.- **Take the products needed**. Depending on the level in which the product is situated the user have to do more or less effort, so the new cart should have more levels and each not very deep.




3.- **Take the products out** of the cart. It involves ducking and standing up again and again.

We also appreciate that in some supermarkets there are different carts that are quite better. In this type of carts is not necessary to duck to left the products inside. The inconvenience of those carts is that you cannot carry a lot of products and that the user has to do a big effort to put in the products of the lowest level. One possible solution is to add a shelf at the bottom.

This scenario is done in the supermarket but Monica has this type of problems every day, when she buys a pair of trousers, when she want to bring something to her garden…for everything because her illness does not let her take any weight.

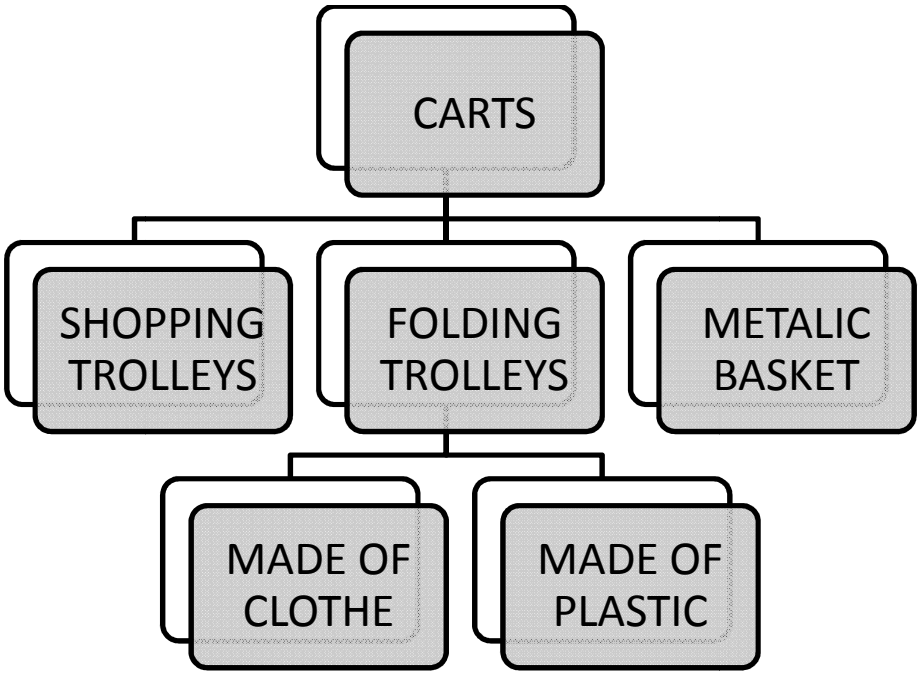
After having that meeting with Monica we already knew her needs so we corrected the problem statement of the beginning because it did not gather all the information needed.

7.2 Market diagram

In order to know what new products we can produce is good to know what it is being produced that can be competitor of our product.

We looked different ways of carrying things because in following steps it may help us to develop new ideas. After that we focused in carts and analyzed different types of carts in the market. We gathered this information in the market diagram.

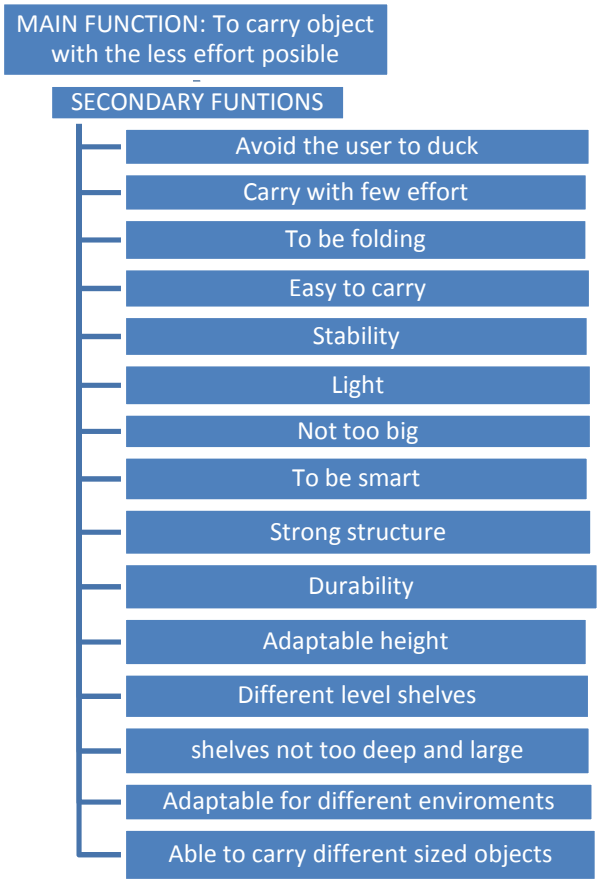
We focused in th different types of carts of the market:



There is more information about the different types of cart in the appendix.

7.3 Function analysis

When we got the information of the different types of carts in the market we made a function analysis with Monica´s help. We have to remember that although we are developing this product with Monica´s help it will not be a cart exclusively for Monica so we have to think in all possible users of the product.



Once we have the function analysis done we can make some idea of how the product will be or which mechanism will feet more or less. So based on the function analysis we collected information about different folding methods, lock systems, telescopic tubes ... all the gathered information is in the appendix.

7.4 Demands specification

After the function analysis we made a demands specification chart to know exactly what the user will need so that all the functions from the function analysis will be satisfied.

Functional	To carry
Evironment	Street, supermarkets, garden...
Users	For everybody
Components and connectors	The device has a quantity of components. Sometimes we could fold the components and we could adjust the height of that kind of devices.
Useful life	It could be guaranteed per 5 years.
Materials	Aluminium
Maintenance	Easy to clean
Shape	Rectangular
Appearance	The shape is the result of its role
Ergonomics	Adapted to the ergonomics of hand to be able to use easily. Modern ergonomic design
Security	No material harmful to skin, non-toxic, without sharp edges, smooth surface
Recyclability	Made of recyclable material
Hygienic	Made of hygienic material
Usability	Its use is easy and convenient
Cost	Between 600 and 900 kr.

7.5 Helpful information

In order to be helpful in our future design, we did some analysis of a normal shopping cart in the market. We analyzed the figure (shape), each part´s function, and syntactic, semantic and pragmatic meaning of the component. All these analysis are better explained in the appendix.

7.6 Ergonomics

In this case ergonomic will be the adequate size of the cart and its shelves, comfortable shape and size of the handle and of course easy mechanism of taking on and off the objects in the cart.

To do it correctly we found some ergonomic charts that are attached in the appendix.

7.7 Environment

The cart will be used in different environments. The part of the cart which most depends on the environment are the wheels. We can consider two different big groups of environments:

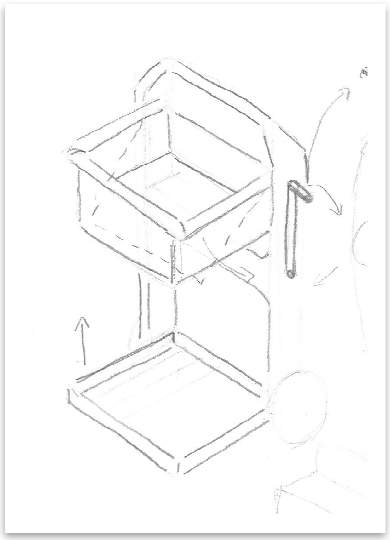
- Inside (home, supermarket...): almost all type of wheels will work in this environment but it would be nice not to be very big so that the user can manage easier.
- Outside (street, garden..): Here we have to take into account that we are in Sweden and almost all the winter it is snowing so the wheels have to be good enough to resist the ice and snow on the floor.

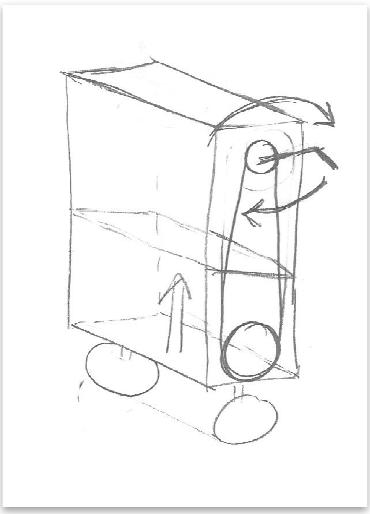
So to choose the correct wheels we must have a combination of both aspects.

7.8 Creative

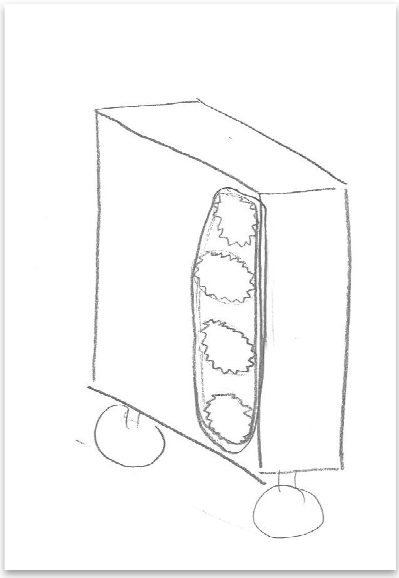
After all the information work it was time to start drawing different ideas. At the beginning it was not very easy so we did a brainstorming session with Ragnar, Henrik and Monica. After this session we opened our minds and we were able to think farther than a usual shopping cart. We had the following ideas:

FIRST IDEA

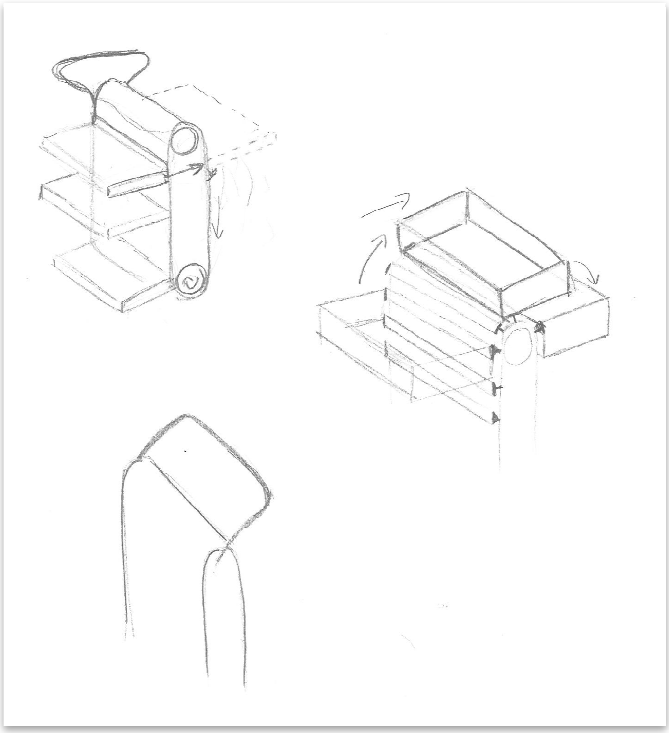




The main idea is to take the load up with a gear assembly. The assembly could be moved with a crankshaft or with motor.



SECOND IDEA

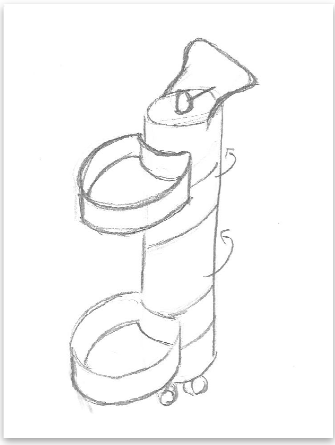


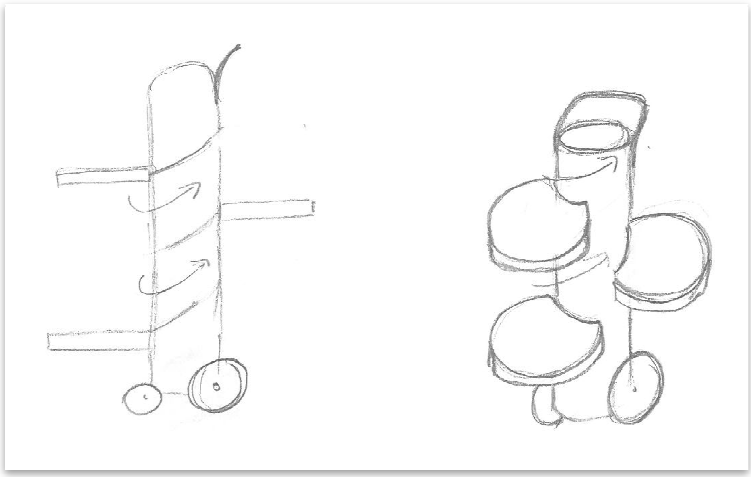
This card is based on the tanks of the army. It is a similar to a conveyor belt, it is placed in vertical and the belt has some flanges where the different shelves will be held, so that the user can move the shelves from one side to the other and adapt the high of them to her/his needs. The size of the shelves can also be changed. The handle can be located frontally or in one side.

THIRD IDEA

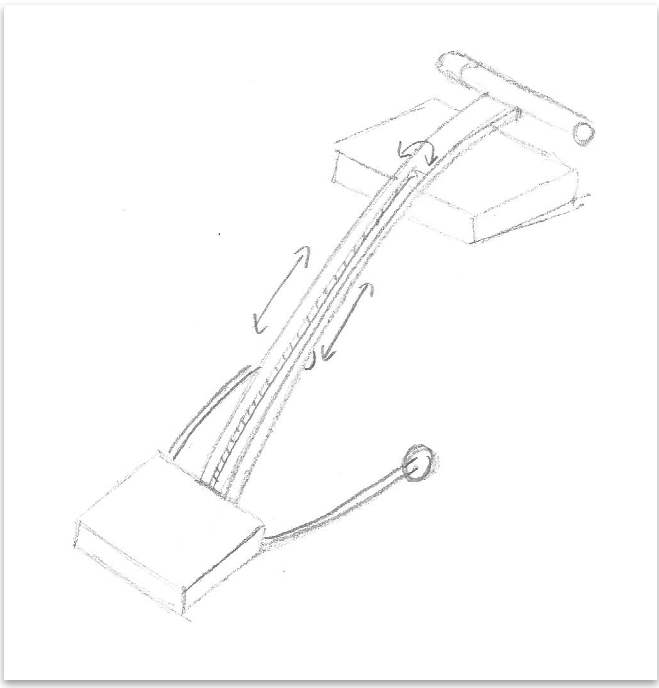
This is a similar to a big threat. It has many shelves around the threat. At the top of axis there is something that makes the threat move, when it happens to the right the shelves goes up and when it moves to the left the shelves goes down.

The wheels of the cart can be situated down the threat so that they can be moved in all directions or in the sides of the threat so that the only move in one direction.





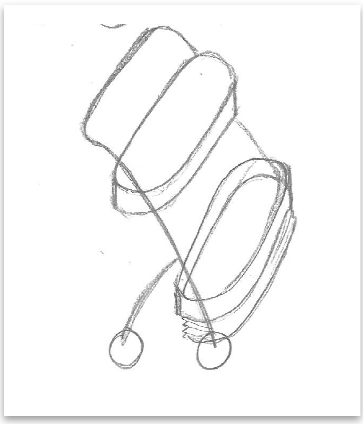
FOURTH IDEA



This cart has a very simple structure; it basically consists of a curved shaft with a chain in it. There are two shelves, one in the front of the structure and another one at the back. They are connected to the chain so, when the shelf at the back is up the other one is down and the same on the other way.

The cart has two wheels at the end of the main shaft and another auxiliary wheel on both sides to contribute in the stability.

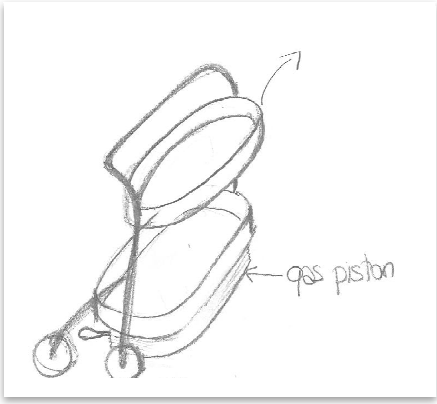
FIFTH IDEA



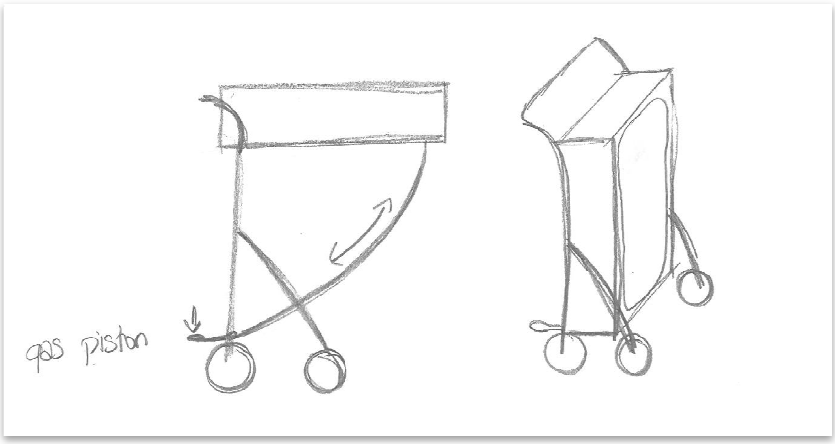
The following two ideas are grouped in one because both of them use the same mechanism: a gas piston.

The first one is a cart with two shelves. The shelf at the bottom has a piston that is activated when the user

push with his/her foot the lever. Both shelves can be located in vertical so, when the shelf at the bottom is elevated the one at the top must be removed. On the other way if they are not alienated, if one is at the back and the other one in front the shelves do not have to be removed but the problem of that is the bigger space that it takes.

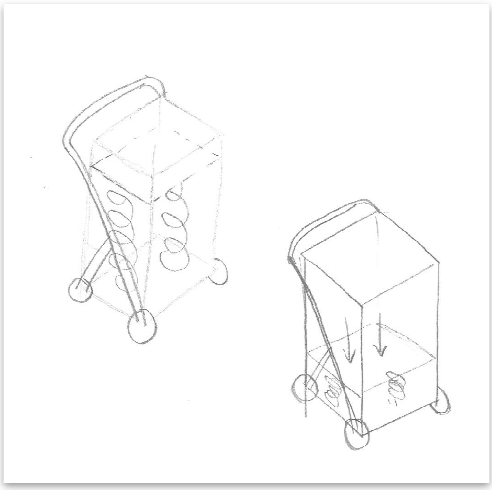


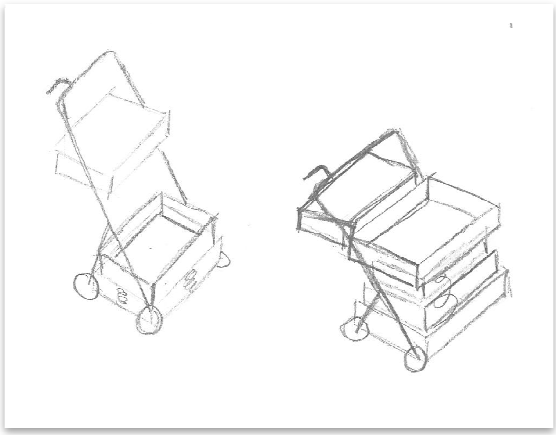
The second idea with gas piston is a normal vertical cart that the down side of the cart can be elevated with a curved piston system, so that the cart´s final position is horizontal and in an adequate height for the user. The piston, as in the idea before, is activated pushing the lever with the foot.



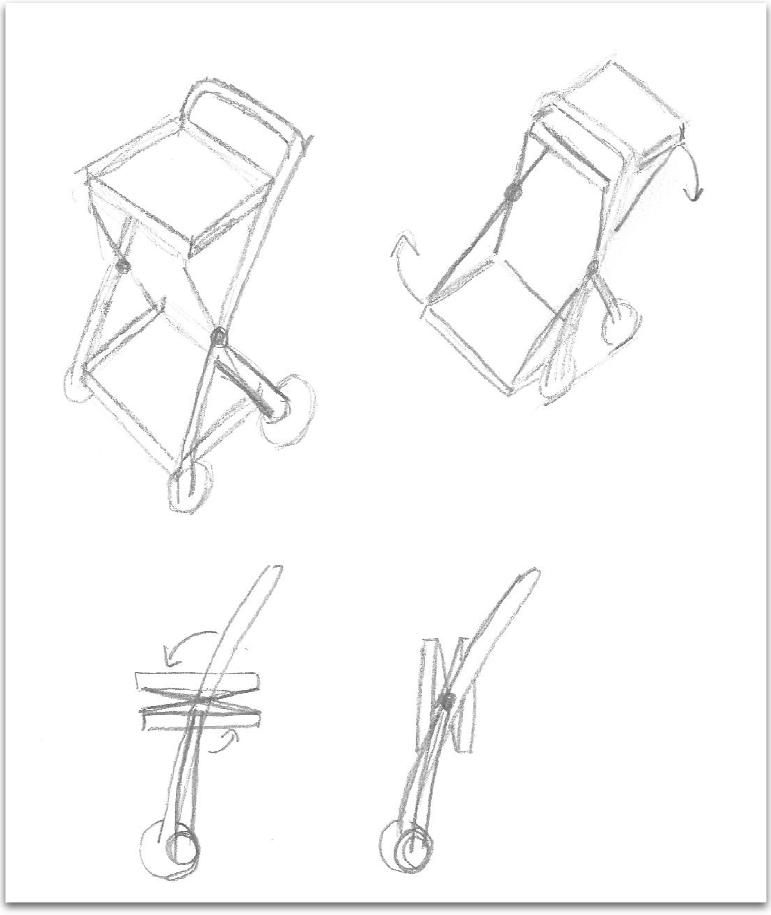
SIXTH IDEA

It is a cart similar to the one with gas piston. The difference is that instead of the piston it has some springs. In the normal way the springs are compressed but when the user needs to take things from the shelf of the bottom have the chance to decompress the spring so that it goes up.



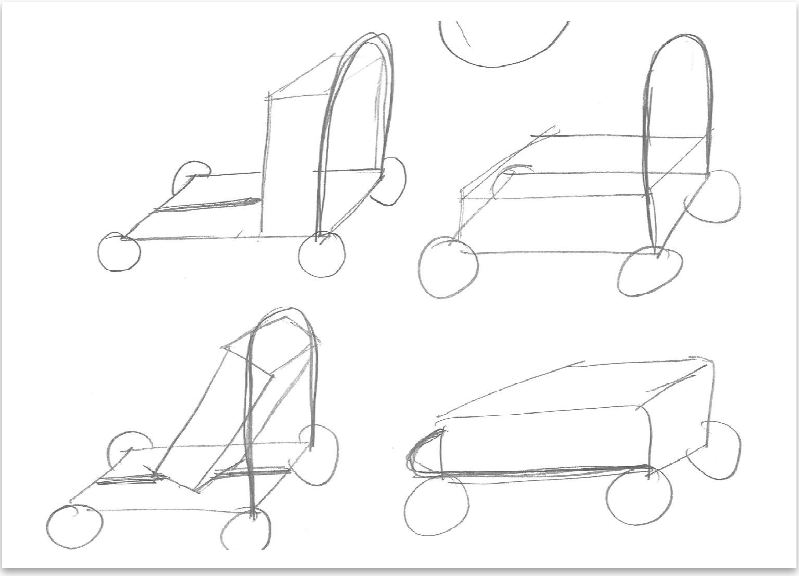


SEVENTH IDEA



Apparently this is a normal cart with two shelves, but the mechanism is quite different to the other carts in the market. Those shelves are connected with metallic bars so, when the user pushes the shelf at the up side, it goes down and the one at the bottom comes up. That cart has a simple structure and is quite easy to fold.

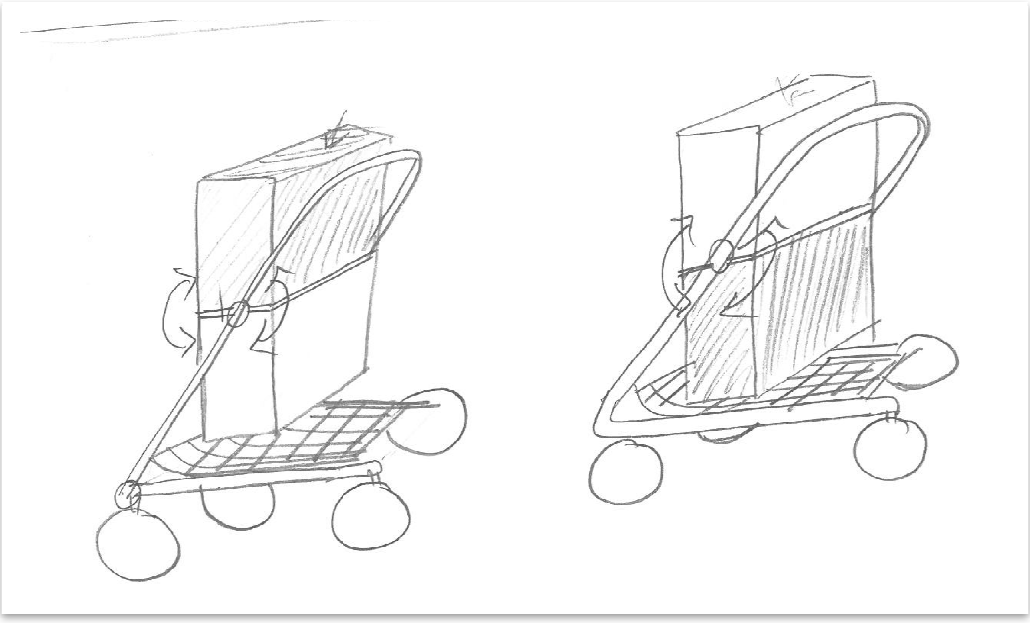
EIGHTH IDEA



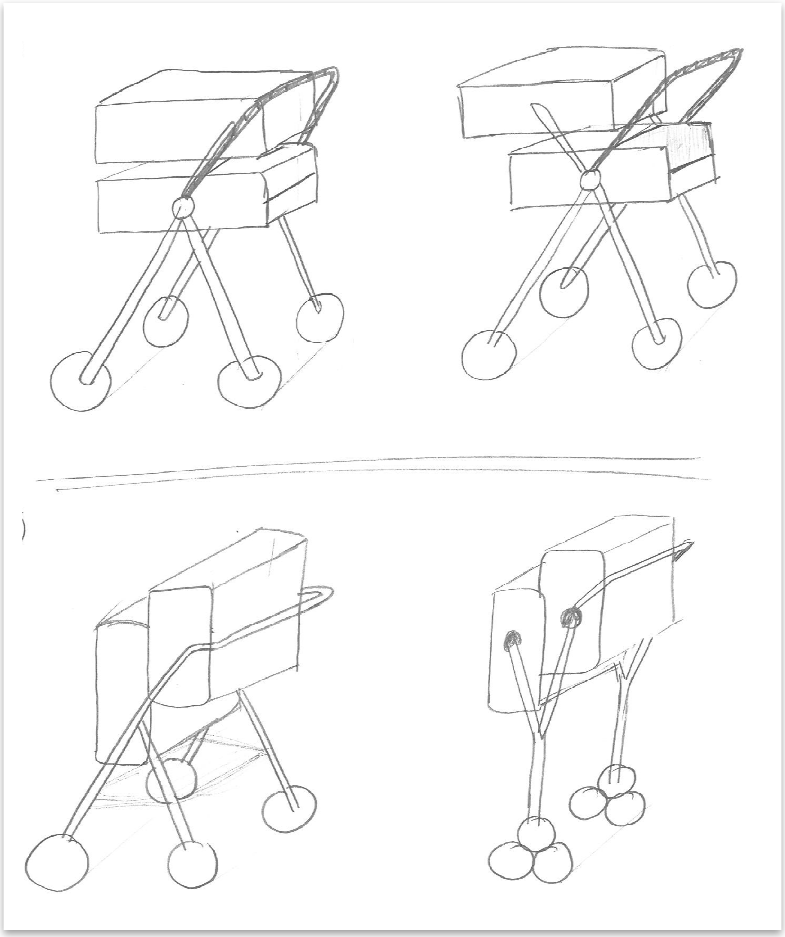
It is a cart shopping in which the load goes in the bottom of the cart and it would be composed for four wheels. To be more comfortable you can move the bag. It would have a guide in which the bag could slide like in the picture. Then, you would have two options to carry. In the first one you only need to push and in the second one, you can fold the handle and you can drag the cart. This option is not possible because it is not good to solve the problem.

NINTH IDEA

In this case, it would solve the problem of ducking. This cart would be composed about two parts. The main idea is that you can turn the bag, so when you have one part full you only have to turn down the bag and continue putting things inside. To allow you to change the position of the bag, the cart would have in the middle of the height a mechanism made up of a shaft.



TENTH IDEA



This alternative we don´t want that the user have to duck, that's why it will have the entire load on the top of the cart.

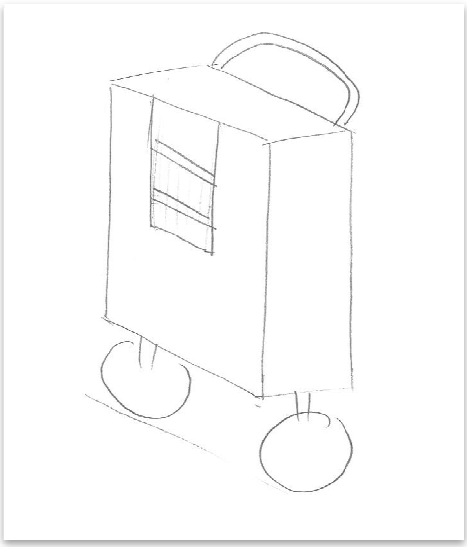
It will be a cart that you can only push. It could have different designs. One of them it would have two bags wider and longer than deeper, and the second one two bags too but in this case deeper than longer.

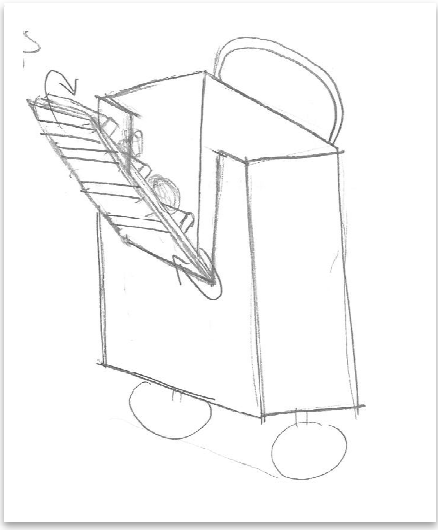
It could have a problem, the center of gravity because the entire load will be on the top and this could cause that the car dump.

ELEVENTH IDEA

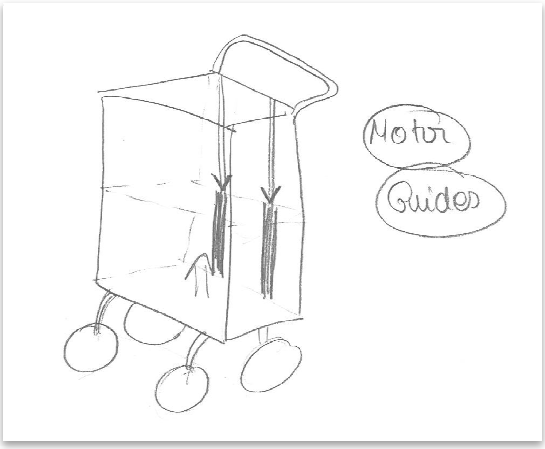
That idea is about the concept of “conveyor belt”. It consist of one part of the cart, that you can open and fold and this part would be a conveyor belt with accessorizes to keep products until go inside of the bag. So, the user don’t need to duck when he want to put products inside.

The problem it will be when the user came to his house and he want to get out his products. In that case the user doesn’t have any option, he must duck to take out his products.





TWELFTH IDEA



This idea would have a motor. The main idea is that you can take up and down the base of the cart without effort and only using the strong of a motor. It could be possible to recharge the motor with the movement of the wheels. But this movement could be difficult only with the recharge of the wheels so it must need a battery to recharge in house. It also need some guides to take up and down the base.

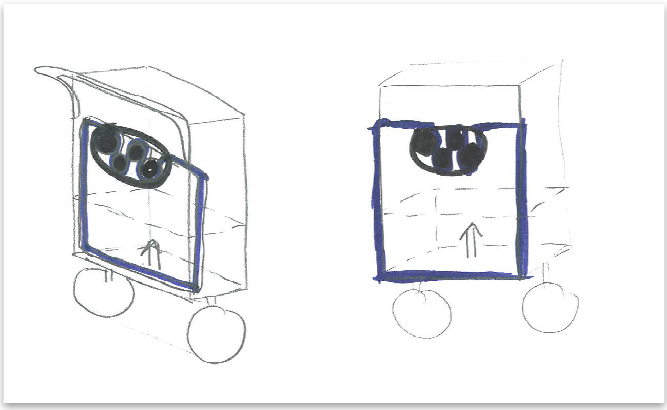
You can push and drag the cart. It would be very good to solve the our main problem. But it requires a lot of strong in the motor and of course a lot of electric energy

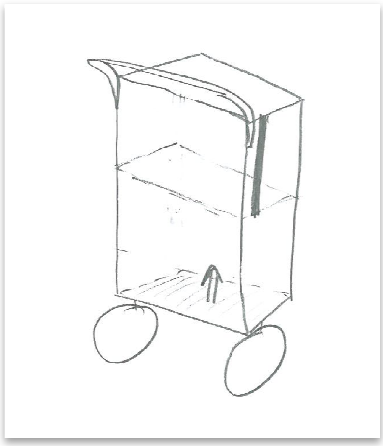
THIRTEENTH IDEA

The main idea in this case would be based on “mountain pulleys” so that you can take up and down the base of the cart. We can use different kinds of pulleys (double, triple) to minimize the effort.

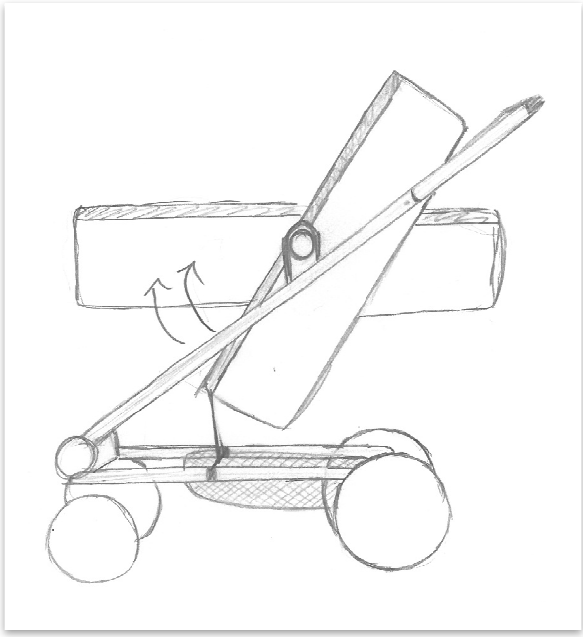
You can push and drag the cart.

Problem: It is possible that we have too much effort that can cause tiredness. So depending on how much is the effort, would be a good or a bad alternative.





FOURTEENTH



Finally, this alternative consists of taking up the load, but in other way. To put things inside you can put the bag horizontal like in the picture, and when it is full, change the position again to carry the cart better. It consists of a mechanism of a shaft with which you can turn the bag from horizontal to vertical.

You only need to push the cart.

7.9 QFD

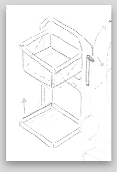
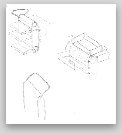
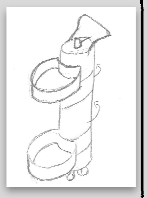
It is good to make a Quality Function Deployment (QFD) transform user´s demands to design quality. It helps us to know in which aspects we must focus in order to make a successful de sign.

QFD												
Product features (Fill in the strength of the relationship with the figure, for example, 1, 3, 9.) →			Material	Shape, design	Weight	Dimensions	Capacity	Number of features	Costs	Set of manufacturing tools	Number of components	Rules and adaptability
↓ **Costumer demands** (Fill in the required weight on the scale 1-5)		**Weighting requirements**										
Interface	Easy to use	5		9	3	9	3	3			3	3
	Intuitive	4		9				3			1	1
	Clear	4		3				3		3	1	1
	View details	2	3	3		1	1	3			3	
Subtotal interface:			6	99	15	47	17	45	0	12	29	23
Physical features	Comfort	5	9	9	9	9	3	3	1		3	3
	Strong	3	9	3	9	1		1			3	
	Stability	3	3	9	9	9	3	1			3	
	Enabling regulatory	3	3	3		9		3			3	3
	Be useful	5	1	9		3	9	3	9		1	3
	Avoid unnecesary movements	5	1	9		1		3			3	3
	Easy to repair	2	3	3				3	3	9	9	
	Allow to carry big and small things	2	9	3	9	9	9	3			1	3
	Facilitate assembly	3	3	9	1	3		3		9	9	1
Subtotal physical features:			133	219	120	149	87	81	56	45	109	63
Moreover	Prevent injury	5	9	9		3		9			1	1
	Use nowadays technology	1	3	3				3	9		3	1
	Respect to environment	2	9	9				9	3		3	1
	Valuable	4	3	9				3	9			3
Subtotal moreover:			78	102	0	15	0	78	51		14	20
TOTAL			**217**	**420**	135	**211**	104	123	107	57	152	106

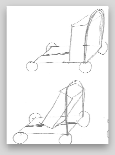
As we can see in the chart above, the most important aspect of the user´s demands that we have to take into account in our design are the material, the shape and the dimensions of the cart

7.10 Selection of ideas

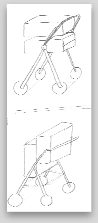
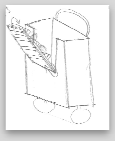
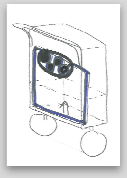
Once we had all our ideas it was time to choose the best ones. To do it, we used the Pugh method so that the selection can be the most objective possible.

		Ref. cart	**1**	**2**	**3**	**4**
USERS DEMANDS	IMPORTANCE					
Avoid to duck	5	0	1	1	1	1
Carry with few effort	5	0	1	-1	-1	1
To be folding	3	0	0	-1	-1	1
Easy to carry	3	0	0	-1	-1	0
Stability	4	0	1	-1	1	0
Smart/modern	3	0	-1	-1	-1	1
Durability	2	0	1	0	1	-1
Adaptable height	4	0	-1	1	1	1
Different level shelves	3	0	1	1	1	1
Adaptable for different enviroments	2	0	1	1	0	1
Able to carry different sized objects	3	0	1	-1	-1	-1
Simple mechanism	1	0	-1	-1	1	-1
Comfortable	5	0	-1	-1	0	1
Light	4	0	-1	-1	-1	-1
			7	**-17**	**-2**	**20**

The chart continues on the next page

		5	6	7	8	9
USERS DEMANDS	IMPORTANCE					
Avoid to duck	5	1	1	1	-1	1
Carry with few effort	5	1	1	1	1	1
To be folding	3	-1	0	1	1	1
Easy to carry	3	-1	-1	1	1	1
Stability	4	1	1	0	1	1
Smart/modern	3	0	0	0	-1	0
Durability	2	1	1	0	1	1
Adaptable height	4	1	1	-1	-1	0
Different level shelves	3	1	1	1	-1	0
Adaptable for different enviroments	2	1	1	1	-1	0
Able to carry different sized objects	3	-1	-1	-1	1	-1
Simple mechanism	1	-1	-1	1	0	0
Comfortable	5	1	1	1	0	1
Light	4	-1	-1	1	1	1
		16	**19**	**24**	**7**	**28**

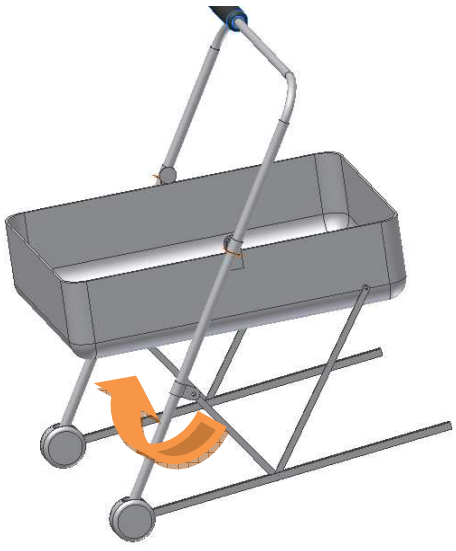
The chart continues in the next page

		10	11	12	13	14
USERS DEMANDS	IMPORTANCE					
Avoid to duck	5	1	-1	1	1	0
Carry with few effort	5	1	1	1	1	1
To be folding	3	1	-1	-1	0	1
Easy to carry	3	1	0	-1	1	1
Stability	4	1	1	1	1	1
Smart/modern	3	0	0	0	0	0
Durability	2	0	0	1	0	1
Adaptable height	4	1	-1	-1	-1	1
Different level shelves	3	-1	-1	-1	-1	0
Adaptable for different enviroments	2	1	-1	-1	-1	1
Able to carry different sized objects	3	-1	-1	-1	-1	1
Simple mechanism	1	1	-1	-1	-1	1
Comfortable	5	0	1	1	1	1
Light	4	1	-1	-1	0	1
		26	**-11**	**-2**	**9**	**36**

As shown in the Pugh analysis, the fourteenth idea is the one which more points obtained. It carries out almost all the demands of the user so we will take this idea and develop it.

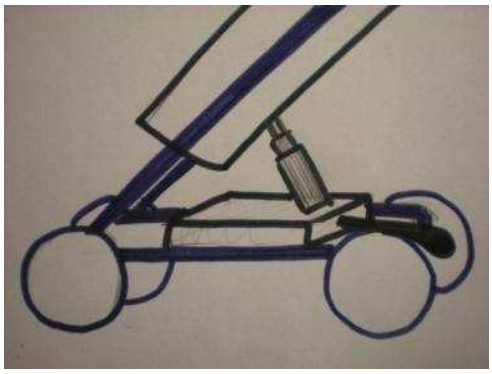
In the selected idea it was not very well defined the way of taking up the cart that is why we started thinking of different ways (mechanisms) that could feet with to lift the cart. We thought that the best mechanism to high the cart was the gas piston because it is light, simple and not very expensive.

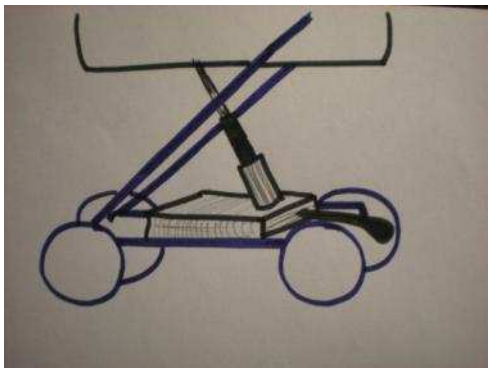
We worked two different ideas in a 3D modeling program based on the gas piston. In the first idea the gas piston is places horizontally, this horizontal movement becomes vertical by some guides, with them we achieve to high the level of the container and also to move it from vertical to horizontal position.



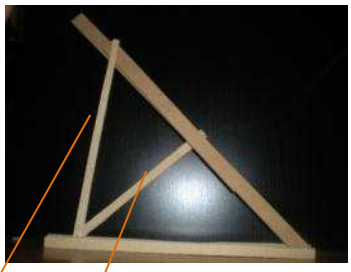
In this picture appears the final position of the cart. It is in horizontal and higher so that it is much easier to take things on and off from the cart.

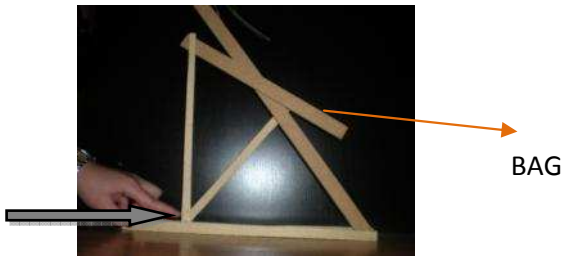
The second idea we had was thinking that the gas piston would high the entire load by itself directly as shown in the picture below. This was more complicated, first because the piston must be inclined and second, because the piston makes the entire effort son that it must be much powerful than in the other way.



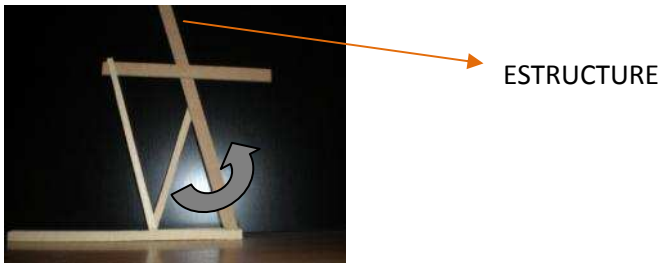


From both ideas that we had modeled we thought that the most viable was the first one so we went to the workshop to see if it could work or not, and if it would be possible to develop some aspects of it.





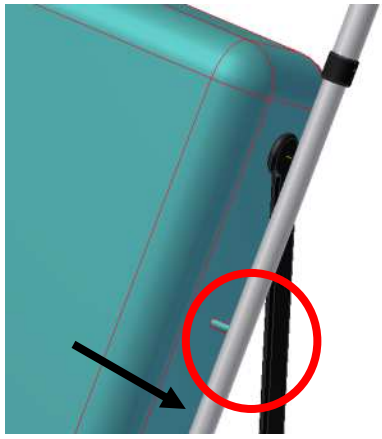
The gas piston would push in that direction



After the turn, it would be the final position

As it is shown on the pictures above, we just made the mechanism of the cart to make sure that it was the correct solution. We appreciated that it was correct so that it meant that we were close to the final result.

We started doing the final modeling of the cart in Autodesk inventor. At first we made exactly the same mechanism that we verified in the workshop, this model had two bars joined in the horizontal rail. The short bar was connected to the structure and the long one to the bag. But we saw that it could not work in an adequate way because of the following reason : folding process was impossible.



When the movement of folding was going to realize the black rail come up with the towing hood and impede the correct folding.

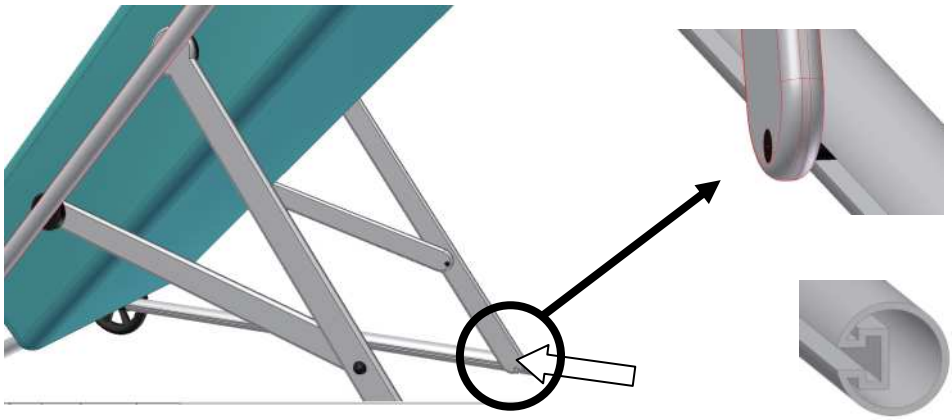
In this first design we also had another problem with de pedal. The pedal was placed in the union bar of the mechanism but we did not realized that in this place when the mechanism was activated the pedal started moving, so it was really uncomfortable.

Those problem´s solutions are explained in the section of “results”

8. Results

The result of this project is a comfortable cart for all types of users. Finally the cart carries out almost all the demands of the user, we will see it on the following steps.

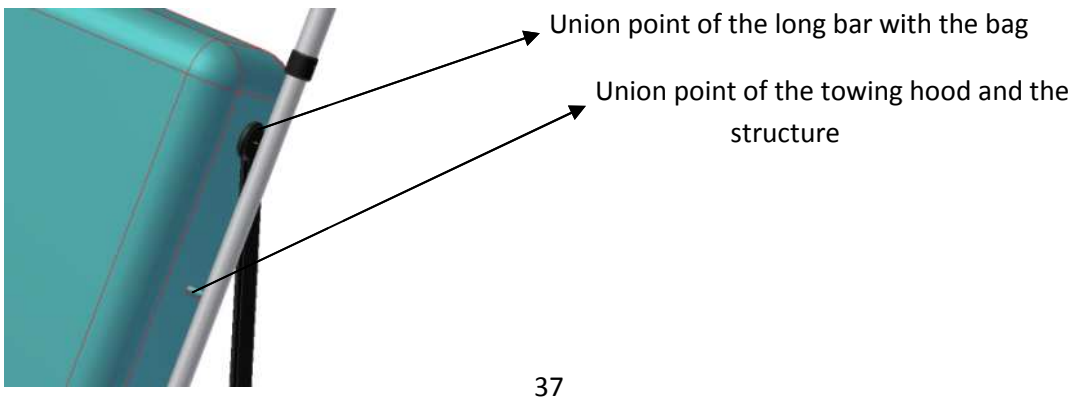
One of the most important demands was to avoid the user to duck, we have finally achieve it by a gas piston. The mechanism consists of two bars connected with 360º movement. One of those bars slides on a horizontal rail with the gas piston´s strength.



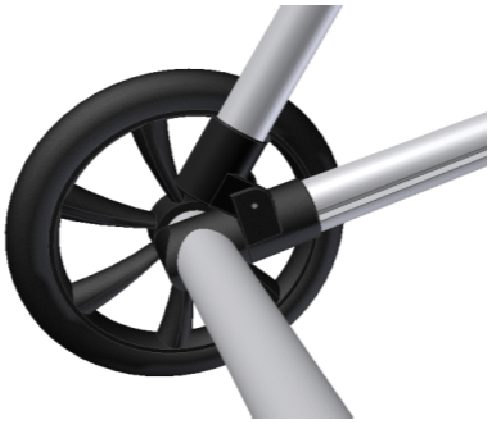
ɛ has a T shape so that
› can slide easily on it

The smallest rail is connected to the bag in order to turn it when the gas piston pushes. On the other hand, the longest rail is joined to the main structure and to the bag at the same time so that with the pistons movement the structure high up its level.

This one is the solution given to the folding problem explained on the page 36. In this way the bars are not joined in the rail so, when the cart is going to be folded the bars must be unlaced to make possible the folding. Only with this change is not enough to fold the cart, the other change we did was to join the towing hood of the bag to the structure and the union of the long bar with the bag in the same point in this way we avoid the collapse of both points.

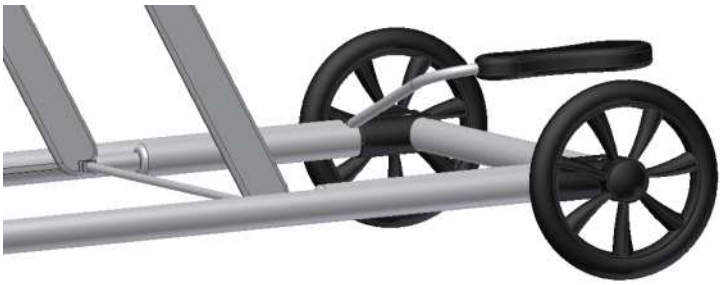


In order to be easier the folding process, we joined the structure´s axles with some strong plastic made hinges.



The cart completely folded would look like the following picture:

The folding process was not the only problem in the first design, there was another problem with the pedal. The location of it was not the adequate one. So we decided to change it and put it on the back side of the piston in order not to be moved when it is activated.



About the environment the demands were that it should work properly not only inside, even outside so the wheel s are strong enough for the snow and outside steps but at the same time are not very big so that it is comfortable to manage inside the house or the supermarket. It has four wheels because we thought that it has more stability and taking into account that it can be a cart for elderly people, we think that the four wheels make the feel sure about themselves.

It was also another demand to be ergonomic. To carry out this function we added some soft rubber on the handle, the rubber avoid sliding the users hands and also makes it more comfortable.

Also for the better ergonomic of the cart, the handle´s height can be changed so that different height people can use it without problem.

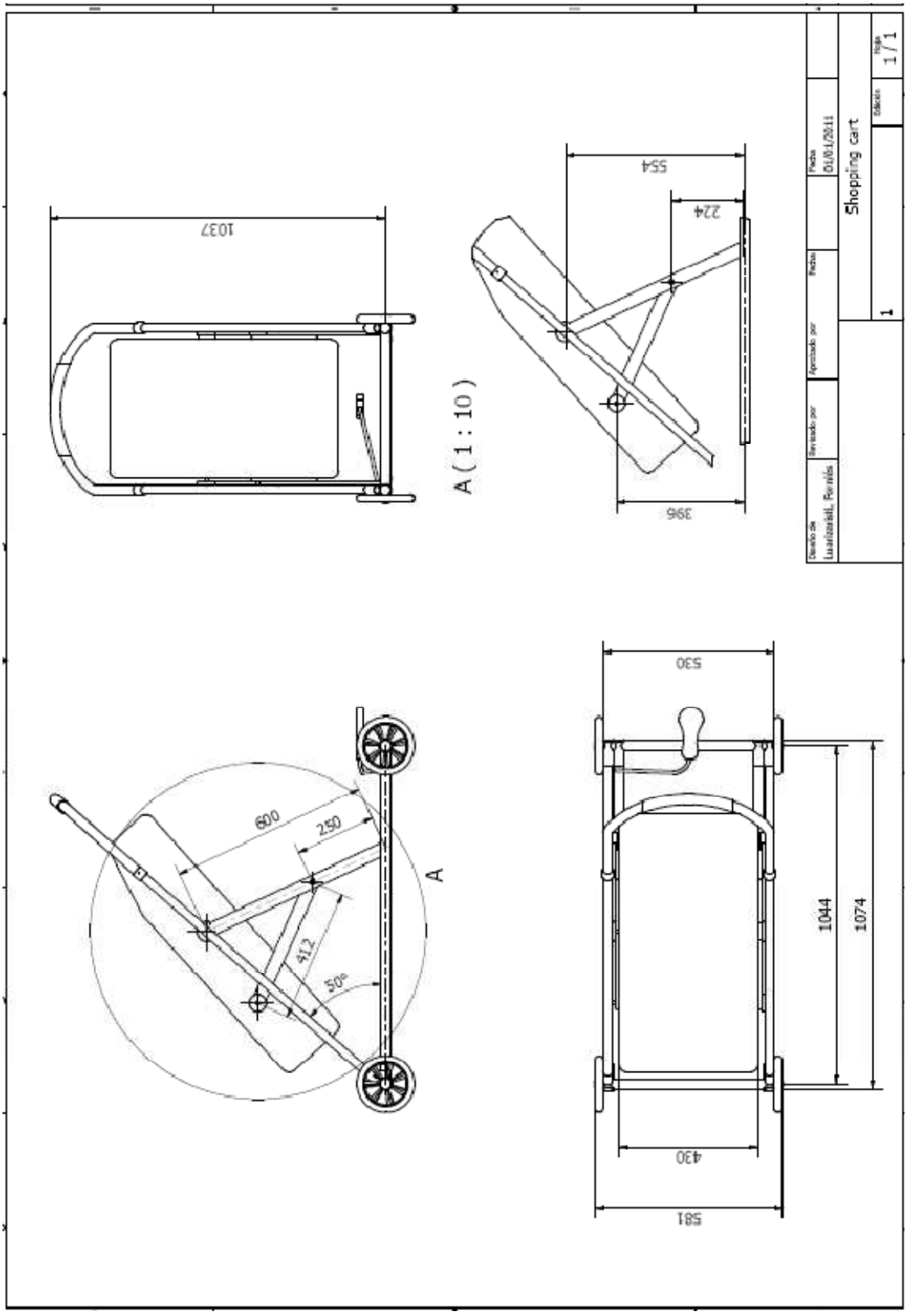
For taller people

The movement of the cart would be the following:

1.- Normal position, to transport the cart . The gas piston has not been activated.

2.- The pedal is pushed so the piston is activated and the cart starts going up.

3 .- This is the final position, now is time to empty or full the cart.


1037
554
224
396
A (1 : 10)
Shopping cart
1/1
530
600
250
412
50º
A
1044
1074
430
581

9. Analysis

In this section it has been analyzed the proposed solution according to the problem of the project.

Problem

The main problem was basically to find a simple way to high the levels of the cart. We focused on it because one of the biggest problems of the user was the effort that she must made to take out the things from the cart. This is a problem that our client has due to her illness but of course, nobody likes to duck to take the things out from the cart so the solution will be comfortable for all kind of users. Nowadays, the ergonomics are really important in design so, to solve this problem we must look for ergonomics charts to adequate our solution to Swedish society´s sizes.

The correct position to high weight from the floor is with the back straight and just folding the knees. In the case o the shopping cart this position is not possible and the user is obligated to fold his/her back. This is really bad for the health so we will try to solve this ergonomic problem.

Development

In front of this problem we decided to explore different mechanisms of the market to see which ones fit better for our project. The ideas were different to each other basically in the mechanism.

The most difficult problem to solve in this project was to achieve the less effort for the user in a light and simple cart. That is why we had to look for a lot of different mechanisms. Finally we think that we achieve the best solution, a combination of everything we needed.

Solution

Finally we chose the gas piston mechanism because we thought that it was the best for our needs. The cart design didn´t change much from the beginning to the end because we thought that it was a simple but good design although we would have had more time we would change some static features.

10. Conclusions & Recommendations

CONCLUSIONS

The main problem to solve in this project was to avoid the user to duck but it was also quite important for Monica to design a smart and fashionable cart.

As it is said before we focused on the problem of having to duck so we tried to find all possible method which could solve this problem. After getting information about all this area we thought that the best mechanism was a gas piston because it was the most simple and it could gave us good results. Maybe, there was some periods that we focused too much in the mechanism and we forgot other demands that also must be carried out.

At the end of the project we have seen that maybe it was not possible to carry out all the user´s demands, for example, we realized that it was quite difficult to put some mechanism in order not to duck and at the same time to obtain a light cart. So finally we tried to reach the best combination of all the demands.

The result of this project is a cart concept. It is not a final product that it is completely defined. We think that everything would work in this way but still needs a fully development.

RECOMMENDATIONS

For future work it would be good to focus on the lightness and physical appearance of the cart because I think those are quite important aspects that maybe are not totally carried out.

The outside design of the cart could be much more modern but we have done it in a simple way, thinking that the shape define the function of a product. But of course some aspects can be changed in order to obtain a more beautiful cart.

While the design of the cart we thought to develop different bags for different functions, for example the user do not need the same bag to do a big shopping in the supermarket and to buy a pair of trousers or to change a carpet from the bedroom to the living room. To carry out those needs the different type of bags must be developed.

11. References

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http://articulo.mercadolibre.com.co/MCO-14553146-arnes-especial-para-cargar-de-2-personas-trasteos-_JM
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Books:

Guía práctica del Diseño Industrial. Juan Manuel Ubiergo Castillo *(Practice guide of Industrial Design by Juan Manuel Ubiergo Castillos)*

Diseño industrial: desarrollo del producto de Sanz Adán, Félix y Lafargue Izquierdo, José. *(Industrial Design: Product development by Félix Sanz Adán and Lafarge Izquierdo.)*

¿Cómo nacen los objetos? Apuntes para una metodología proyectual. Bruno Munari. *How the objects can born? Notes for a Project methodology by Bruno Munari)*

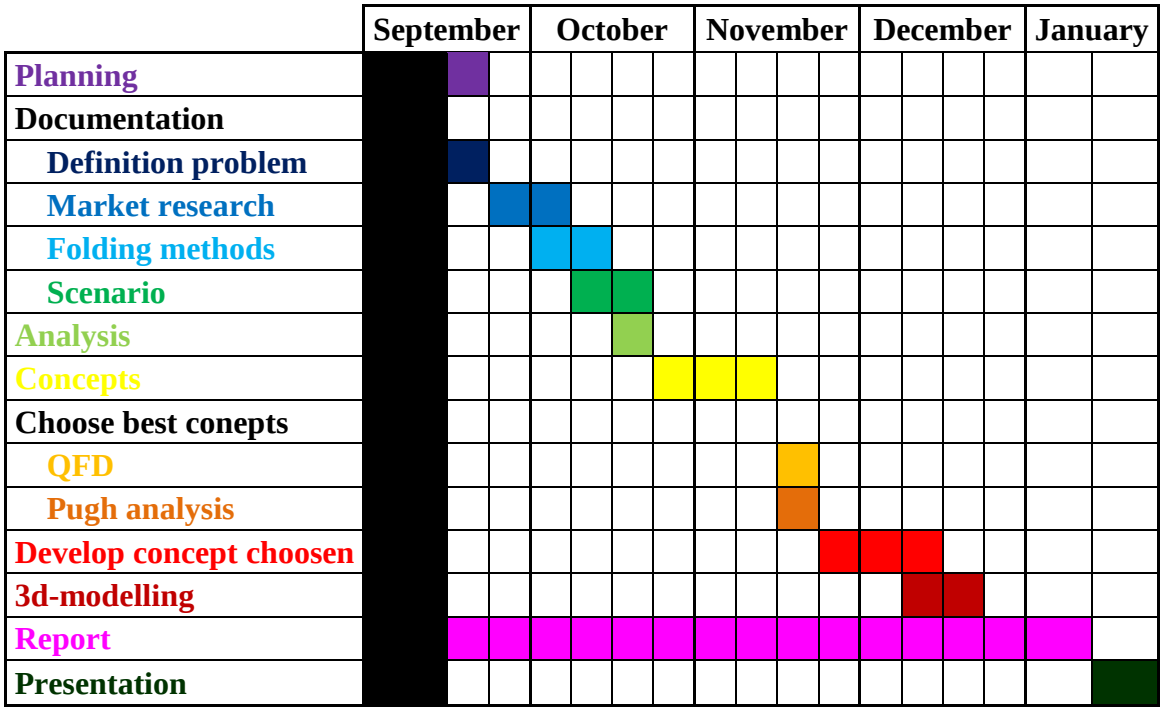
Creatividad y transformación. Teoría y técnicas. Gilda Waisburd. *(Creativity and transformation. Theory and techniques by Gilda Waisburd.)*

Psicología de la creatividad. Manuela Romo. *(Creativity phychology by Manuela Romo.)*

12. Appendix

I. Planning

Our project will be developed in four months. It is important in every project make a planning, so that we have one sketch in which we will put everything that we have to do and we distribute all the time.



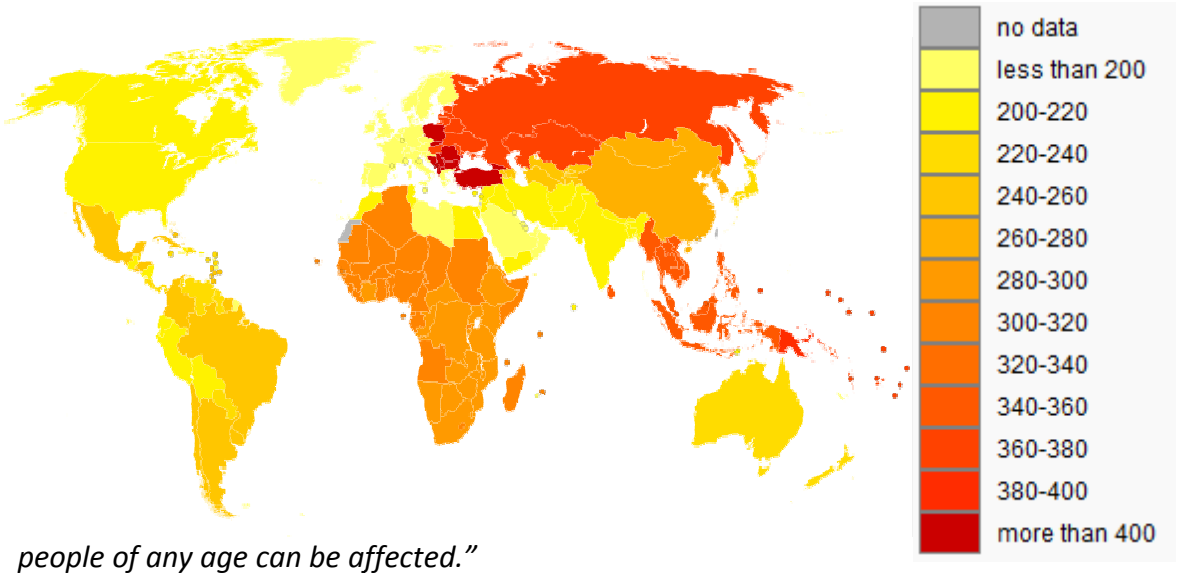
Documentation

All the information about the project that we have search is here.

- Definition of the illness:

"Degenerative arthritis or degenerative joint disease is a group of mechanical abnormalities involving degradation of joints, including articular cartilage and subchondral bone. Symptoms may include joint pain, tenderness, stiffness, locking, and sometimes an effusion. A variety of causes hereditary, developmental, metabolic, and mechanical may initiate processes leading to loss of cartilage. When bone surfaces become less well protected by cartilage, bone may be exposed and damaged. As a result of decreased movement secondary to pain, regional muscles may atrophy, and ligaments may become more lax".

"About 1% of the world's population is afflicted by rheumatoid arthritis, women three times more often than men. Onset is most frequent between the ages of 40 and 50, but



people of any age can be affected."

Information from Wikipedia: rates from Osteoarthritis by country (per 100,000 inhabitants).

- Market research:

There are several ways to carry things.

On the head

On the back

On the shoulders

With the hands

with the help of machines

Wheels

suitcases

We can find all kinds of shopping trolleys:

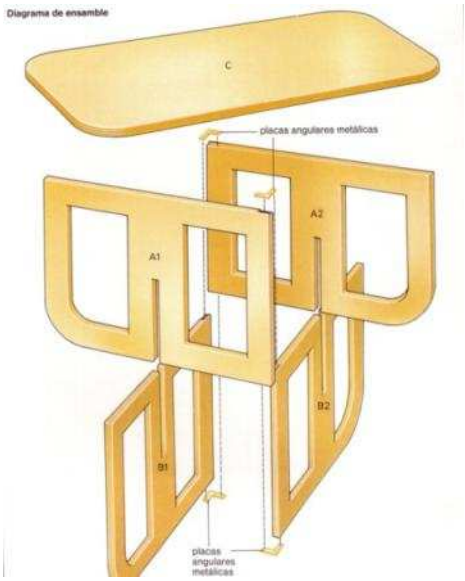
i. Trolleys with two, three or four wheels.
ii. Trolleys with thermal bag.
iii. Folding trolleys made of cloth and made of plastic.
iv. Metal baskets.

Scenario:

The scenario of our product will be the supermarket, the street, the garden… every place that the user will need the help of the cart.

Folding methods:

We look for different folding methods in order to get ideas to fold the shopping cart.



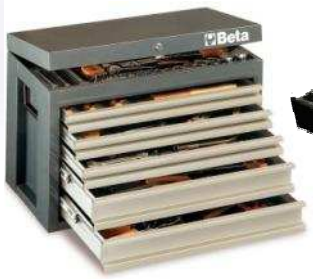
Telescopic tubes and rails:

Different ways to lock:

Under pressure

Locking with rotation

Mechanical regulation:

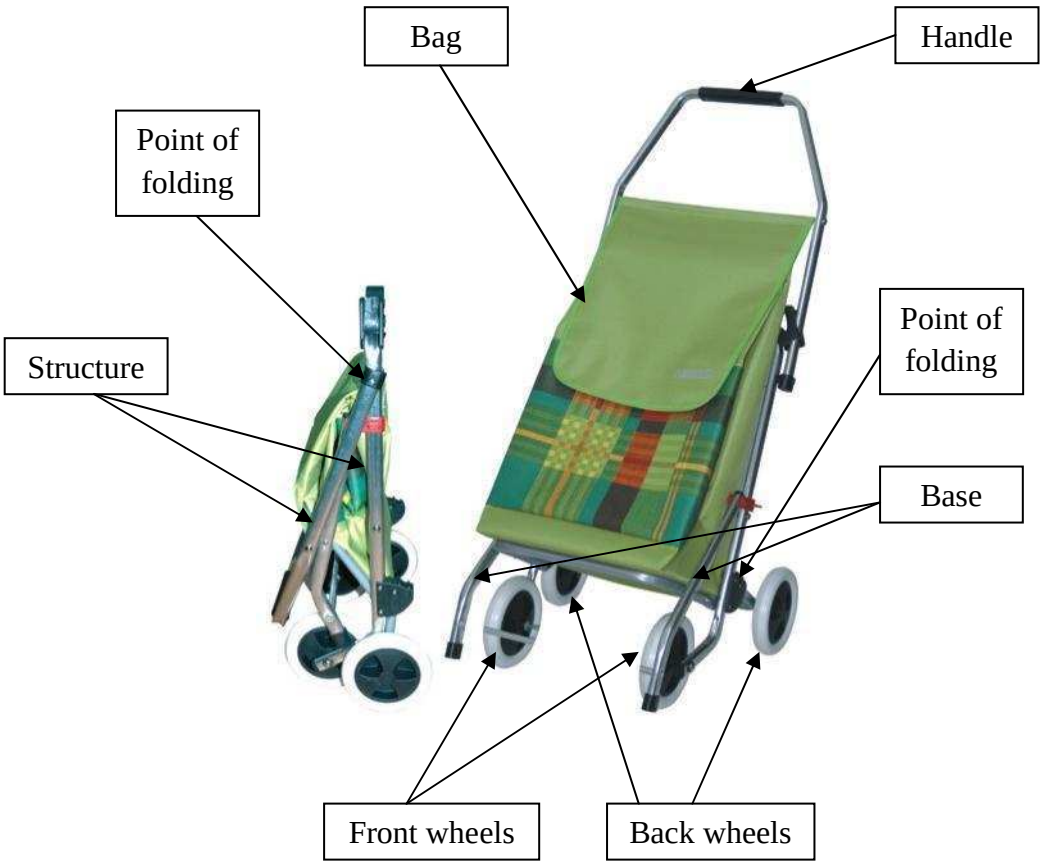


Gas tubes:

- Figure analysis

It is very important to know the structure of the shopping cart to do a good develop, with pictures and details of the object.

Here we are going to analyze several things: how many parts compose a shopping cart, how looks, the design, semantics connotations, connection between user and figure and connection between environments and figure.



How looks	Rectangular shape. The structure use to be fold.
Graphic design	The design depends on the type of the user. It is used darker or brighter colors, with squares or circles and different materials for the bag.
Semantics connotations	Values and simple shapes give to the object seriousness and neutrality but sometimes there are developed designs which can achieve values of sophistication or technology.
Connection figure/user	The form is appropriate always with the function.
Connection environment/figure	Neutral design homogenized with the rest of objects of the special environment.

- Functional analysis:

The main function of the shopping cart is:

To carry

Besides of the main function, there are several secondary functions. These functions are carried out by the different parts that composed the shopping cart, that's why we have done previously the study of the figure. Knowing all the parts and their main functions, we can study the possibility of add new secondary functions, reduce the number of pieces or collect up two functions to be carry out by only one piece.

So that, we are going to do a table with the different parts of the shopping cart and the secondary functions. With that table, the study that we have talked about is going to be easy.

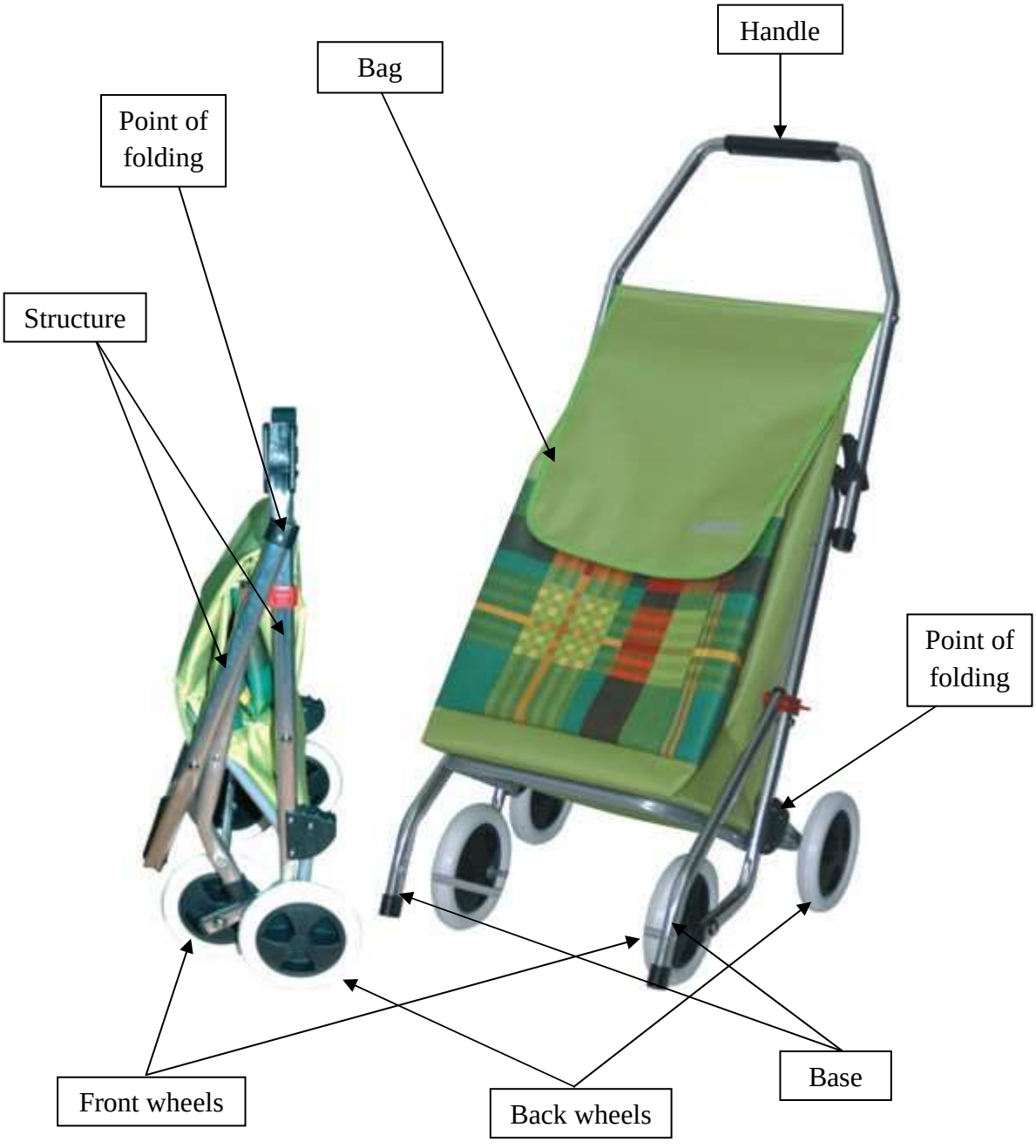
Shopping cart parts	Function
Handle	• Grab • Push/pull
Bag	• To keep the things • Light • Durability • Smart
Point of folding 1	• Strong • Small • Allow folding of the structure
Structure	• Strong • Hold everything together • Resistant • Light • Adjustable height
Front wheels	• Move the cart • To turn
Back wheels	• Move the cart without effort • To turn • Be folded • Stability going on
Base	• Strong • Stability when the cart is resting
Point of folding 2	• Strong • Small • Allow folding the back wheels

- Technical data:

Here we are going to study the components of a common shopping cart. We will define every element in three levels which are included in the communication between user and product. These three levels are Syntactic, Semantic and Pragmatic.

Syntactic description is going to be physical, the shape and approximately dimensions. Semantic level includes telling us how this part is and pragmatic level will explain how this part tells us the message.

The easier is to understand these meanings, the easier is to use the object. So it is very important to take care about the relationship between the object and the future user, so that he or she will never have problems during the use.

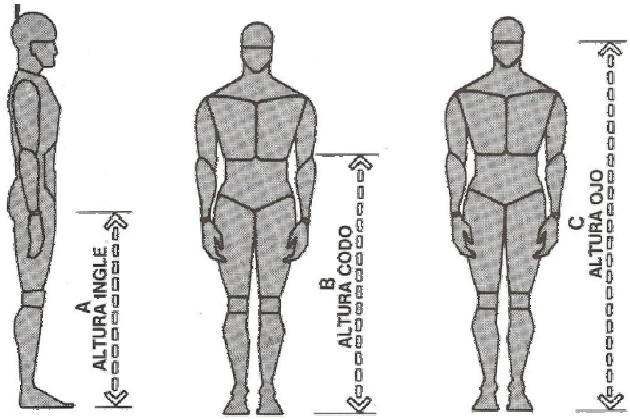


Elements	Syntactic	Semantic	Pragmatic
Handle	Black plastic tube with a softness touching	It is not as cold as the structure. It can be holded	Place where you put your hands and push
Bag	Square bag made of cloth	It´s soft	Place to put all the things bought
Point of folding 1	Piece of plastic that allows the movement of the handle to fold it	Resistant to the movement	Place where the part of the structure turned down
Structure	Tubes made of metal joined by screws and with two points of holding	It is adjustable, folded and support whole the weight	You can fold the structure to reduce the height.
Front wheels	Two wheels made of plastic	They are fix	You can carry the cart only with those ones
Back wheels	Two wheels made of plastic	You can fold them	You can carry without too much effort using those two wheels
Base	Tubes made of metal with two pieces of plastic	Used only when works the front wheels	If you need to leave the cart and you are using only the front wheels, you have to put the base on the floor
Point of folding 2	Piece of plastic that allows the movement of the back wheels	Resistant to the movement	Place where the part of the structure of the back wheels turned down

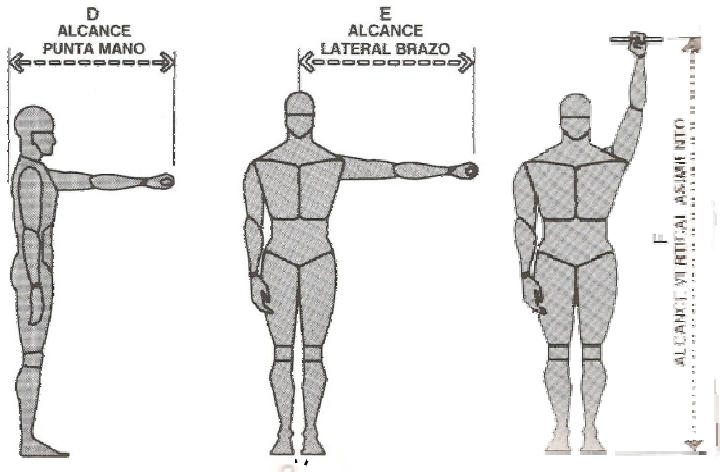
- Anthropometry and ergonomic:

Body: Dimensions of adult men and women in inch and cm depending on how old are they, the sex and percentiles.

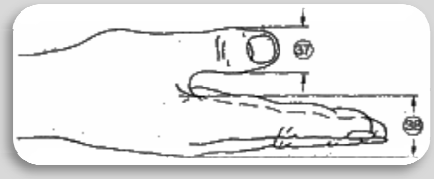
Percentils	Sex	A	B	C	D	E	F	G	Peso (Kg)
95	Men	91,9	120,1	174,2	94,0	120,9	155,7	188,6	97,7
	Women	81,3	110,7	162,8	94,0	108,7	141,4	172,8	74,9
5	Men	78,2	104,9	154,4	81,3	105,5	136,5	168,2	65,2
	Women	68,1	98,0	143,0	68,6	96,5	122,9	152,3	47,4



Percentils	Sex	A	B	C	D	E	F
95	Men	97,3	117,1	131,1	88,9	86,4	224,6
	Women	92,2	124,5	124,7	80,5	96,5	213,4
5	Men	82,3	100,1	149,9	75,4	73,7	195,7
	Women	75,9	86,4	140,2	67,6	68,6	185,2



Hand and fingers:

		PERCENTIL					
		Men				Women	
		5 %	50 %	95 %		5 %	50 %	95 %
37	**Width of the thumb**	2,0	2,3	2,5		1,6	1,9	2,1
38	**Width of the hand**	2,4	2,8	3,2		2,1	2,6	3,1

- Biomencanichal

Shoulders and elbows: