BACK IN THE BOAT

A SAFER BOATING EXPERIENCE

MASTER THESIS PROJECT

ADVANCED PRODUCT DESIGN
Umeå Institute of Design

MALIN ANDERSSON
2014

In collaboration with Sjöräddningssällskapet

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Content

introduction

01.

INTRODUCTION

I have always been interested in spending time at sea and when I started to look into the subject of safety issues in this context, I found some interesting statistics. The fact that I found the statistics quite surprising, is probably in itself a manifestation of the statistics.

Because people did not die where I thought they would be dying. I thought people would be at a big risk in bad weather, high waves and far from the shore and safety. That was not the case. Drowning is understandably the biggest risk at sea. But people do not drown far out at sea, succumbing to bad weather. At least not most of them. They are drowning in smaller lakes and rivers, quite close to shore, often alone in small open boats.

I suspect my surprise to the statistics is a manifestation of the very root of the problem. People who spend time at sea do not feel threatened in those situations. They largely underestimate the risk, and overestimate their own ability to save themselves in those situations.

This is typically one of those issues I find fascinating to work with as a designer, where the human factor is at center.

I decided to pry into this area to see if I could do anything about the problem. What I found was that it really comes down to “boat or float” as a researcher put it. I ended up focusing on getting back in the boat after one have fallen overboard.

ABSTRACT

My result address the problem that getting back up in the boat after one have fallen in can be very difficult. My research led me to focus on the very smallest boats, rowing boats and open motorboats under 6 meters in length.

My solution to the problem is to provide an easily attached footstep that can be reached and pulled down from water level. The product can be adapted to different boats. For the smallest boats, manually activated flotation units can be integrated to prevent the boat from tipping.

40

In Sweden, around 40 people die every year from leisure boating related accidents.

10-20

In Denmark, 10-20 people drown every year from boating related accidents. To that number there must be additional deaths from other causes than drowning. Speed boat crashes for example.

30

Around 30 people die from drowning only every year in New Zealand from leisure boating activity.

700 =

In the United States of America there is about 700 deaths per year (2011 National recreational boating survey) and the numbers have been leveling off since the 90's. That is more than an airplane crash a year. This numbers represent all deaths during recreational boating.

FATAL ACCIDENTS AT SEA

Almost all deaths by boating accidents could be avoided if people used the safety equipment that is available, life jackets, personal emergency transmitters, stayed away from alcohol and took a course in boating safety. The problem is that people do not use these items, and do not follow recommendations. Tough luck? Or could safety be improved in another way? Laws could have an impact, but the reinforcement of such laws would be difficult except for some places where there are many boats passing by each day, such as some harbours and canals.

I believe it is worth a try to adopt safety measures to the consumer in a better way.

The European Union, EU, will sharpen its regulations around boating and safety. For example new boats must float in their inverted position (i.e. Upside down), and there will be sharper rules regarding floatation devices and emergency equipment. The regulations is still under revision at current date (2014-12-23).

ABOUT ME

I happened to grow up in a family that spent a lot of time on the water. I have been sailing my whole life and spent time in various types of boats, both for sport and recreation. I understand what important role the sea plays in many peoples life, and this is the reason I wanted to explore this area as a thesis topic. I decided to look at safety issues in relation to recreational boating.

I have been studying in the Swedish town Umeå for both my bachelor and my master degree in industrial design. I am interested in design that can make a difference and be really useful to people.

SVERIGES SJÖRÄDDNINGSSÄLLSKAP, SSRS

I was collaborating with Svenska Sjöräddningssällskapet, SSRS (Swedish sea rescue society). Sjöräddningssällskapet takes care of about 70% of all rescue missions at sea or in water in Sweden. They are operating by volunteering means only, and all money for the operation is coming from members fees and donations.

They took part in this project by contributing with information, providing contacts and by giving me access to observation possibilities. They did not sponsor the project with money.

1 www. https://www.transportstyrelsen.se/sv/Sjofart/Statistik/Fritidsbatar/

RECREATIONAL BOATING

I am focusing on recreational boating, rather than people who are at sea by profession.

Recreational boating can take many forms, from the alone fisherman in a small open boat to a family vacation on a sailboat, or anything in between.

The Nordic countries, United States, Canada, Great Britain, France and New Zealand are some of the big boating nations in the world. Some of these countries have been included in my research regarding accident statistics.

HOW TO BE SAFE AT SEA?

According to Fredrik Frode at Baltic, a Swedish company that produces and sell life jackets and other clothing items, published in an article in www. dagensbatliv.se 2014-01-13, this is what a person should wear to be really safe at sea. (Keep afloat, not drown from inhalation of waves or from hypothermia and be found easily.)

A flotation overall (even better dry suit but not many people find those practical to wear). Estimated price: 2400 SEK

A life jacket 150 N with hood (see picture), crotch strap and emergency light (very few life jackets have lights built in).
Estimated price: 2000 SEK

AIS emergency transmitter. Enables you to be seen by navigation systems of nearby vessels.
Estimated price: 3000 SEK

Waterproof mobile phone case. Estimated price: 300 SEK.

Emergency light rocket. Estimated price: 500 SEK

Total: 8200 SEK, or 1125 US dollar (5th of February 2014)

The total price is an estimation based on store prices when the article was made. My perspective is that it is a lot to pay for a situation that most people calculate never will happen.

research

02.

RESEARCH:

METHOD

I started looking into the topic of safety at sea in a broad picture to determine where my skills as an industrial designer could create the biggest benefit. I did so by gathering insights in the field to be able to map out problem areas.

ACADEMIC RESEARCH

I will look into safety statistics of accidents related to boating and water rescue, in an attempt to get an overview picture of where which accidents happen and how. I will compare statistics between different countries and try to map the differences. For example to see if different laws and legislations have an effect, for examples alcohol laws and mandatory use of life-jackets. In Sweden, there is no law that says that a life-jacket has to be worn, only that one should be present on the vessel for each member of the crew. In Norway however, there is such a law.

Different countries have different systems and different conditions for rescue at sea or waters and different conditions for gathering statistics about it. Sweden have a volunteering rescue service who has limited resources. Data of accidents is also to some extent lacking in details. By comparison, Sweden also has a relatively small population and the number of accidents are relatively small.

As a comparison, the American statistics up to 2012 provide a much larger database of statistics and also more detailed information about the type of accident.

Different countries also have different cultures and the habits of being at water may differ.

A final reason for gathering statistics from different countries is also to detect different patterns in different climates. What role does water temperature have? Initial research shows that it has great importance. I will therefore also look for more research regarding rescuing victims with hypothermia.

Some relevant questions I will try to answer are for example: What effect will a law about life-jacket use have on the statistics? Have countries that have made such a law actually seen a decrease in deaths, or do people ignore the law because of small chance of getting caught? The law usually only require people to have a life-jacket for all people in the boat, not to actually wear them. This may result in a pattern where people only have the life-jackets in the boat, but not actually wear them. Is this the case in the countries that have such laws?

The international research I will limit to these nations: Sweden, Finland, Norway, USA and New Zeeland. This selection is based on the fact that these countries are in the top when it comes to number of boats per capita.

I will try to look at both boating safety as well as general drowning statistics. It may be difficult to look closely on accidents that where not fatal, because there might be quite small amounts of data on this area.

EXPERT INTERVIEWS

Initially, I tried to talk to people who has a wide understanding of safety at sea and water rescue missions. I did so to get a wide overview over the subject and the difficulties that could be opportunities to work with.

First of all, I talked to the people in charge at the SSRS station in Umeå, Örjan Ovesson, and volunteering rescuer Magnus Jonsson.

I interviewed Johan Ledin, Command at Sjöfarsverket (Coast guard) helicopter rescue in Umeå. He has been in the helicopter rescue for 10 years and have seen a lot of different accidents and scenarios. The helicopter rescue services can be called in on missions where the coast guard is responsible for the main rescue, as well as waters that are the responsibility of the municipality.

I also talked with Fredrik Falkman, industrial designer and head of innovation and development at Sjöräddningssällskapet, SSRS.

USER STUDIES

The user studies was in an initial stage limited to the study of the rescue service. The sea rescue organization in Sweden, Sjöräddningssällskapet, or SSRS, have exercise drills the whole year around, although at the time of this projects research phase, I could not find any exercises that involved actual training such as handling of boats or simulated victims.

Instead I attended one of the SSRS self rescue courses at a training facility in Öckerö, near Gothenburg in Sweden, about a week into the research phase. This course was aimed at educating the “rescuers to be” about how they can stay safe themselves. This information could therefore be of value to anyone who want to stay safe at sea. This course took place at the time I was starting up the ideation phase of the project, and served as a final base for concept direction.

MARKET OVERVIEW

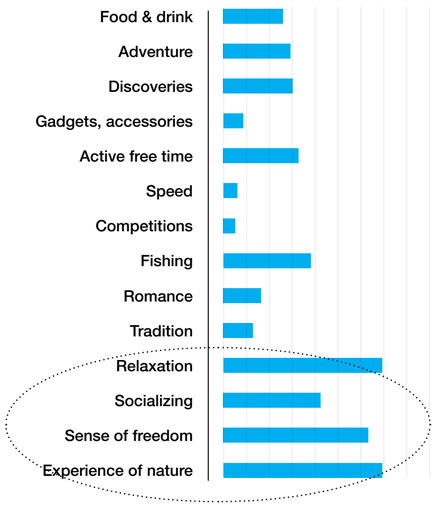
In order to get an overview, I mapped out the areas of related safety products for the consumer market.

ACADEMIC RESEARCH

WHY PEOPLE LIKE BOATING AND THE SEA.

According to a study made in Sweden 2005, "the boating life of tomorrow"[1] the main reasons people want to spend time at sea or on water is the experience of nature, sense of freedom, relaxation and socializing.

This study is only reflecting Swedish conditions, and is based on the "båtlivsundersökningen 2004" (boating lifestyle research), and interviews by phone and focus groups. Even if the study reflects only the Swedish market it gives a hint to what people value when they are spending time on water.



1 Morgondagens båtliv2005/6, by RealityCheck AB

ACCIDENT STATISTICS IN BIG BOATING NATIONS

Boating accidents with deadly outcome, see references page 131 - 140.

SWEDEN

40-69

Most of the deadly accidents happened to people above 40 years old.

18%
Of all drowning victims related to boating accidents had a alcohol related diagnosis

90%
Of the drowning victims in boating accidents were men.

The last 15 years the decline in boating related deaths have leveled off to around 40 deaths per year.

MAY
JUNE
JULY
Most accidents and drownings

95%
Of all alarms are made by mobile phones.

LAKES
64%
OF WHICH SMALL LAKES
54%

DENMARK

45-65

Most of the deadly accidents happened to people above 45 years old.

16%
Of the drowning victims in boating accidents had been drinking alcohol.

95%
Of the drowning victims in boating accidents were men.

92%
Of the victims in all boating accidents where **not** wearing life jackets.

FALLING OVERBOARD
CAPSIZED/ SINKING BOAT
Are the two most common causes of drowning.

31%
Of those who drowned in boating accidents where fishing or hunting.

OFFSHORE & COAST (FJORDS)
88%

NEW ZEALAND

15-65

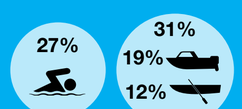
Deaths are equally distributed among age groups from 15 years and up.

16%
Of the drowning victims in boating accidents had been drinking alcohol.

97%
Of the drowning victims in boating accidents were men.

54%
Of the victims in all boating accidents where not wearing life jackets.

Having means of calling for help is seen as equally important as having a life jacket



RIVERS
27%
OFFSHORE
15%
LAKES & PONDS
13%

USA

35-55

Most deathly accidents are among 35 to 55 year olds.

17%
Alcohol was the leading contributing factor with 17%

70 - 79 F (21,1 - 26,1 C) most accidents occur but only 11% is lethal.

40-49 F (4,4 - 9,4 C) is 46% of all accidents lethal.

85%
Of the people who drowned in boating accidents where **not** wearing a life jacket.

DECEMBER
MARCH
APRIL
Higher percent of accidents are fatal. (But most accidents happen during June and July)

70%
Of boaters who drowned where using vessels smaller than 6,4 m (21 feet).

LAKES & PONDS
54%
RIVERS
27%

RESEARCH CONCLUSIONS

Almost all of the victim are men.

The clear majority are above 45 years old.

Alcohol is an important factor, but not the whole problem.

Small boats under 6 meters in length is the most common boat type to be involved in an accident.

Inland waters such as lakes and rivers and coastal areas are the locations where most accidents happen.

Water temperature seems to play a large role for how likely it is that an accident has a deadly outcome.

People underestimate their ability to swim in cold water.

In all areas I have researched, except New Zealand a clear majority of those who drowned did not wear a life jacket. In New Zealand about 50% had one, and means of alarming the accident was seen as equally important.

It is clear where most fatal accidents happen, and what group of people who is most often the victim. The statistics of course reflects the usage of the boats. There are more people out on water in the summer when the water is warmer and therefore more accidents happen at that time. Going out on sea alone to fish is also culturally an activity most common among men, and there are many more boat owners who are men, so that the victims are mostly men is not that surprising. It is difficult to know how much alcohol had been consumed before the accident if the victim is not found immediately. That many who drown are lacking a life jacket is clear, and that is interesting because it is the simplest lifesaver, not expensive and new flotation garments are coming out on the market that should reduce any stigma around the life jacket wear. On the other hand, some people I have talked to say that wearing a life jacket only increases the chances of a decent funeral.

MARKET RESEARCH PERSONAL SAFETY: LIFE-JACKETS

Traditional Safety

Modern Fashion

Most protective. Made to hold the users head over water, Clumsy- strong signal colors. Mostly seen on children who cannot swim.

Sport life-jacket. Do not hold the users head above water, but it is easier to move and swim. Used mostly by people who perform water sports such as wake boarding, water skiing, surfing or some types of sailing.

Inflatable life-jacket. Common today by people who spend a lot of time on sea but who do not expect to need it frequently (for fishing- sailing- cruising) There are types that require a manual trigger and types that are supposed to inflate themselves as the user lands in water. Both types needs regular checks to ensure they will function.

Similar to the sport life-jacket, but with a fashion appeal.

Fisherman's life jacket/ fishing west. Provides pockets and a style that associates more with hunting.

A life jacket- jacket. Flotation aid is built into a regular jacket.

MARKET OVERVIEW FOR PERSONAL SAFETY EQUIPMENT

Traditional lifebuoy. Is most often seen in harbours- and on bigger ships.

This kind is often seen on smaller boats.

This is an example of a floating line to throw out to a person in the water.

Inflatable life rafts like these is very expensive to buy and almost never used on small boats.

Light to be attached to a life - buoy

AIS transmitter. Sends a GPS signal if triggered. Personal device.

LITERATURE STUDY: “ESSENTIALS OF SEA SURVIVAL”.

The book “Essentials of sea survival”, by Frank Golden and Michael Tipton, 2002, is a often referenced piece about drowning accidents. It’s main points in the beginning chapters is that immersion victims mostly drown as a consequence of cold water, but not often due to hypothermia. The authors of the book argue that most people die as a result of either the cold shock that occurs when a person is quickly immersed in cold water or as a result of the later stage of cold adaptation.

In the first stage, that occurs almost immediately after immersion, and lasts from three to five minutes, the immersion victim experiences an involuntary gasp reflex, followed by hyperventilation. This happens to everyone who is not on a daily basis immersed in cold water. It takes several minutes before the victim can gain control over the breath. During this time there is a high likelihood of drowning if the victims head is not held above water.

In the following stage, called cold adaptation, the body adapts to the cold in an effort to restore body core temperature. This means that the blood vessels in extremities are contracting (vasoconstriction) to prevent loss of body temperature. This also has the effect that the muscles in particularly the arms and hands gets weaker and also stiff. Depending on water temperature this stage is developed after 10-30 minutes. It becomes more and more difficult to swim and the swimmer gets a more upright position in the water, with short and quick arm strokes. This is tiering and ineffective and eventually results in swim failure. Any operation that involves grip strength or fine movements of the fingers quickly becomes impossible. If there are no means of flotation, the user will sink because he or she can no longer swim and keep the head above water. Holding on to a boat hull can also be too tiering after some time.

For the victim to develop hypothermia on the other hand, which is a lowering of the core body temperature below 35 degrees Celsius, the body must be immersed in cold water for a longer period of time. Over 30-60 minutes depending on the water temperature. Most drowning victims die before this happens, and that is why most drowning victims are found without life jacket, if they are found at all. This is a common misconception among people, and many drowning victims has incorrectly been assumed to have died from hypothermia.

Something that also caught my interest is the many descriptions of the panic of the victim- and at a later stage apathy and disorientation that prevents the victim to aid in his own rescue. There are examples where safety lines has been thrown close to a conscious victim who has made no visible attempts to catch it.
My conclusion is that you have a very short time frame in which you can effectively save yourself if you are immersed in cold water. I think that many people believe they can swim to rescue, but that is not always the case.

The reason most people are drowning, is that they cannot keep themselves afloat during the two first stages previously described. More than half of those who drown, do so before they have reached the stage of hypothermia. Almost all of them did not have a life jacket. Of those who died in the first two stages about half of them died in the initial shock phase, the other half during the cold adaptation stage.

WHY PEOPLE DIE

There is a common misconception that most people who fall overboard into cold water die from hypothermia, but in reality more than 50% of the victims of those accidents die long before the body becomes hypothermic. They drown as a result of the body’s response to cold water or from being unable to swim when the body adapts to the cold.

IN WATER OF TEMPERATURES BETWEEN 10 TO 15 DEGREE CELSIUS WILL...

AT LEAST 25%

DIE FROM COLD SHOCK RESPONSE

AT LEAST 25%

DIE FROM SWIM FAILURE

LESS THAN 50%

DIE FROM HYPOTHERMIA

Death by hypothermia is the least likely scenario in this context since research show that most people die due to cold shock response or swim failure (result of vasoconstriction). The time frame in which one can effectively save oneself is therefore very short.

OBSERVATION AND INTERVIEWS

MAIL INTERVIEW WITH DIANA STARK EKMAN

Diana Stark Ekman is a Swedish - American researcher who have been doing research about drowning primarily in Alaska and Iran. She therefore has insights in both cold water drowning and warm water.

She claims that there are no real evidence that swimming ability does any difference in saving lives in immersion incidents. She say that the only real difference in cold and warm water drowning is that there is no such phenomena as "dry drowning" in warm water. Dry drowning occurs as a result of a reflex that closes the throat and airways when the head is under water. This is the reflex seen in infants when they are submerged under water and in some people this reflex can come back in adult age when submerged in cold water.

Furthermore, she confirms that what I previously heard that about 25% of the people who drown without a life jacket, die within the first two minutes of immersion (cold shock response) is a good rule of thumb. This would indicate that at least 25% of the victims survive until the cold adaptation stage. (Since more than half of all drowning victims die before they reach a stage of hypothermia.)

She says that it is impossible to know who will die from cold shock response and who will survive a little longer.

She states that to save a person, one can either focus on keeping him afloat or get him back in the boat (to boat or to float as she puts it). She does not think that most alone fishermen who falls overboard are capable of pulling themselves back into the boat.

INTERVIEW WITH FREDRIK FALKMAN, SSRS

Fredrik Falkman is an industrial designer who has been behind the projects of FIRST, the mass rescue at sea project. He has also designed the Rescue Runners, the small personal watercrafts used for getting access and be of use where other rescue vessels cannot.

In the interview, we discussed problem areas, partly the ones I had already been looking at and partly some insights he had. The additions he had was that he could see a need for an autonomous rescue vehicle. He claimed that sometimes in rescue missions it would simplify things if there was an alternative to sending a rescue worker into the water. We talked about rescue buoys and how difficult they are to throw. He sees a potential in some sort of rescue buoy that could swim by itself.

He also had some ideas about improvements that could be done to the life jackets, such as making them float in the right direction. We also talked about the rescuers dry suit and how clumsy they where. Apparently they are too warm to wear to the way to the accident, but quite difficult to put on while on sea.

INTERVIEW WITH JOHAN LEDIN

Johan Ledin has been working with helicopter rescue for approximately 10 years. He is in command at one of the coast guards helicopter bases. He did give me some new insights that was valuable to understand the whole area of safety at sea.

The coast guard is responsible for the national waters (the coastline) but can get called in on rescue missions in the municipality area (lakes, rivers, some inland waters) if a helicopter is needed.

The benefits of using a helicopter is often that in remote places it is faster to get to the accident, and faster to get the victim to the hospital. Sometimes it is easier to lift up a person with the helicopter instead of trying to transfer him or her to a rescue boat. When we talked about the difficulties with helicopter rescue he mentioned the fragility of the vehicle. The helicopter is a complex machine with many parts that can break. It is especially sensitive to ice on the rotors. If there is risk for ice, they will not take off. He mentioned that they will get new helicopters that has a defrosting feature- but admitted that some of the problem will still persist. He said that it is the most frustrating part, to know that they need to hurry to save someone and the weather is too bad to go out.

Other problems with the helicopter is the fact that it cannot take too many passengers, it is only optimized for tree victims. On larger accidents it may be insufficient.

There is a lot of calculating before the helicopter can go out. Such as fuel consumption, weather conditions as well as making sure all the instruments are functioning.

The helicopter is also in danger if they are about to winch up a person from a sailboat and there are heavy waves. The mast of the sailboat will swing unexpectedly and impose a danger to the helicopter. They prefer the victim to get into the water during such circumstances, but many are reluctant to do so.

Johan claimed the most common type of accident is a boat with engine failure or similar, it is quite rare to go out on critical missions. I asked if it was sometimes difficult to find people and he immediately answered yes. He claimed people buy blue or black life jackets and they are not easy to spot. They should be bright orange or fluorescent. When it is night, or in fog and bad weather it is particularly difficult. I asked if they do not have a heat camera, and the answer was no. It was unclear why, he said he thinks it could be of help.

I asked how they communicate with the victim and he says that it is difficult. They talk with SSRS and if they are not there they can sometimes talk to a victim on a boat if he has radio equipment, but that requires that the victim is able to use this in his condition of distress.

If that is not possible they have to send down a surface rescuer, which they usually need anyway. There is no megaphone or such things, but it is debatable if it would be heard anyway over the sound of the rotors.

I asked if they have any medical equipment in the helicopter and he says they have a defibrillator and some basic first aid equipment. They have a hypothermia stretcher and blankets. That is about it. He stated that this is not a ambulance helicopter, and that usually it takes no more than 15 minutes back to the hospital. No one in the helicopter crew is required to have a medical training, but many have it anyway. Many started working as nurses before they became helicopter rescuer. In terms of hypothermia they seem only to take care to the fact that the victim should be lifted properly.

We talked about the stretchers and he said it can be little difficult sometimes, but there are tricks. It is usually easier if the victim is unconscious, otherwise they might be in panic and difficult to deal with.

He claimed getting people out of sailboats is particularly difficult, since the boats are very narrow.

In the end we talked of rivers and streams. These can be difficult to save people from if there are power lines over the river or nearby. They are difficult to spot (the wires, not the structures that holds them) and may cause the helicopter to crash.

When the helicopter is called on inland missions it is usually because it is too remote to be able to go there fast with a car.

He also tells an anecdote of a 11 year old girl found in the water with a body temperature of 14 (!) degrees. He thinks this is some kind of record since she survived. This indicates the difficulty to justify when a rescue mission should be aborted. Many with severe hypothermia also may appear dead while they are not. He said that they do not take chances if it is not obvious that the victim is dead. Then it is the SSRS or the police matter to take the body.

INTERVIEW WITH HÅKAN ISENKLINT (RESCUE SERVICES)

I made an interview with Håkan Isenklint at Räddningsverket, which is the rescue service on municipality level in Sweden. Many of the accidents that end badly happens, as previously shown, on small lakes where the ordinary rescue services are responsible for rescue missions. The general feedback I got from this meeting was that for the accidents I am investigating, the help mostly arrive too late.

Håkan Isenklint have been a rescue leader at the fire station in Umeå for a long time, and he has not experienced the type of accidents that I have chosen to focus on in this project. According to him it is more common that the drowning victim falls in the water from land or a bridge.

"During my years here, I think it is very rare that we know exactly where the victim is located."

"If we have a person in the water we swim out with the lifebuoy, we never try to throw it. It only takes time."

"If we need to use the dry suit, and search in the water, the victim is often already dead."

"It is my impression that in the types of accidents you are talking about, we are often arriving too late"

"The accidents I know of where we have been involved (other water accidents) the emergency calls all came from an eye witness."

OUTCOME:

The rescue services does most often not know where exactly the victim is.

The accidents they are called out on (boating related accidents) are most often reported by an eye witness.

The rescue services often arrive too late.

The rescue services has too short time frame to operate even if they react quickly, and may not be aware of the accident in time.

They do not see so much issues with their tools and equipment, except the life buoy (img x on page x) that is unpractical to throw.

The AIS transmitter has saved many lives according to the helicopter rescuers.

HELICOPTER RESCUE

The interview with the helicopter rescuers was a part of the course in own safety with SSRS. They gave me some insights in how difficult it can be to find people who are reported missing at sea.

OUTCOME:

Victims in water is often difficult to spot due to dark clothing. Many popular new life-jackets are dark blue or black.

The helicopter rescue team can be hindered by bad weather (ice) and require many calculations before they can fly.

The AIS transmitter simplifies their search very much.

The helicopter rescue can go out on missions where the other rescue services have difficulties to reach.

"The AIS or PBL transmitter is a great lifesaver. It is a good life insurance."

"What you wear on you, is what you got with you." (When surrendering a vehicle on water.)

TO GET YOURSELF UP IN THE BOAT

Most of us found it very difficult to climb up in a small boat. Especially the life jacket was in the way and hindered climbing.

It was sometimes necessary to empty the life jacket of air in order to climb up in a boat, but to empty the life-jacket while wearing it is very difficult.

I was participating in a course in personal safety at sea arranged by Öckerö Maritimcenter. This course was for future members of the SSRS (Swedish sea rescue society) and was aimed at how to keep yourself safe before you rescue someone else. This course was a mandatory part of future lifesavers education. I participated in all the exercises they took part in and the course curriculum spanned over everything from first aid and CPR, cold water experience, equipment orientation, fire safety and fixing boat leaks.

I got a first hand experience in how the body reacts in cold water. Because of the dry suit I was wearing, the cold shock was not so severe. Non the less, I was breathing heavily before I had even begun swimming, and swimming the 200 meters against the current in the canal was exhausting to the point that I almost could not do it. The cold water numbs the hands very quickly and I can describe the experience as quite stressful.

I also experienced how cumbersome it is to swim in the inflatable life jackets that is getting more and more popular due to their neat package when they are not used. It is only possible to swim on the back and the inflated life jacket is obscuring the vision. Several times my course mates had to tell me to adjust my direction to stay on course.

TO GET OTHERS UP IN THE BOAT

To lift a passive victim up in the boat is also tricky if you do not know the tricks.

analysis

03.

IN THIS CHAPTER:

PROBLEM OVERVIEW

Area 1: Personal safety

These are the problem areas I found related to safety risks for an individual in a boat for recreational boating.

PANIC IN COLD WATER - INHALATION/ EXHAUSTION

The risk of drowning posed by hyperventilation upon immersion in cold water and the body's adaptation to cold water. (Fatigue and weakness, stiffness.)

HYPOTHERMIA

Hypothermia is only a risk if the immersed victim have means of keeping himself afloat for a long time. A hypothermic victim is disoriented or unconscious and require special care in the rescue process to avoid heart failure.

PROVIDE MEANS OF GETTING BACK IN THE BOAT

Many people try but fail to climb back up in the boat after fallen into the water. Many small boats lack proper means of getting back, such as ladders.

PROVIDE BETTER POSSIBILITIES TO ALARM WHILE IN THE WATER

If the communication systems are still in the boat or water damaged when the victim falls overboard it is difficult to get help.

HOW TO MAKE PEOPLE NEARBY TO NOTICE THE ACCIDENT

What if nearby vessels or people could be notified and help?

SPEEDBOAT COLLISION CONTROL

Many speedboat accidents are collisions with solid objects or other vessels.

DISAPPEARING BOAT PROBLEM

The victim falls overboard and the boat drift away.

HOW TO ALARM WHEN YOU ARE UNCONSCIOUS

If the victim is alone and unconscious, how will anyone know he needs help?

LIFE-JACKETS ADAPTED TO USERS

Life jackets are sometimes unpractical and uncomfortable.

Area 2: Rescue service equipment

These are the problem areas I found related to safety risks for the rescue personnel (SSRS, fire fighters and helicopter rescue).

HANDLE SOMEONE ON A SPINE BOARD

It can be difficult to handle a person on a spine board in narrow boats, or to transfer a person between their boats and rescue vessels.

CUMBERSOME WORK CLOTHES

The dry suits and rescue clothes can be time consuming to put on. Issues with leakage, temperatures and trapped air can cause difficulties and even a risk. Time could be saved.

MAKE IT EASIER TO LIFT SOMEONE OUT OF THE WATER

FIND A PERSON IN DARKNESS AND HIGH WAVES

It is very difficult to visually spot a victim floating in the water if the victim is not wearing reflective clothing or a light, something many do not have.

PEOPLE DO NOT ALWAYS KNOW WHERE THEY ARE

It is not so easy to tell the exact position out in the nature. People might be disoriented or in panic.

BE THERE IN TIME

Sometimes weather conditions prevent rescue staff from reaching the accident in time.

COMMUNICATION

Sometimes the rescue staff doesn't know what to prepare for because of lack of information about the accident.

THERE IS ALWAYS A RISK GOING INTO COLD WATER TO HELP A VICTIM

To always have to send a person into the water to help an immersion victim is a risk that always have to be calculated with.

BETTER AMBULANCE COMPARTMENT, HANDLING OF STRETCHERS

The rescue boats are not adapted for all situations.

NOT NICE HANDLING DEAD BODIES

AREA 1: PERSONAL SAFETY

FOUND PROBLEM AREAS:

Life raft for small boats

A better life jacket

Means of getting up in the boat

Integrate alarm function in everyday equipment

Arguments for category:

⊕ HELP IS FAR AWAY.

LOW RISK AWARENESS.

SHORT TIME FRAME IN COLD WATER

CLEAR USER GROUP

POSSIBILITY TO PROTOTYPE

⊖ DIFFICULT ATTITUDE PROBLEM

MANY EXISTING PRODUCTS ON THE MARKET

AREA 2: RESCUE EQUIPMENT

FOUND PROBLEM AREAS:

A better dry- suit

Autonomous rescue vehicle, to not always need to risk the life of a lifesaver

Arguments for category:

⊕ PROVIDE HELP FASTER

MARKET OPPORTUNITY

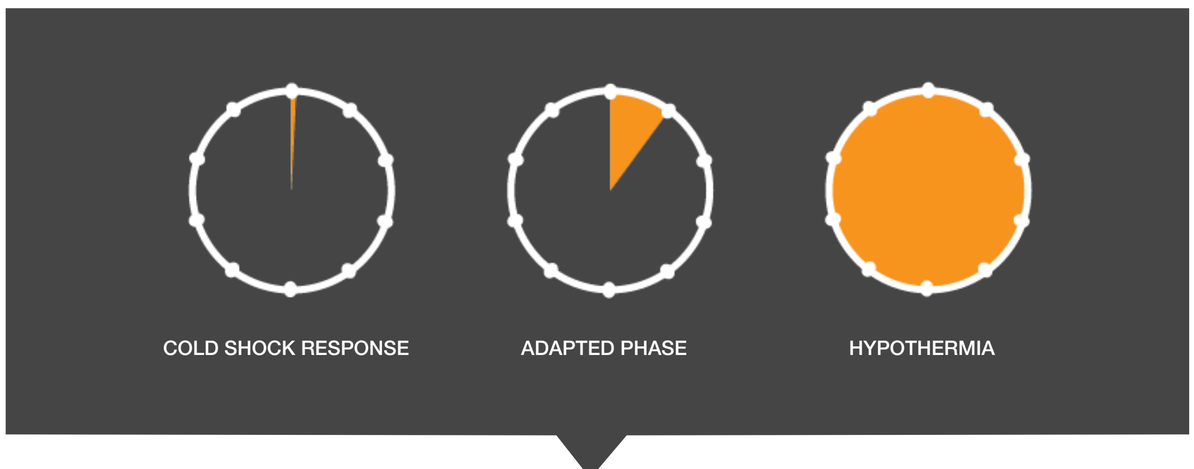
CLEAR USER GROUP

POSSIBILITY TO PROTOTYPE

⊖ MANY EXISTING CONCEPTS

MARGINAL DIFFERENCE IN NUMBER OF SAVED LIVES. (THE VICTIM NEEDS HELP QUICKLY AND RESCUE SERVICES ARE OFTEN FAR AWAY)

CHOSEN PROBLEM AREA: AREA 1, PERSONAL SAFETY



Focus area

This is the time when people have the biggest chance of saving themselves.

CHOSEN PROBLEM AREA

I have chosen to work with the area 1, personal safety. This area includes staying afloat, fight hypothermia, alarming the accident and getting back up in the boat.

I chose this area because this is where I can see the biggest potential for the design competence to make a difference. If the victim of a boating accident can save himself in a better way, much could be gained. Maybe even sometimes make the rescue services redundant.

USER GROUP

I have seen quite clearly in the statistics that almost all of the victims are men why it would make sense to focus on them.

Although it is likely to be more women boating in the future, the majority of men who dies is so vast that it will take a very long time before that statistic changes. There are also more men involved in accidents in general, they seem to take bigger risks in general. This suggest that even if more women start taking a bigger part in boating, men will continue to top the accident statistics.

The age group is a bit more diffuse, the New Zeeland statistic breaks the pattern of older men. To include a slightly larger age group than the Scandinavian statistics suggest, ***I will focus on 35-65 year old.***

Furthermore, it is quite clear in what kind of boats are the most frequent in the accident statistics, and that is ***small boats under 6 m in length.***

PROBLEM DESCRIPTION

How to provide a person better means of getting back up in the boat when falling overboard from a small boat (under 6 m long) into cold water?

How to increase the likelihood of the solution being used and even liked?

GOALS (SHOULD BE REACHED):

To increase the chance for the victim of the accident to save himself from drowning if he was conscious at the time he fell in the water.

To provide an easier way for the victim to get back up in the boat if it is afloat.

To provide floatation if the boat sink.

Generate a higher usage frequency than the equipment available today.

WISHES (OPTIONAL):

To create an interest for the product beyond safety, to provide added value to the boating experience.

To make sure that the product is being used correctly.

To ensure an alarming function that will report the accident if the victim was unconscious when he fell into the water.

Provide better means of localization to the rescue services and people nearby.

PERSONAS

MATS GRANLUND

61 years old, Family: Wife and a son (27 year old)
Profession: Engineer

Mats love to go fishing in the weekends, he lives close to a small lake in Sweden. Sometime he goes fishing alone and sometimes his fishing friend accompany him.

The important thing for him is to get away, out in nature. He finds it relaxing and it is a bonus if he catches a fish.

He is a nature lover and very patient in his fishing. He can sit for many hours. He brings sandwiches with sausage and coffee in a thermos. He is fishing quite often and enjoys the quietness and calm. He has gotten to know the lake well and know when the chance to catch a fish is the biggest.

The lake where he usually is fishing is quite small and he therefore only tells (his wife) that he is going to the lake to fish. No need to be more specific. He doesn't wear a life jacket, because he never have. He think he is a good swimmer. And the shore is pretty close.

He most often uses a casting rod and have a box of different bait with him. He also has a knife. The sandwich and thermos he keeps in a plastic bag in the boat. The boat is small so he doesn't bring much. He thinks it is a hassle to have too many things. He know what he usually needs. He usually takes the bike to the lake as well, so he cannot take much.

He doesn't bring his phone with him, he is afraid it will land in the water. Besides- he does not want to be disturbed. He usually takes the bike to the lake. The fishes he gets he sometimes brings home and eats.

ANDRÉ

38 years old, Family: Divorced, Two kids, age 4 and 7
Profession: IT-support

André does not live close to water, and he does not have his own boat. But a friend of him lives by the coast, and a couple of times in the summer he visits his friend and they go out fishing. If the kids are not with his wife that week, they have come along.

André has no real clue about fishing, but he likes to think he has. He has a pretty expensive casting rod and he bought a set of bait. His biggest catch is a huge bass that he caught last summer. His friend helped him photograph the fish. André always releases the fish (what else should he do with it? Not eat it, that is for certain). When the kids are with them the youngest one gets a cheap jigging rod and the older gets a regular fishing rod. If any of the kids get a fish, they get to keep it. The youngest one needs help of course, if he get a catch.

The boat is small so it is usually pretty crowded with the kids and all the equipment. André prefers to only be out with his friend.

He always have a life jacket on the kids- and if the weather is cold on himself as well, but since he usually only goes fishing in the summer in warm weather, he is often leaving it at home. They do not go that far out with the boat.

He always has his smartphone with him. Of course. How else could he instagram his fishing success? He also always brings snacks and, if the kids are not with them, one or two beers.

THOMAS

48 years old

Fishing is Thomas' great hobby. He is out all year round. Thomas is a so called "specimen hunter", and is specializing on a few species of fish, depending on the season. He is well known in the local fishing club and has the trophy of this years biggest Walleye and Pike.

Thomas loves the competition and the challenge and years of experience has taken him to this level. He is also a bit of a gadget nut, and after some years he has equipped the boat with all kinds of useful stuff. Some of it is home-built, as holders for different tools, holders for fishing rods etc. Some of it is very expensive- such as his first class sonar and GPS plotter. On that he can plot the route he has taken and mark a good fishing place. But in reality he barely needs to, because he is so familiar with his waters.

If it is really cold in the water, he might have a life jacket, but not otherwise, he thinks it is uncomfortable. He has an inflatable one, but if he is out several hours in a row it weighs on his neck and is uncomfortable.
He wears a flotation overall if the weather is cold.

He always releases the fish after he catch it. He is only out to weigh it, get a picture as an evidence. He has a holder for his smartphone in the boat so he can take a picture of himself holding the fish if he is out alone, which he often is. When one is out as often as he is- it is difficult to get people to go with him all the time.

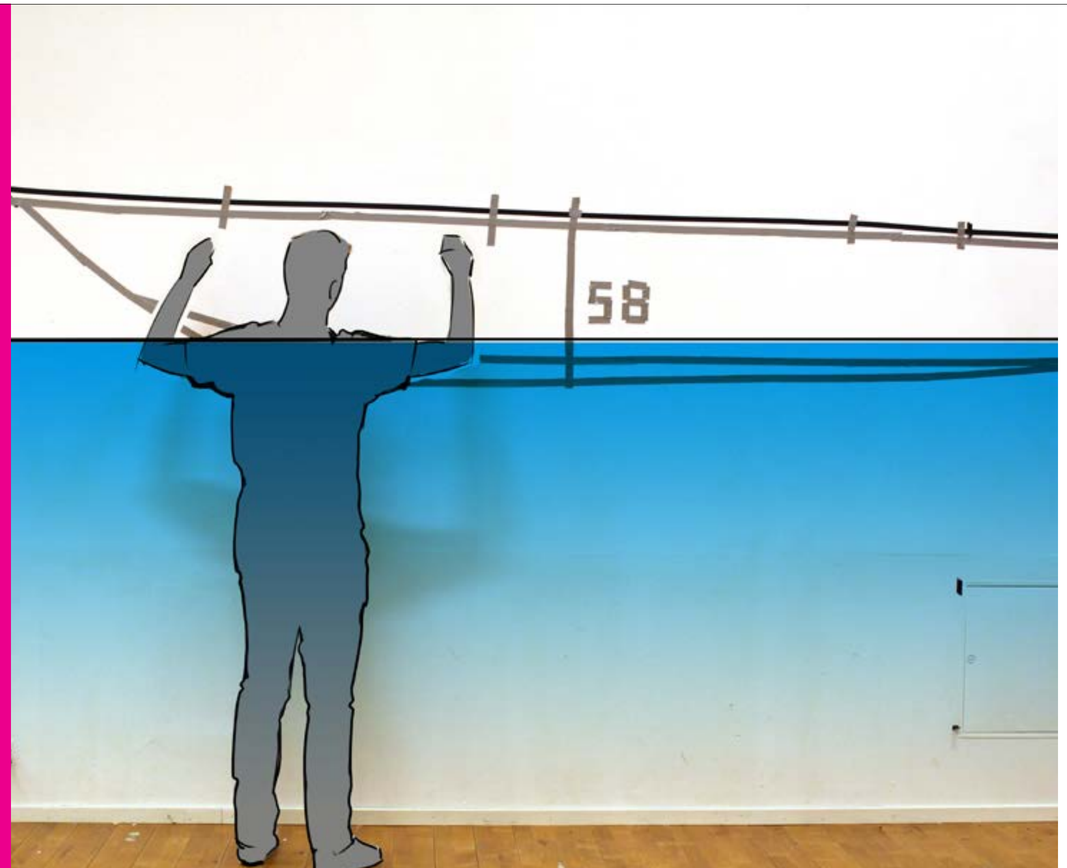
There is a lot of stuff that has to be taken to and from the boat. He does not want to leave stuff in his open boat because he is afraid it might get stolen or damaged. He needs his car to transport the stuff to and from his boat.

TYPE OF BOATS

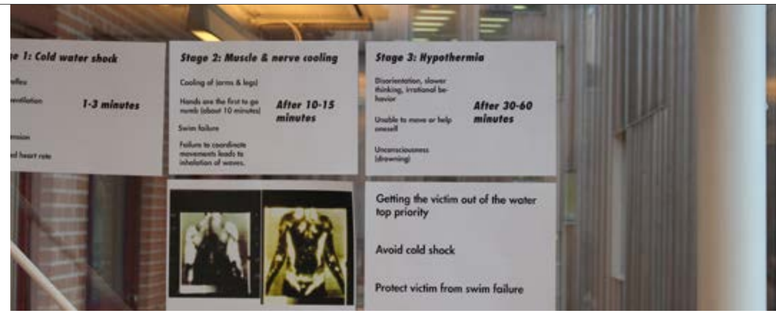
These are examples of open motorboats under 6 meter in length.

ideation

04.



IDEATION



FIRST IDEATION SESSION: SCENARIOS

The first idea generating workshop was held around a few scenarios to get a broad spectrum of ideas. The scenarios was based on the typical accidents of falling overboard in a small boat on a lake. Variations in the scenarios regarded if the user was alone or not, if the boat stayed on the right keel or was tipped and what the user was doing prior to the event. The task was simply to come up with ideas in how to let the user be able to save himself, and in a second round, how to get the solutions to be used.

The ideas clustered mainly around these topics:

Alarm / awareness

Getting back into the boat

Life jackets / flotation aid outside of the boat to be de-attached from water level.

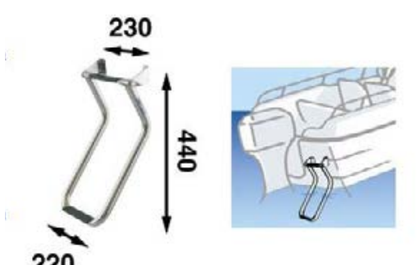
FIRST IDEATION, GETTING PEOPLE BACK UP IN THE BOAT

The ideas from the first ideation session was developed into more refined concepts to be evaluated further.

BENCHMARK PRODUCT

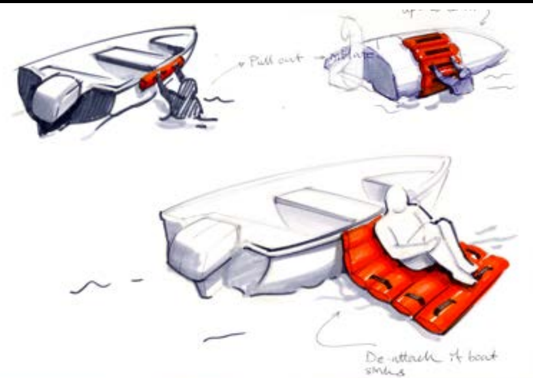
The bigger boats in the category (boats under 6 meters in length) might sometimes have a ladder (most used for swimming from the boat). However it is not designed for emergencies, they can sometimes be difficult to fold down from the water level (depending on the model) and they do not fit all boats. Smaller boats, and particularly open boats does often not have a ladder.

The types of ladders that there is today often require a lot of work to be mounted properly.



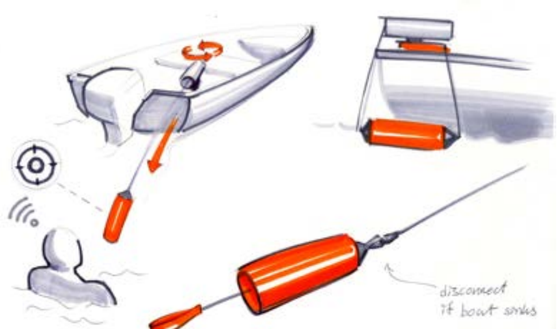
CONCEPT A: FLOATING PLATFORM

An mattress or platform gets inflated when pulled out from the railing. Hand grips and reduced height should aid in climbing and the mattress could have secondary uses such as being used as a life raft if the boat sinks. It could also aid visibility.



CONCEPT B: LOCKED ON TARGET

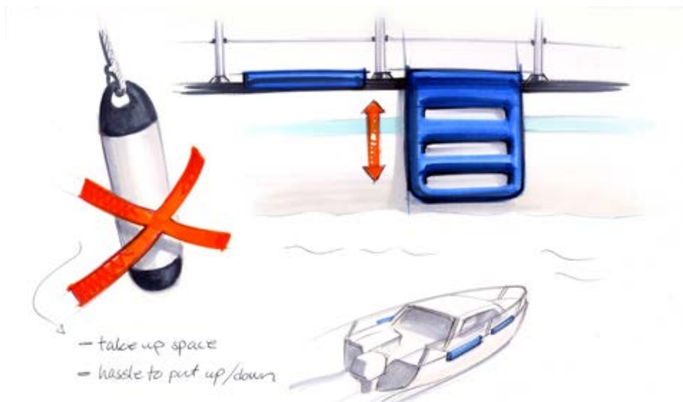
This concept assumes that the user is wearing some sort of tracking device that gets triggered when the user falls overboard and / or gets wet. A floating unit is then shoot out in the direction of the victim and the victim can get help to be pulled back to the boat. The floating unit can then be used as a footstep to climb back up.



CONCEPT C: FENDER LADDER

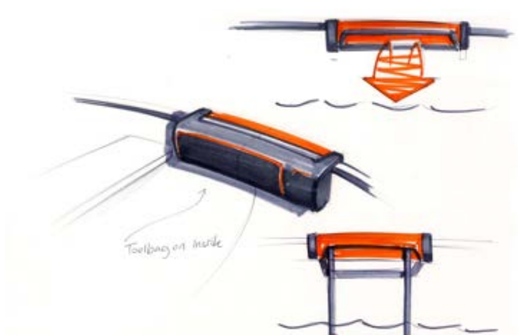
This concept replaces the traditional “fender” (Normally only used to protect the boat from damages while moored in a harbour) with an inflatable ladder.

The ladder would become minimal when not in use and with a possibility to both be used as a bumper and a ladder. One negative argument is that it maybe most beneficial on slightly bigger boats.



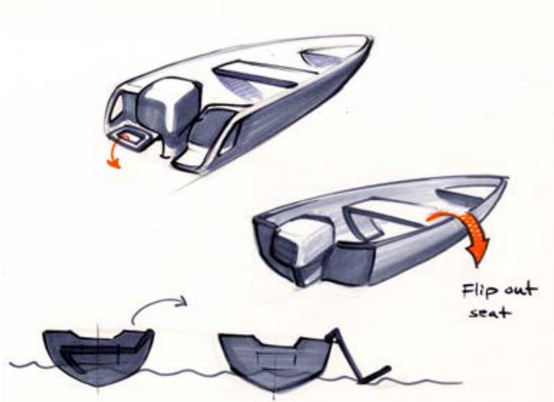
CONCEPT D: TOOL BAG STEP

This concept is combining storage space with a simple step to be pulled down. The tool bag could be for fishing equipment or similar and be purchased for that reason. On the outside attachment to the boat a footstep can be pulled out from water level to aid climbing back into the boat.



CONCEPT E: A BETTER BOAT

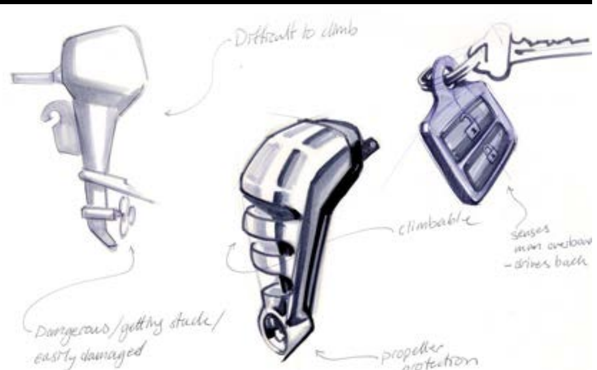
This concept aims at creating a small boat for recreational purposes that have built in functions that makes climbing back up into the boat easier. There is a big potential for creating safer boats for the future but it does not aid the owners of all those old boats that will still be in use for a long time.



CONCEPT F: CLIMBING FRIENDLY BOAT ENGINE

Many tips to boaters advocates the use of the engine to climb on in an effort to get back up into the boat. The problem is that boat engines are not built to climb on. It is difficult and with a risk of further injury to the victim.

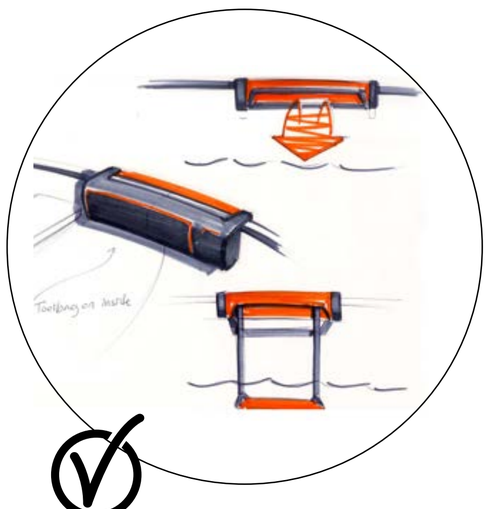
This concept aims at creating a more climbable boat engine. The benefit of this concept would be that it is a product every boat owner already need. The risk is that the market is very conservative.



EVALUATING CRITERIA:	A	B	C	D	E	F
Ease of use	1	0	0	2	2	1
Adaptable to different boats	1	2	0	1	0	1
Benefit to the user, other than safety	0	0	2	2	2	2
Economical	1	0	0	1	0	0
Fail safe	1	0	1	1	2	2
Provide “plan B” action	2	2	2	2	2	0
Possible to use without fine motor skills	1	0	1	1	2	1
Likelihood of usage	0	0	2	2	2	2
TOTAL	**7**	**4**	**10**	**12**	**12**	**9**

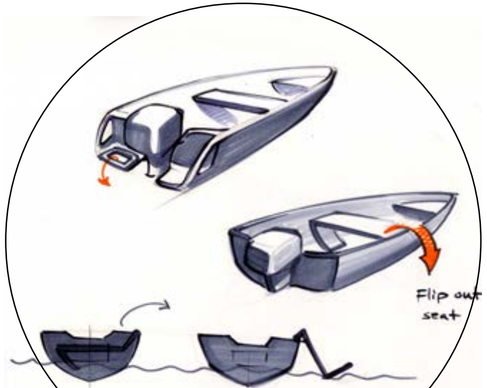
0= worse than benchmark product 1= same as benchmark product 2= better than benchmark product

The tool bag concept



- ⊕ Applicable to existing boats - a faster implementation.
- ⊕ Can be adapted to a wider range of boats.
- ⊕ The use as a toolbag is percieved as a realistic reason to buy the product.
- ⊖ Add on product - difficult to make it fit all boats.

A new boat



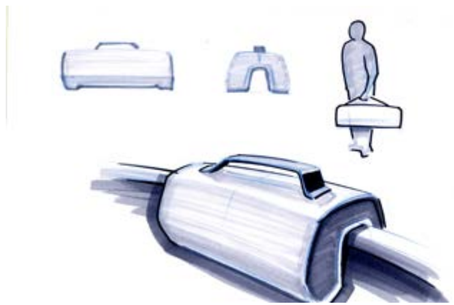
- ⊕ New possibilities to make a smart next generation boat.
- ⊕ New boats need to change due to new EU regulations.
- ⊖ Longer implementation time.

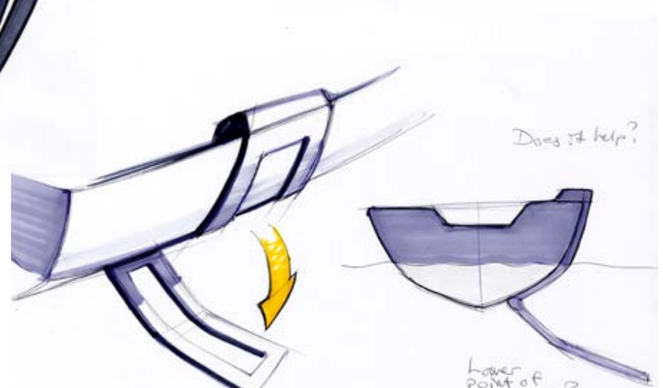
SCALE REFERENCE

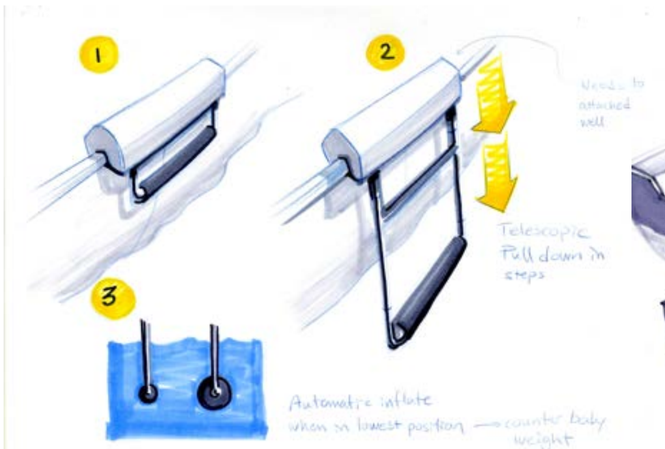
I started out with some full scale reference in 2D before I started to create concepts. It was clear that climbing up in the rear of the boat could be difficult because of the engine.

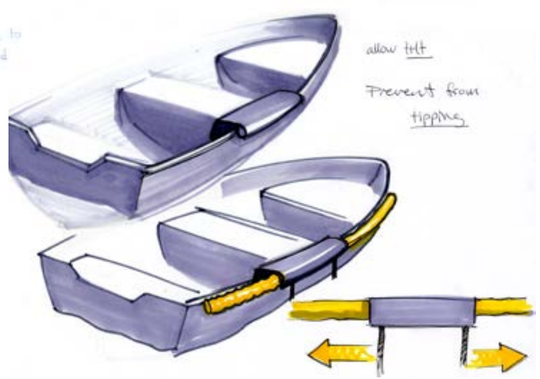
IDEATION: TOOL BAG WITH STEP

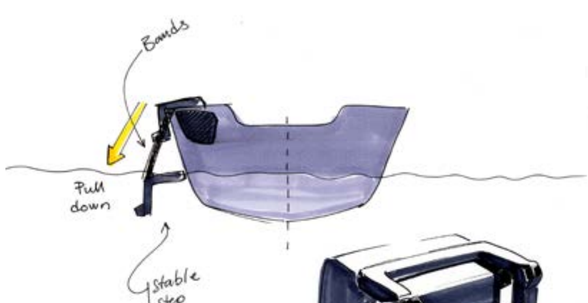
For all sketches, see page 141 -142.

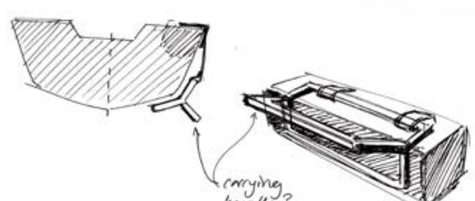












USER TESTS IN THE SWIMMING POOL

I developed test models of three chosen concepts and tested them in the swimming pool. The pool had a deep part, and the test subjects where instructed to not stand on the pool floor when trying to climb into the boat. I tested my models both with and without an inflatable life jacket.

The reason for choosing an inflatable life jacket was that they are becoming increasingly more popular, and my observations at Öckerö suggested that they where a significant issue for the user when trying to climb into a boat from the water.

THE TIPPING PROBLEM

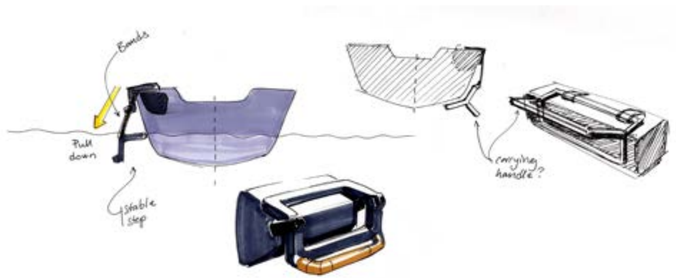
The boat in my test had a weight of 55 kg. A user with a weight of 80 kg would almost flood and sink the boat. When I tried with two people, together 140 kg, the boat would sink.

My estimation is that if the user is about twice as heavy as the boat, climbing in from the side without tipping the boat is difficult.

Both of my test subjects was able to climb up in the boat without aid when they didn't wear a life jacket, but they were young (around 30) and quite fit, and also not wearing so heavy clothes. The woman in my test had a problem climbing up in the back of the boat because of the height.

With an inflatable life jacket, It took one of my test subjects three tries before she could climb in from the side, and in the back of the boat it was impossible.

CONCEPT 1
Hanging step



The hanging step idea is based on the idea that a footstep that is tilted out from the boat side is easier to use. If the step itself is locking to the boat side, there is no need for a stiff ladder I thought.

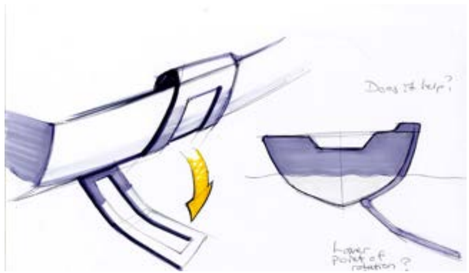
This concept proved to be the easiest one to use. Also with a life jacket. What took three tries for one of my test subjects now took one, and climbing up from the back of the boat was also possible. The flexibility of the hanging step proved beneficial.

CONCEPT 2

Folding step

The folding step was very easy to fold down, and easy to understand. Unfortunately it broke during my tests and could not be fully evaluated. It seemed to work pretty well, but the test user (in the pictures below) put his foot pretty far in on the step, which was not beneficial for climbing.

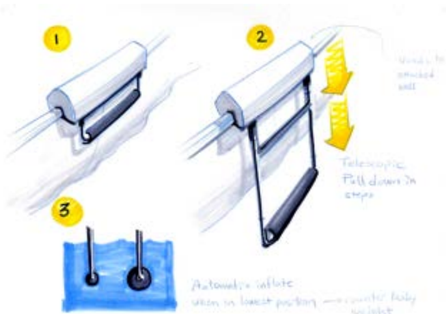
One downside of this concept is that it is pretty big and bulky quite visible on the boat side.

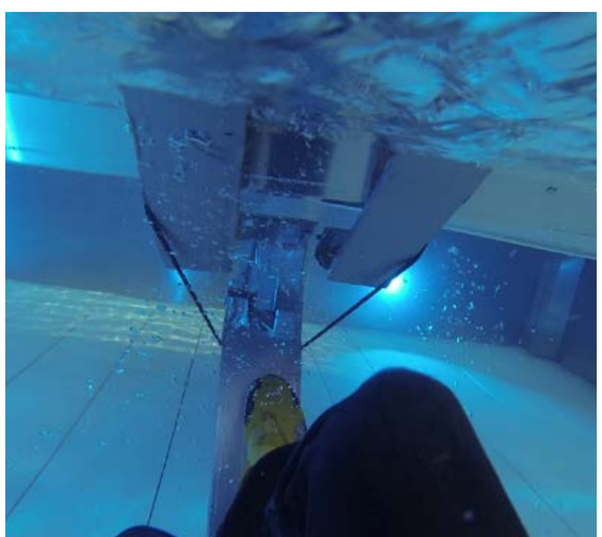


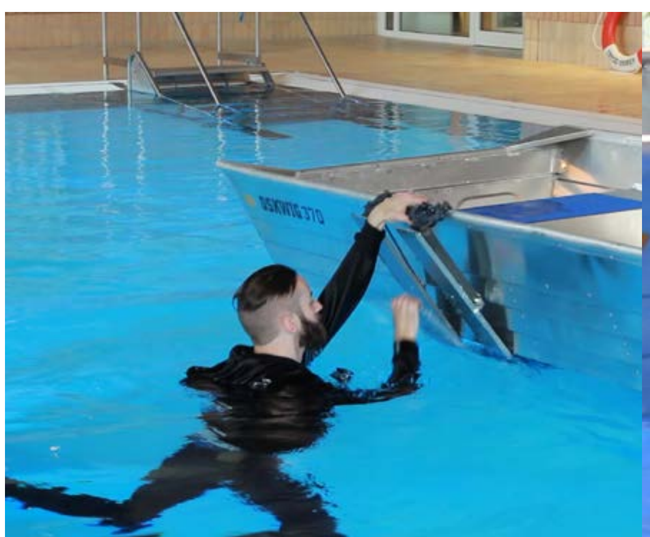
CONCEPT 3

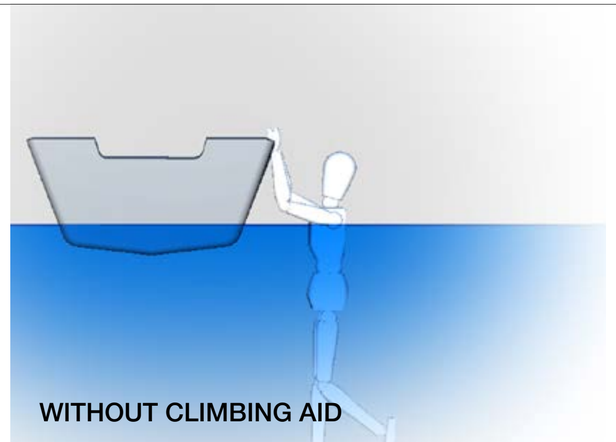
Telescopic ladder with flotation

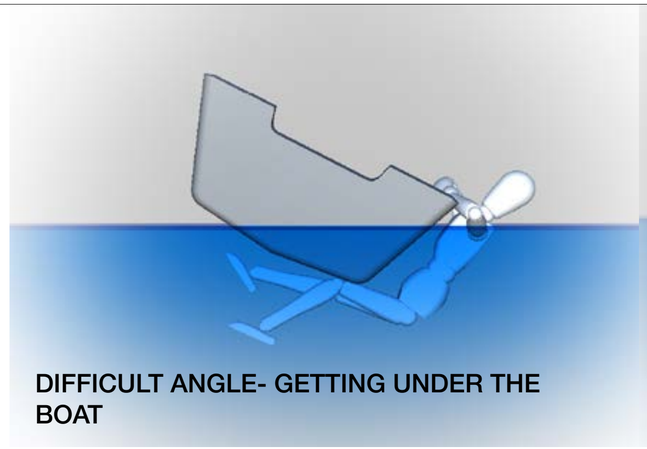
The idea with this concept was a telescopic step that could be pulled down from water level and that a pillow could inflate at the step to prevent the boat from tipping. I was not able to test the flotation at this occasion but a straight telescopic ladder was tested. This concept did not work very well due to the fact that a straight ladder creates a non ergonomic climbing position.

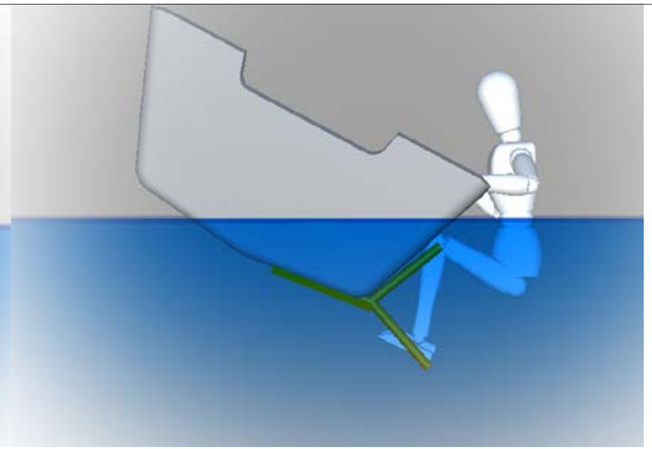


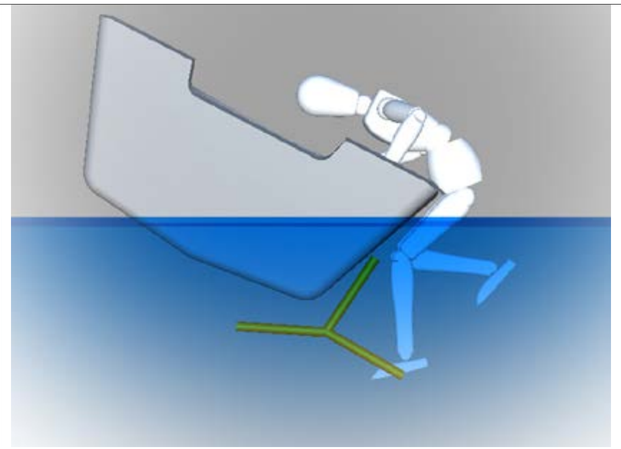


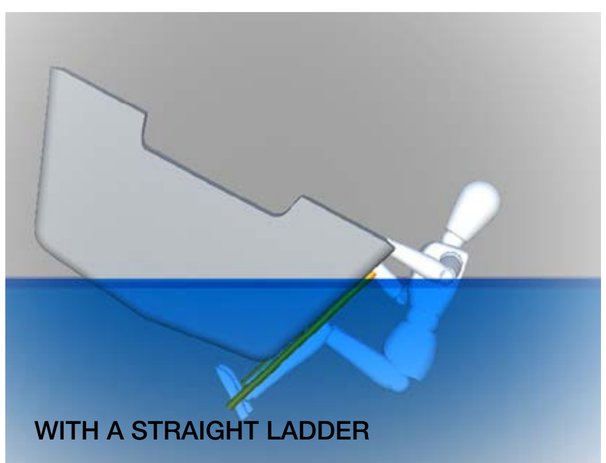


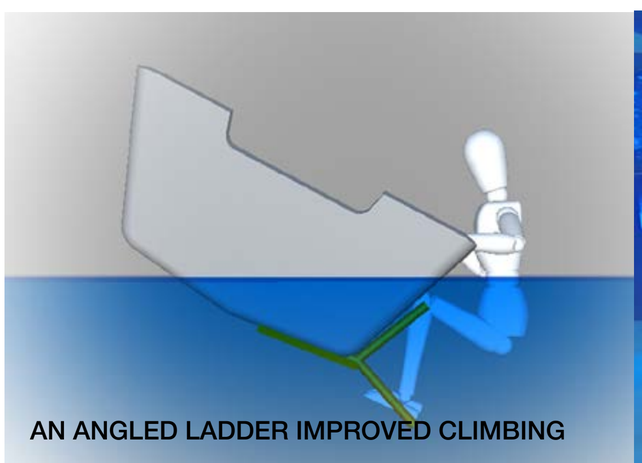

WITHOUT CLIMBING AID

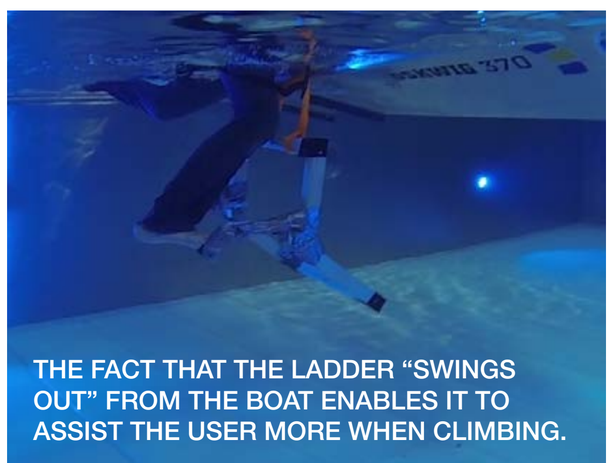

DIFFICULT ANGLE- GETTING UNDER THE BOAT



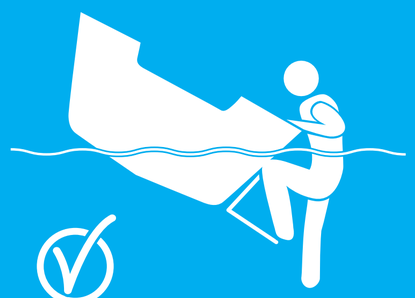



WITH A STRAIGHT LADDER

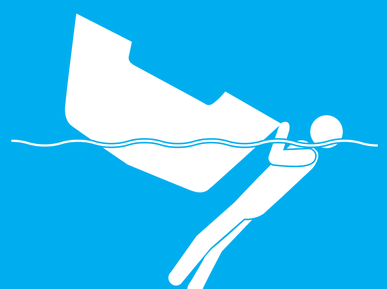

AN ANGLED LADDER IMPROVED CLIMBING


THE FACT THAT THE LADDER “SWINGS OUT” FROM THE BOAT ENABLES IT TO ASSIST THE USER MORE WHEN CLIMBING.

OUTCOMES FROM USER TESTS



A footstep in an angle out from the boat is clearly beneficial. A footstep that swing out is even better.



No footstep or a straight ladder seemed to have equally bad results due to climbing angle.

If the user is about twice as heavy as the boat, he or she might sink it.

The user needs space to climb, especially If the victim is wearing an inflatable life jacket.

QUESTIONS AFTER USER TEST

Added flotation?

The added flotation in concept 3, the telescopic ladder, was never tested due to time limitations. The tipping of the boat could be a problem if the boat is very lightweight and the user is very heavy. Would it help to add a flotation unit to the side of the boat? Would it be in the way?

Tool bag part

The tool bag part was not evaluated in this tests either. In my observations with my test users it seemed obvious that you need some space inside of the boat to be able to climb. Especially when wearing an inflatable life jacket. The female user even complained that the bench of the boat was in the way to some extent (when the equipment was attached directly over it). There is a space of 15-20 cm between the bench and the railing. The tool bag part must be greatly reduced from my initial concepts or totally taken away.

TAKEAWAY'S AFTER USER TEST

Footstep out from the boat

It became clear that a footstep that enabled the user to put the foot some distance away from the boat would be a requirement because of the tipping of the boat. A straight ladder creates a difficult position to climb.

The swing function

The hanging step had the possibility to swing out from the boat, and therefor gives the user the possibility to utilize the step in a longer part of the climbing process.

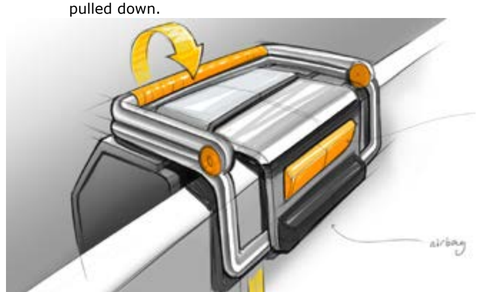
Climbing from the side is easier because of the tipping and more space to climb.

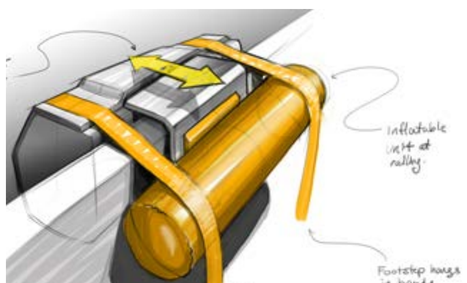
It was considerably easier because of the shorter climbing distance, which was of greatest importance when wearing a life jacket. Also, I did not have an engine, and my test users used the space that would have been taken up by an engine while climbing, even though they tried not to.

TO ADD A FLOTATION UNIT?

Concept: Added flotation to the railing

Added flotation to the side of the boat. Inflates when activated by user. Hanging step to be pulled down.





⊕ Probably provides good flotation (fixed at railing)

⊕ Could be visible. Reflective.

⊖ Might be in the way while climbing.

Concept: Added flotation to the step

Flotation added to the step. Requires stiff structure and firm attachment to the boat.

⊕ Not in the way so much while climbing

⊖ Demands stiff structure and joints. (Might get stuck?)

SCALE TESTS OF FLOTATION AID

With no air pillow, the boat sinks rapidly when the simulated person weight is hung on the side (twice the weight of the boat).

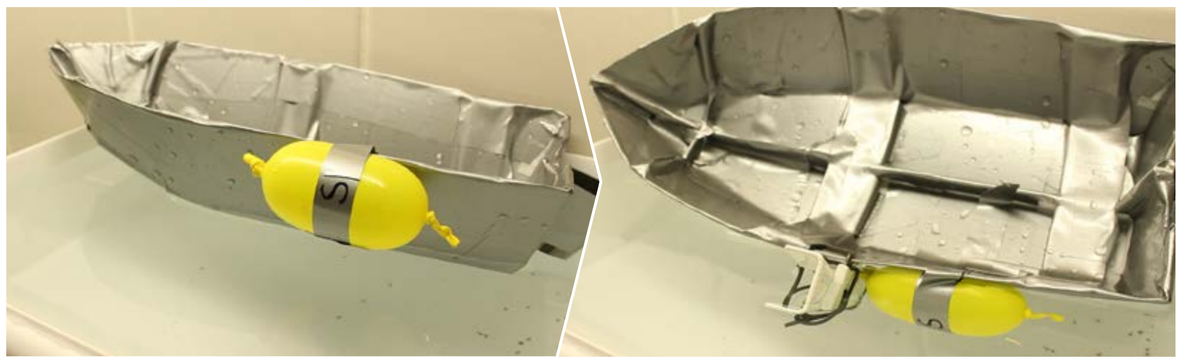
In the lack of a real boat to test the added flotation theory, a scale test was made. In my first user test in the pool, I concluded that you had to weigh at least twice as much as the boat to risk getting the railing under water level, ant thus flood the boat and sink it. This is absolutely possible if the user is very heavy and the boat is very lightweight. For example, in my previous tests the boat weight 53 kg and we estimated that a person with a weight of 100 kg or more would sink it while climbing in. (In our test, a 80 kg person would almost sink it, and a 140 kg person certainly would)

In my scale test, the boat weighs 90 g and the test dummy 200 g.

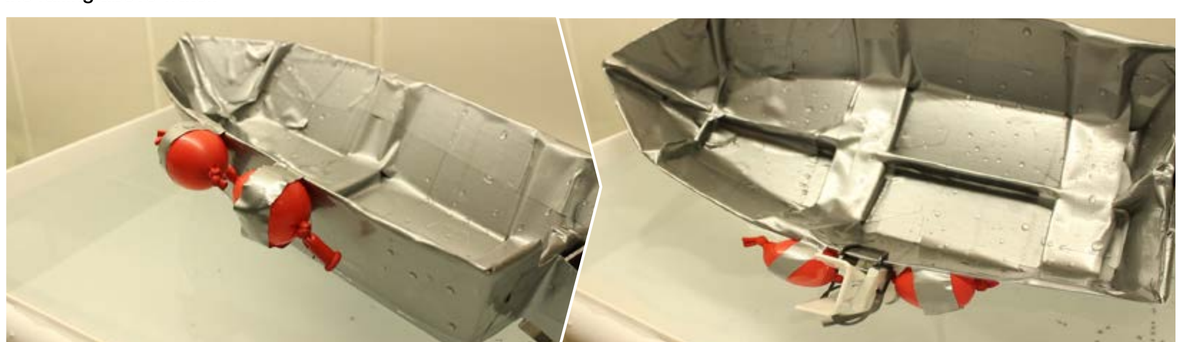
At railing level, the flotation seems to work as expected. The read air pillows are the smallest volume that managed to lift the weight and prevent the boat from tipping.

Depending on the weight of the motor attached- it seemed to matter where the flotation was attached on the side of the boat. Too much weight at the rear would but the rear corner under water and slowly flood it.

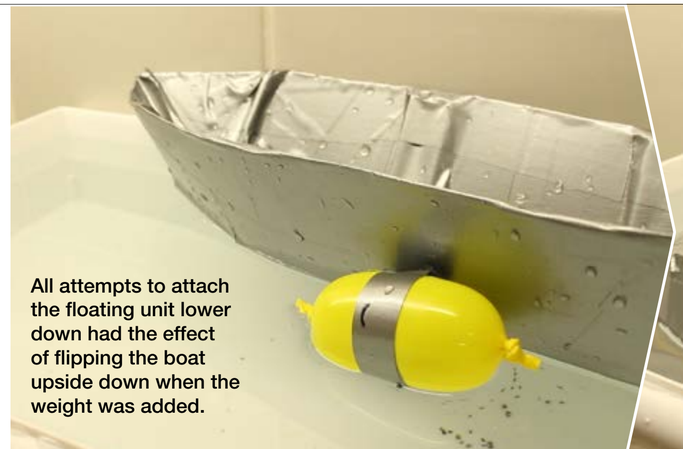
The possible downside with having a floatation pillow at the railing would be that if the user is not that heavy, he or she would not tip the boat enough to get the flotation unit under water. It might then be in the way while climbing, especially if the user is wearing an inflatable life jacket.



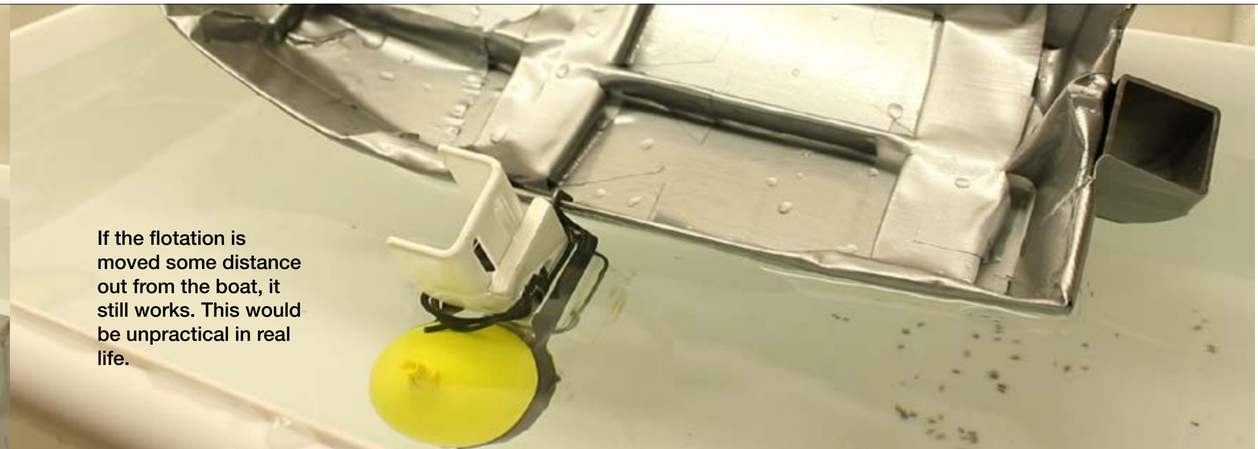
The volume of air attached to the railing clearly helps to keep the railing above water.



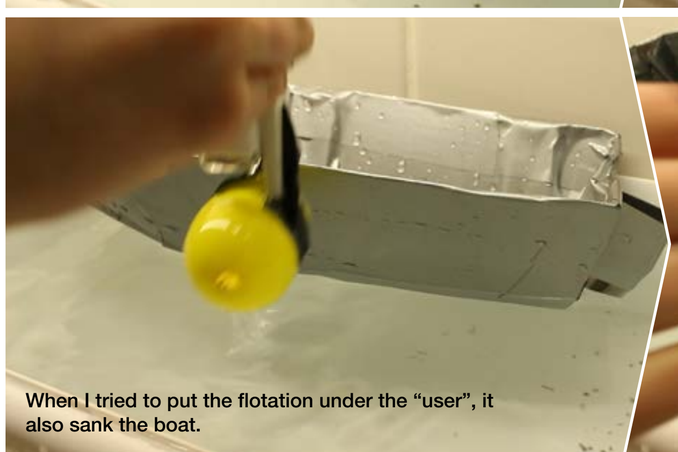
This was the smallest volume required to counter the weight.



All attempts to attach the floating unit lower down had the effect of flipping the boat upside down when the weight was added.



If the flotation is moved some distance out from the boat, it still works. This would be unpractical in real life.



When I tried to put the flotation under the “user”, it also sank the boat.

When the flotation unit was placed at water level or the level approximately where a footstep would be, the boat tipped over immediately when the dummy weight was attached.

I experimented with moving the flotation unit to the “ back” of the dummy, and then it was helpful with flotation. When the flotation unit was underneath the dummy the boat tipped and sank rapidly again.

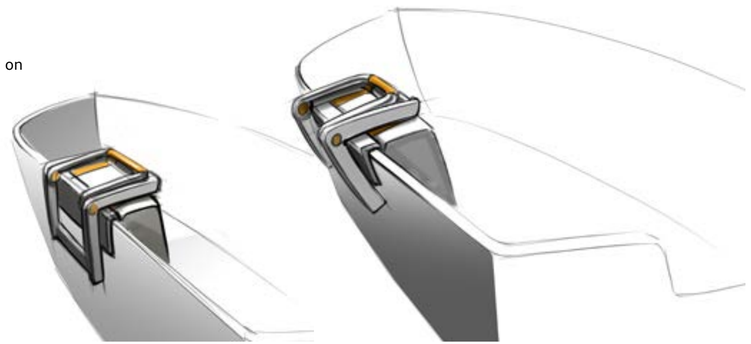
My conclusion is that the closer the flotation unit comes to the center of the boat, it aids to tip the boat even more. At railing level, the flotation unit is enough distance from the center of the boat, to be a successful aid in getting back in the boat again.

An alternative would be to have it at the level of the step, but far out from the boat. Although I consider that to be unpractical and difficult for both climbing and handling purposes.

NEW CONCEPTS OF STEP

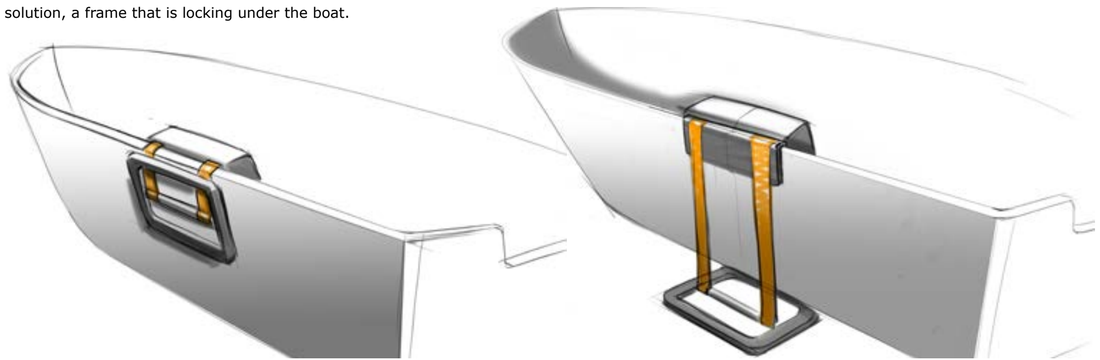
FIXED STEP

Similar to the previously tested hanging step, with some exploration on different angles to fit the boat side better.



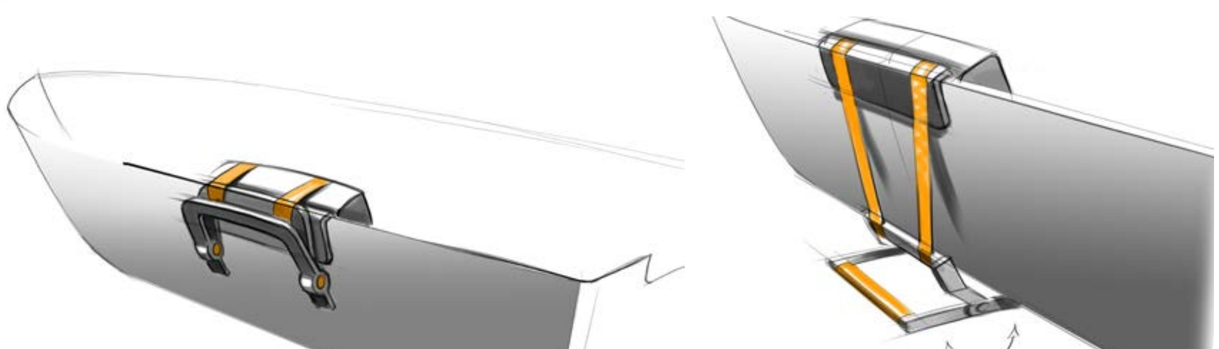
ROTATING STEP

The simpler solution, a frame that is locking under the boat.



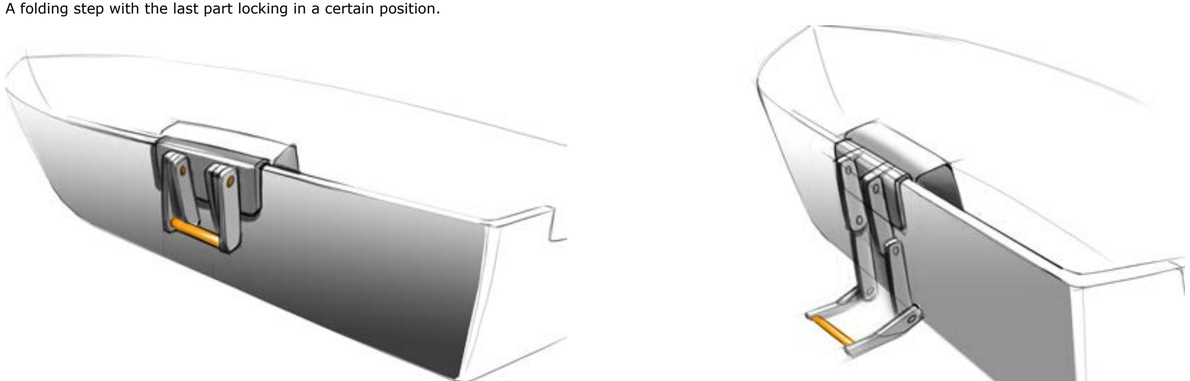
FOLDING STEP

The same basic function as the fixed step, but it folds neater on the boat side.



FOLDING LADDER STEP

A folding step with the last part locking in a certain position.

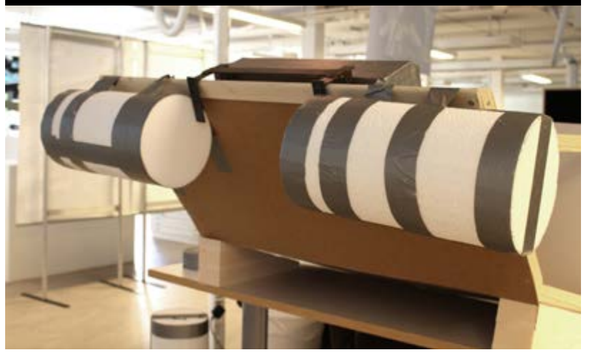


FIXED STEP

FOLDING STEP

ROTATING STEP

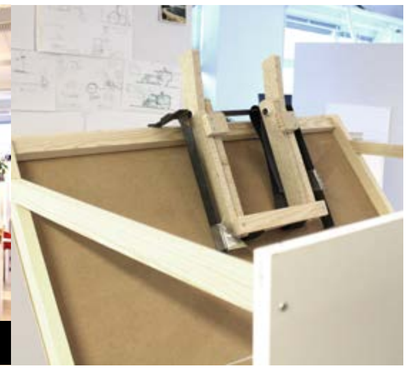
INFLATION TEST VOLUMES

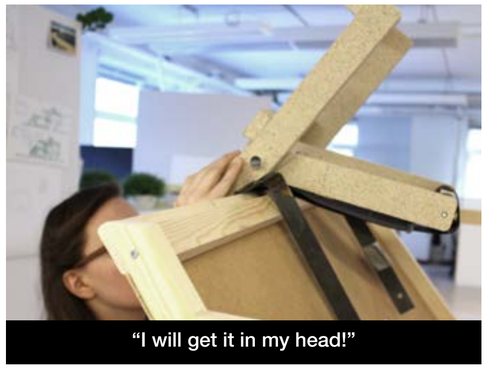


"No way! This is impossible to climb"

EVALUATION WITH TEST USERS

"Will it slip?"





"I will get it in my head!"

"Need more space to climb"

"It could be great if it could slide down."

EVALUATION RESULT

The tool bag part must be very slim and mounted on a very low level in the boat to not be in the way.

The folding step concept or the rotating frame concept is preferred. The rotating frame concept might not due to the fact that it can slip and not lock under the boat under the boat as previous concepts.

The inflation part must have enough space between them as to not be in the way while climbing. They should have a manual inflation activation function.

Maybe it would be good to add stability sideways to the step, or a lower attachment point.

To have the ladder on the inside of the boat would create the risk that the user gets the step in the head as it falls down, but having it on the outside is not practical due to the fact that it might hit the water while driving the boat and also get damaged in narrow harbours.

DECISION TAKEN BASED ON EVALUATION:

Ladder on the inside of the boat.

Folding step

Remove the tool bag

Manual trigger for flotation units.

ONE SIZE DOES NOT FIT ALL?

THIS BOAT WOULD *NOT* TIP EASILY

THIS BOAT *CAN* BE TIPPED

It became clear that my original target group- small open motor boats or rowing boats under 6 meter, needs two different solutions.

The smallest boats that weigh 50 - 110 kg could be prone to tipping. (You have to weigh approximately 220 kg to tip the 110 kg boat). This includes single hull aluminium boats, and plastic and wooden boats of the smallest kind. This type of boat would benefit of flotation aid at the railing.

The slightly bigger boats are often double hull, and weigh more because of this. It might not be a big difference in length, but a bigger difference in weight. They can weigh from around 110 kg to 300-400 kg. There is no need for flotation to these boats because I estimate that very few to none users would weigh more than 220 kg.

To provide the same solution for these type of boats seem ridiculous. There is no need for flotation to the slightly bigger category. They might still benefit from the step, but that version must be sold without the flotation. These slightly bigger boats often have double hulls and are more diverse in their construction, with different type of bench solutions and railings.

I will focus on the smallest version, where a flotation aid is useful. In a later stage the concept could be adapted to bigger boats , but then sold without the flotation aid. For bigger boats the railing might look very different and needs different options for attachment.

ADJUSTMENT OPTIONS OF TARGETED BOATS

SMALLEST BOATS ONLY

- Step on the inside
- Floatation integrated

WIDER RANGE OF BOATS (50 - 300 KG)

- Step on the inside
- Floatation optional

⊕ Most complete concept

⊕ Most market opportunity

⊖ Smaller target group

⊕ Bigger target group

⊖ There are other market options for a larger boat segment

⊖ Flotation option must be a separate version

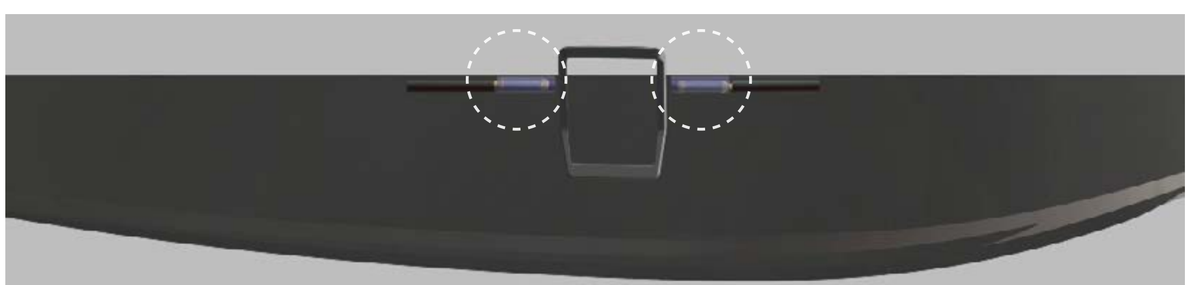
PRIMARY FOCUS AREA

LIST OF FUNCTIONS

Function	Note	Class	Importance
Enable climbing into boat	From water level	MF	Needs to
Ease climbing	From water level	NF	5
Provide footstep	With distance from boat, one foot	NF	5
Provide hand grip	At railing level	NF	5
Few steps of use	Climbing	NF	4
Adapt to different types of boats		NF	4
Adapt to different railings		NF	4
Minimize weight	Of whole product	NF	3
Adapt to different height of railings	Height from water level	NF	4
Minimize need for fine dexterity movements		NF	4
Provide attachment to boat		NF	5
Provide flotation	To counter tipping	NF	3 (?)
Enable climbing with inflatable life jacket		NF	3
Maximize simplicity	Construction	NF	3
Easy to pull down	From water level	WF	4
Provide stability	Construction	WF	3
Easy to understand		WF	4
Few steps of use	Attachment	WF	2
Minimize getting stuck	With clothes on ladder	WF	3
Provide visibility	Footstep	WF	3
Provide locking to boat	Railing	WF	3
Provide flotation	If boat sinks	WF	1
Provide other use	Than ladder	WF	4
Avoid accidentally activation	Of ladder	WF	3
Provide first aid kit		WF	1
Include alarming function		WF	2
Avoid accidentally activation	Of AIS transmitter	WF	4
Maximize assistance in climbing	Number of steps in climbing	WF	2
Enable getting the ladder back into standby position		WF	2
Minimize size	Ladder	WF	3
Minimize visual impact	Of ladder, not in use	WF	4
Enable storage of boat upside down		WF	4
Minimize attachment time		WF	4

PLACEMENT OF CO2 CARTRIDGES FOR AIRBAG INFLATION

There is a risk that the user get stuck while climbing if the CO2 cartridges sit in the middle



It is better if the CO2 cartridges are located one on each side of the step, to prevent the user from getting stuck while climbing.

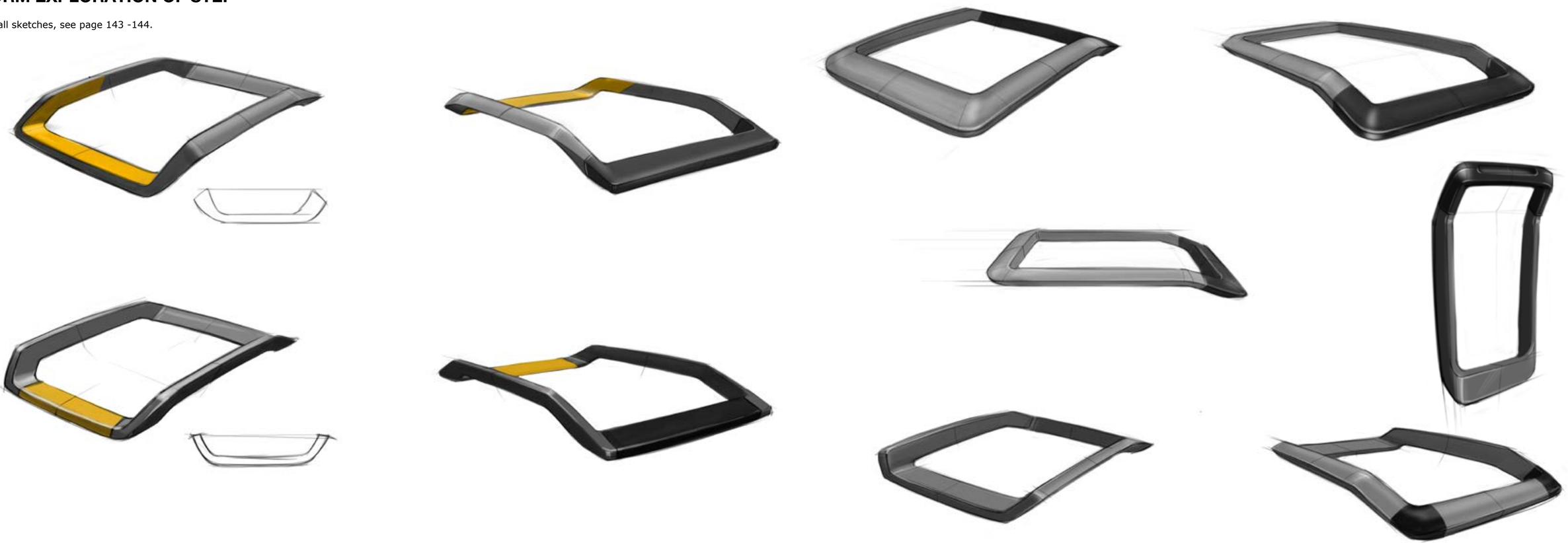
FORM AND MOOD

The form should be discrete, yet feel like a high end product. The color theme is connecting to a fisher/ hunter lifestyle. Robust and rugged, yet optimized and elegant.

Color scheme:

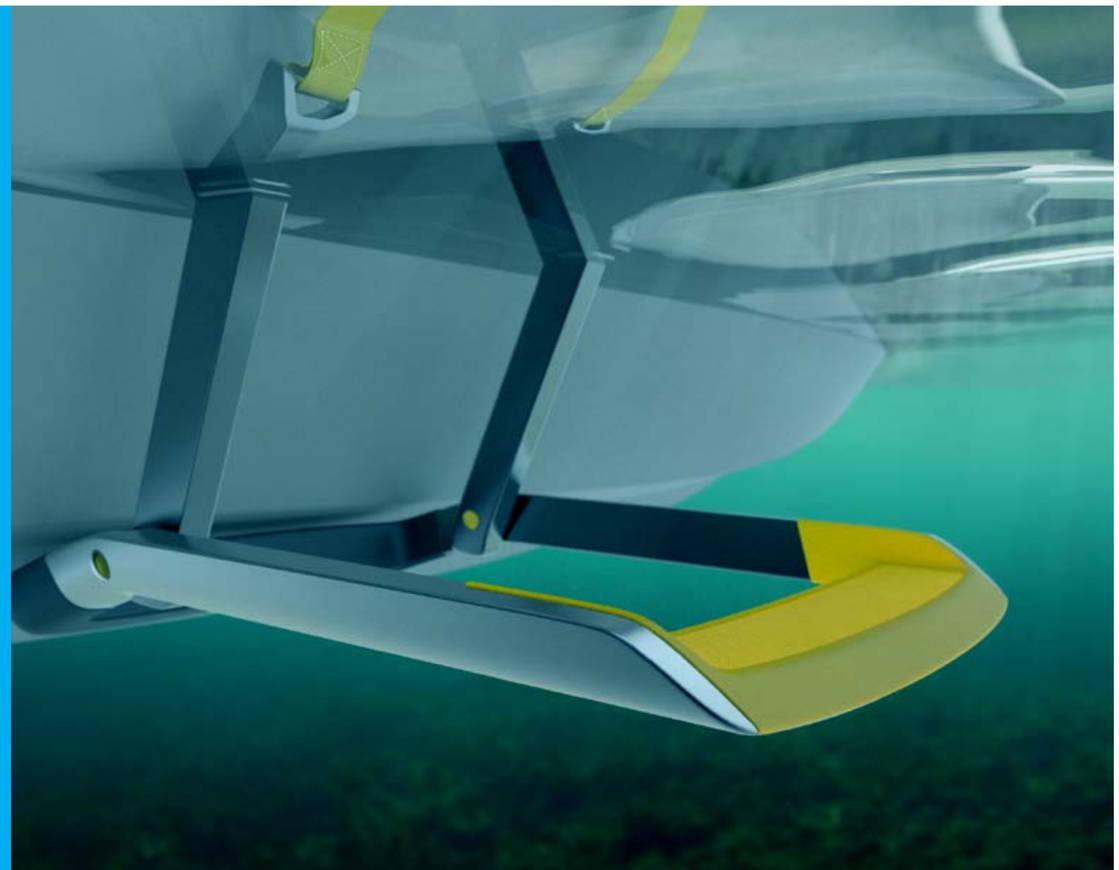
FORM EXPLORATION OF STEP

For all sketches, see page 143 -144.



result

05.



RESULT

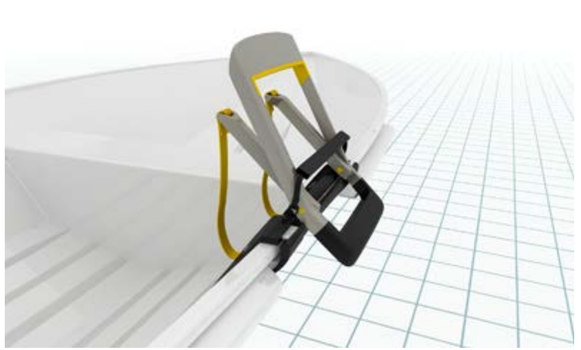
REDEO

REDEO is a step that can easily be mounted on the side of the boat. It can be pulled out from water level and greatly enhances the chance of climbing back up in case of a fall overboard. For the smallest boats there is a possibility to add inflatable units that prevent the boat from tipping while climbing.

FUNCTION OF STEP

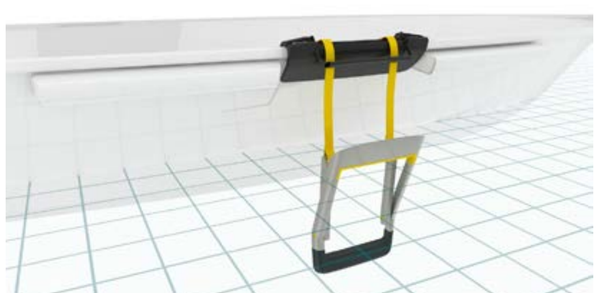
1. The step is mounted on the inside of the boat.

2. The step can be pulled out manually from the outside by gripping the back part of the step.



3. A strap holds the step in place so it doesn't fall down in an uncontrolled way.

4. The step slides out of the strap.



5. When the step has fallen down, it unfolds and reveals the yellow footstep.

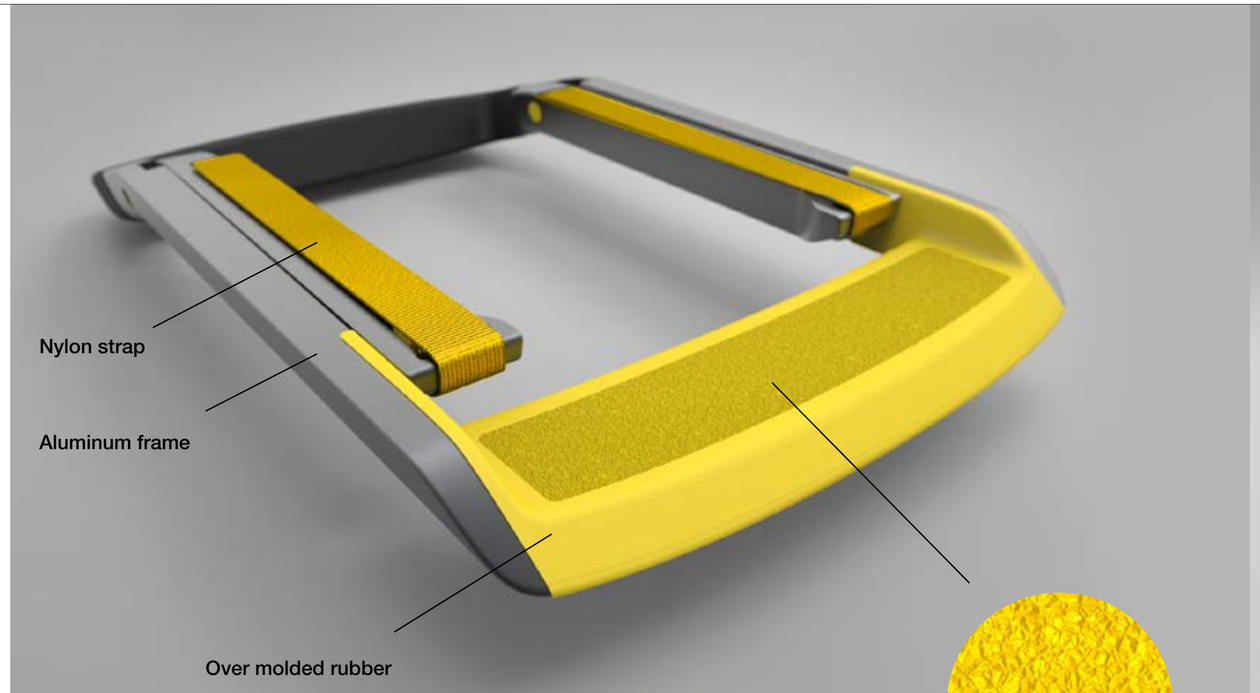
6. When the user climbs up, the step lies against the boat in such a way that it locks against the side. This provides a footstep for the user with a distance away from the boat side. This feature makes it a lot easier to climb.

WITH FLOTATION UNITS

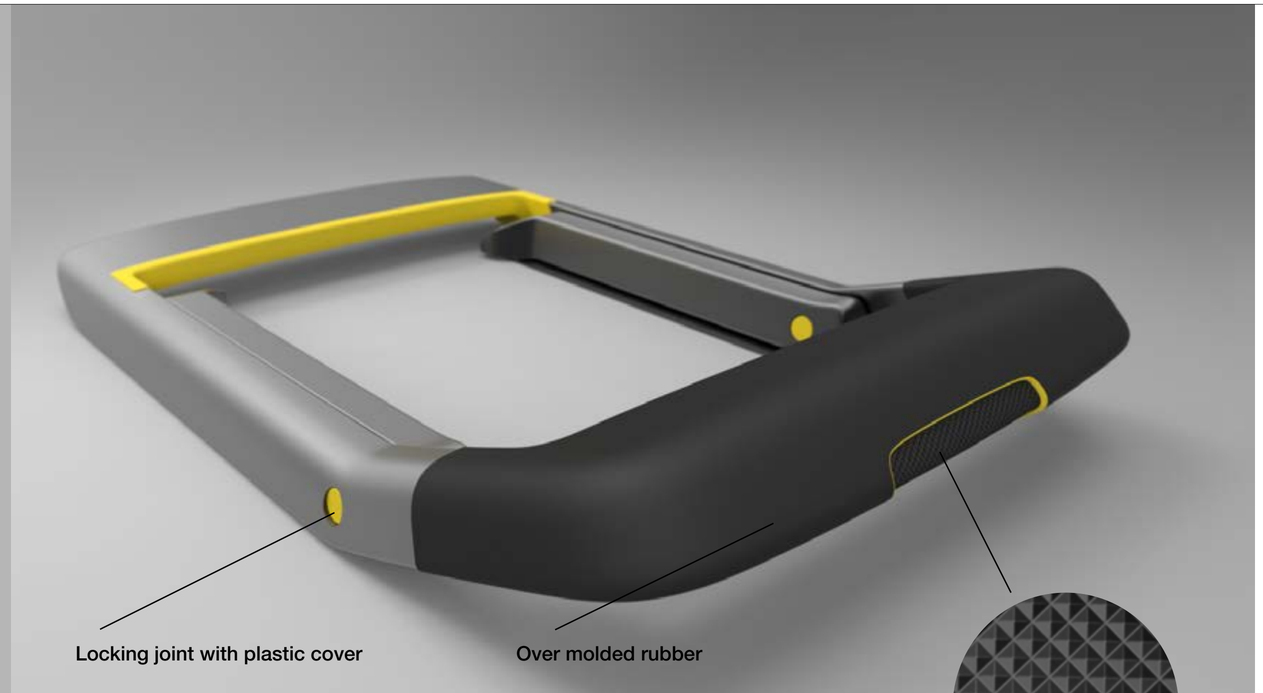
From the outside of the boat, one can only see the top of the step and the attachment. This picture shows the version of the product with the inflatable units. They are mounted right under the railing of the boat, and inflates by pulling the yellow handle.

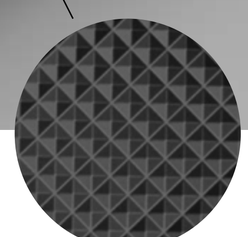
WITHOUT FLOTATION UNITS

The step can also be purchased without the flotation units if the boat is big or stable enough to not be in risk of tipping. The product in its' most minimal state looks like the picture above.



Grip texture

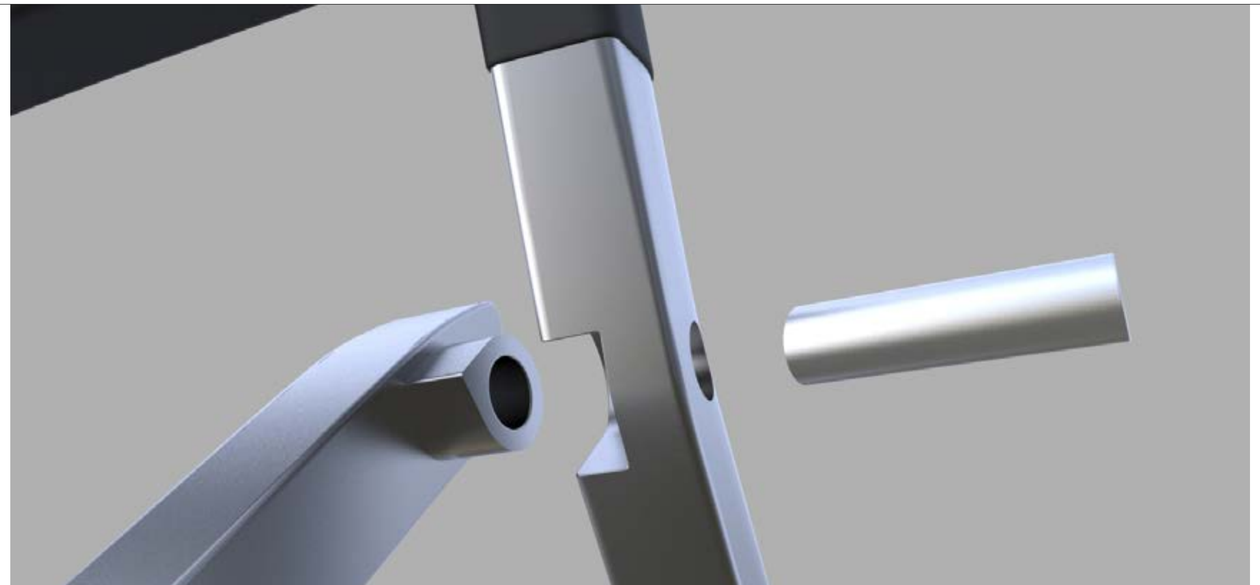




Grip texture

MATERIAL AND CONSTRUCTION OF THE STEP

The step is made of aluminium for its' light weight. It is attached with nylon straps to the attachment part. The front is over molded with texturized rubber to give a better grip for the foot and to add visibility. The back of the step is also over molded with rubber to prevent slipping on the side of the boat while climbing.



STOPPING JOINT

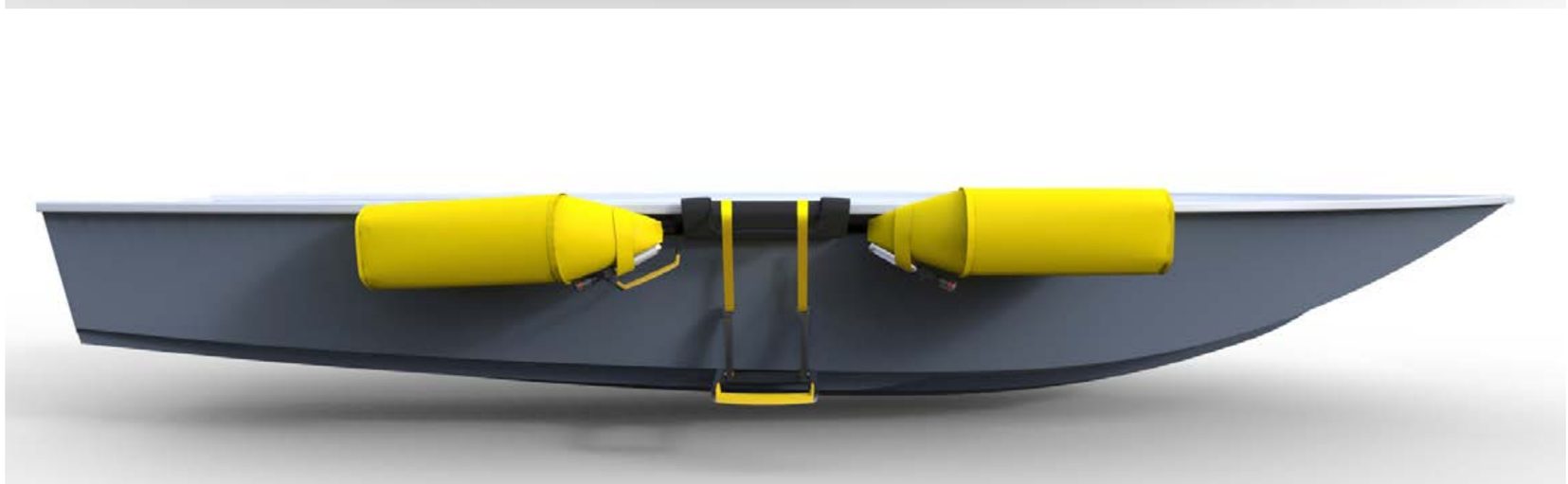
The step needs to lock in the right angle to work properly. This is achieved by a joint working with the principle shown in the image above.

THE ATTACHMENT TO THE BOAT

The step is held to the boat side with an attachment in plastic. The attachment holds the step, it prevents vibration noise as it holds the step in place. The holding strap also guides the step when pulled out of the boat and prevents the step from falling un- controlled into the victims head for example. The attachment is also necessary to hold the straps that the step hangs in.

The attachment is fastened with two bolts that pierce the hull of the boat. There is no risk of leakage as the bolts sit very close to the railing of the boat.

Information about the product placement and the inflatable units (if that version is applicable) is printed on the inside of the attachment. It can be read even when the step is in place.

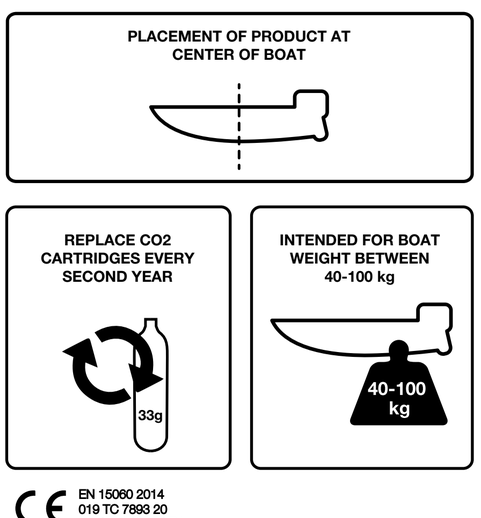


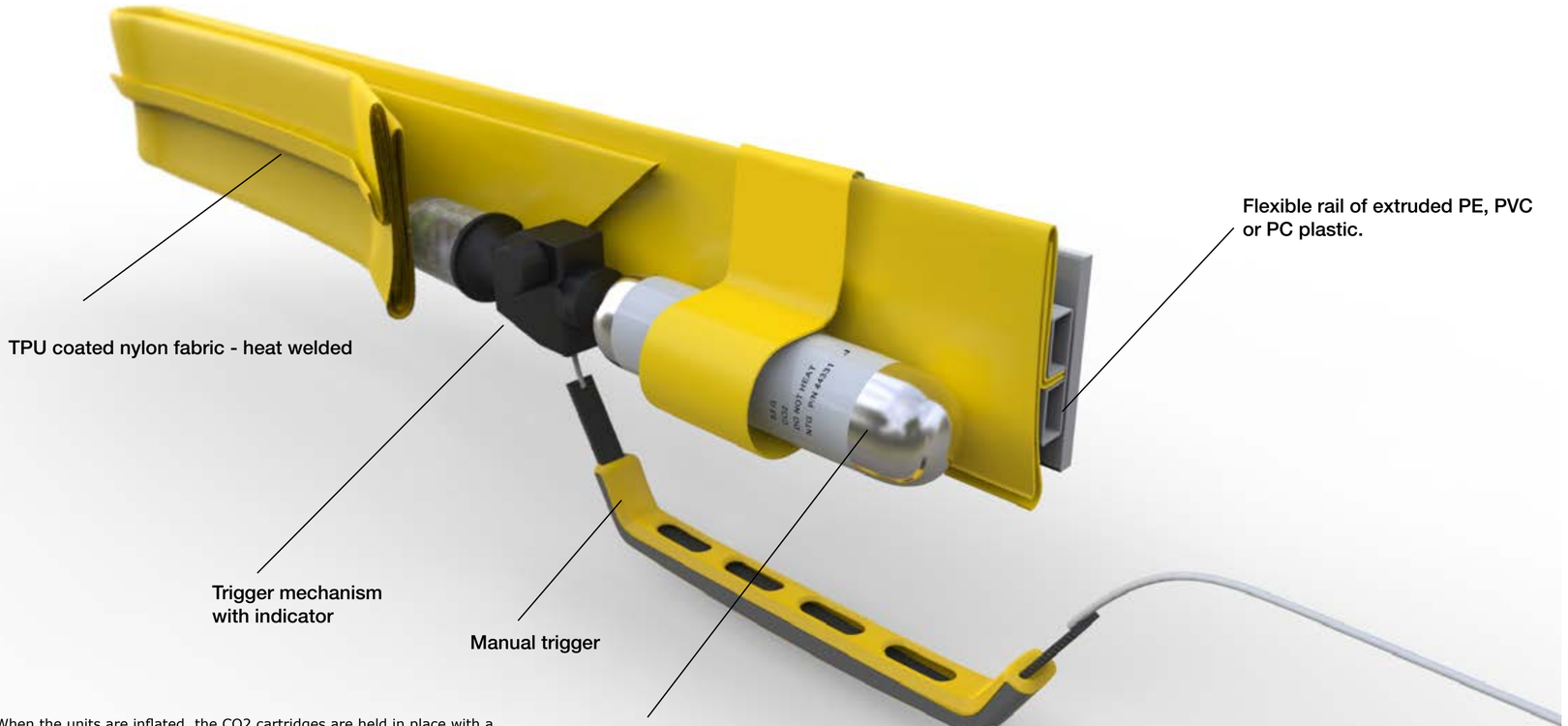
FLOTATION UNITS

If the product is purchased for a boat that weighs less than 100 kg, there should be an option to buy a version with attached flotation units. These will prevent the boat from tipping when using the step to climb in.

The inflatable units are packed tightly and attaches to a rail under the railing of the boat. When the yellow trigger handle is pulled, they inflate due to the CO2 cartridges attached to each unit.

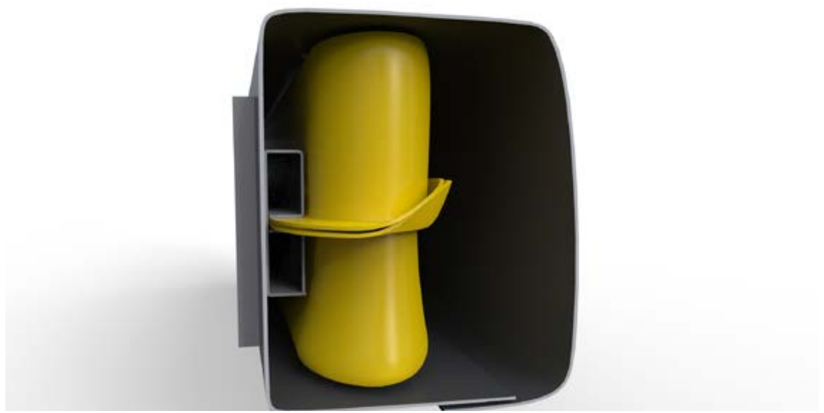
When they have been used, the CO2 cartridges need to be replaced. This is not very expensive, the cartridges are the same kind that are being used on inflatable life jackets. The Swedish retail price is about 200 SEK each*. The cartridges have to be replaced with two years interval. This information is clearly stated on the safety information on the attachment on the inside of the boat.





When the units are inflated, the CO2 cartridges are held in place with a strap of the same fabric as the inflated units. This is to prevent the user to get stuck in the cartridges while climbing.

The trigger mechanism shows a red color when it has been activated. Then the cartridges needs to be replaced with a re-arming kit.



FINAL MODEL AND EXHIBITION

The final concept was visualized in a full scale model, and shown at the Umeå Institute of design degree show.

MASTER THESIS PROJECT
Advanced product design
Umeå Institute of Design

MALIN ANDERSSON
2014
Back in the boat

DISCUSSION

I started this project with a very wide question: how can I make boating safer? The reason for the question was the number of people who drown every year in boating related accidents but also a personal interest for boating and the sea. The research was quite clear on what kind of accident is the most common and whom it affect.

The biggest difficulty I found was the mindset of the user group. The problem is not a lack of safety equipment, but a lack of use of the equipment that exist. The people who are at risk at sea often overestimate their own abilities and the danger of the situation. Alcohol was also an important factor.

My solution is an add-on product to existing boats. The benefit of this is that it is a solution that can be implemented within a short time frame, and therefore save lives sooner. The new EU regulations require all new boats to be equipped with means of getting back in the boat from water level, and this is a good requirement, but it does not help all those who already have a boat. Boats have a quite long lifetime (maybe 20 years) and it will take time before a new type of boat gets implemented. From this perspective my product can have an impact in saving lives.

One downside to an add-on product is that it is very difficult to make my product fit all boats. The boats I have been investigating have a wide range of different railings and designs, and my design does not fit every type of those boats. I have addressed the difference in railings by having different versions for the attachment, a solution that will make the product fit most boats i this category without adding too much confusion for the consumer. Three different sizes with some flexibility in each size will be sufficient. However, the product require some free space on the inside of the boat, under the railing, and while most boats in these sizes have space for this, not all boats have this space. For the few boats that have benches all the way around the railing or a deck that prohibit anything to be attached on the inside of the railing, there has to be another product solution. However, my product concept will fit enough boats in the size category that I am trying to address so it is my opinion that the market is big enough.

The goals for this project was to increase the chance of getting up in the boat from water level if the victim is still conscious, to provide flotation if the boat sinks and to generate a higher user frequency than the products that are on the market today.

My user test clearly show that a footstep of my design would be a great help for getting back up in the boat. When the test user was wearing an inflatable life-jacket a footstep was the difference of getting up or staying in the water. To provide flotation if the boat sinks is only an option if the consumer chooses to buy the version with the flotation units, which is only for the smaller boats. One can argue that it is only the very smallest boats that are at risk of capsizing, but of course there is a risk also for larger boats as no boats are unsinkable.

When it comes to motivation to use the product, I took away one of the reasons to buy it: the tool bag that was part of the initial concept. I did so because my user test clearly showed that it would be in the way while climbing and would greatly decrease the performance of the products main purpose: to save lives.

There could be other motivating factors for buying this product. One can be that the user see the risk of falling overboard, even if he or she does not think that falling overboard can cause death. It is simply more practical to be able to get up easily than to abandon the boat and swim to the shore. The product can also be distributed by an insurance company in favor of a lower insurance cost. My concept will also be easier to mount on the boat than current products. There is also a chance that people see the opportunity to use the product for the purpose of swimming from the boat. Then my concept could add convenience.

In my wishes I stated that I wanted to include an alarming function. I did not manage to do this in this project due to time constraints, but I see no reason for why it could not be easily added to the product in future development. For example there is no reason why a personal AIS transmitter (described on page 39 - 40) could be activated when one inflates the flotation units for example.

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TIME PLAN

W. 4
Research
- Identification
- Identification
- Research statistic
- Research statistic
- Research statistic

W. 5
Research
- Research statistic
- Interviews Planning
- Interview
- Analyze
- Interview

W. 6
Research
- Analyze
- Identify extra research
- Extra research
- Extra research
- Extra research

W. 7
Research
- Extra research
- Extra research
- Extra research
- Prepare presentation
- Research presentation

W. 8
Research
- Sum up- decide
- Fill in gaps
- Fill in gaps
- Finish brief
- Finish brief

W. 9
Ideation
- Plan Workshop
- Own ideation
- First ideation workshop
- Sum up of result/persona
- Plan workshop

W. 10
Ideation
- Workshop
- Sum up result
- Refine result ideas
- Travel
- Self safety course

W. 11
Ideation
- Identify ideation cluster
- Create concept
- Prepare presentation
- Halfway presentation
- Decide on main direction

W. 12
Develop concepts
- Sketch, refine
- Sketch, refine
- Test model
- Test model
- Test model

W. 13
Evaluation
- User test
- User test
- Evaluate
- Decide concept
- Mood board

W. 14
Refinement
- Form/semantics sketch
- Form/semantics sketch
- Detail test model
- Detail test model
- User test

W. 15
Refinement
- Final design sketch
- Final design sketch
- Prepare presentation
- Process presentation
- Design adjustments

W. 16
CAD
- CAD
- CAD
- CAD
- CAD
- CAD

W. 17
Model
- Send to mill/ print
- Model
- Model
- Model
- Paint

W. 18
Report
- Report
- Report
- Report
- Report
- Report

W. 19
Presentation
- Report deadline
- Rendering/ visualization
- Rendering/ visualization
- Movie edit
- Movie edit

W. 20
Ideation
- Movie edit
- Rendering/ visualization
- Presentation
- Presentation
- Presentation

W. 21
Examination
- Presentation
- Presentation
- Presentation/ movie
- Examination
- Examination

SWEDEN

Since Sweden is one of the biggest boating nations in the world (calculated in boats per capita) the statistics are relevant. Although there are good data of number of deaths, boat types and where accidents happen, the data is lacking in detail information. Partly it is difficult to evaluate what happened if there is no one alive to tell, partly there have been poor routines for reporting detailed circumstances around an accident.

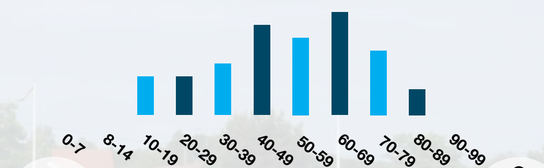
There is also poor correlation in accident reports of the connection to the average use of boats in Sweden. For example, the group most frequently involved in accidents are small open motorboats, but that is also the most common boat-type and most of those boats are located inland, in lakes and rivers. It is therefore likely that this group and locations are well represented in the statistics.

Sweden does not have a law that regulates the use of life jackets, but such a law is being lobbied for. Sweden does have a law of alcohol levels, but it is only applies to the boats bigger than 10 meters, exactly those who are not very frequent in the accident statistics.

95%
Of all alarms are made by mobile phones.

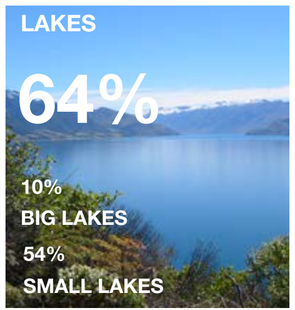
18%
Of all drowning victims related to boating accidents had a alcohol related diagnosis

Drowning per 100 000 after boating accident 1997-2011



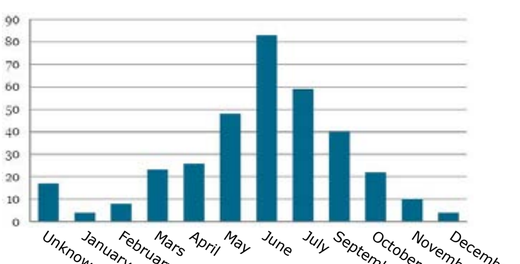
The majority of all deaths related do recreational boating accidents happened to 40-69 year old.

Fatal boating accidents 2011



The diagram shows dead and missing people in leisure boat activity on Swedish waters. The decline has leveled off for the last 10 years, but the Swedish ministry of transportation has set a goal to further lower the numbers of dead and missing until 2020.

Drowning while boating by time of the year

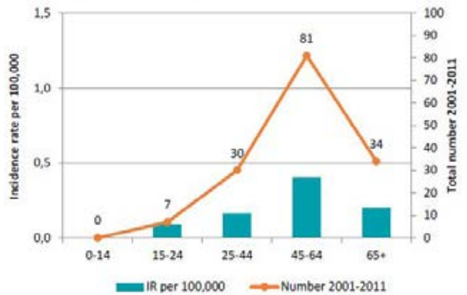


DENMARK

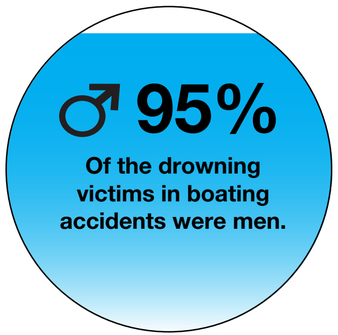
Denmark is also one of the countries with a large number of leisure boats.

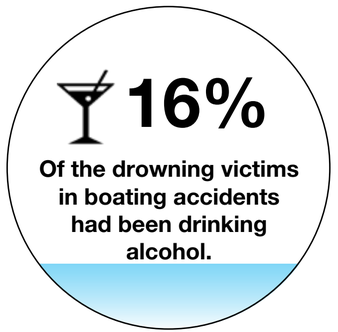
In Denmark, most drowning happen out at open sea, in harbours and close to coast (general drowning). The lower rate for lakes and rivers may reflect the fact that there are not as many big lakes in Denmark. The inland waters existing mainly of fjords (Limfjorden being the biggest). The most common activities was bathing/ swimming, leisure boating and in harbours. Also here there is a lack of information on more precise activity.

Figure E: Unintentional drowning deaths during leisure boating 2001-2011. Number and rate per 100,000, by age group

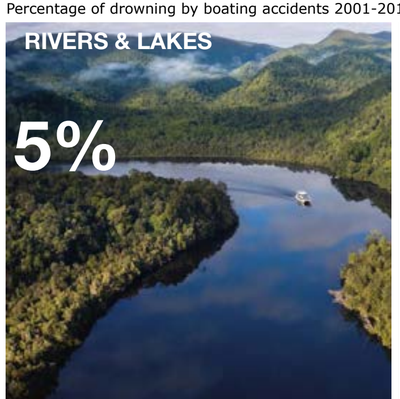


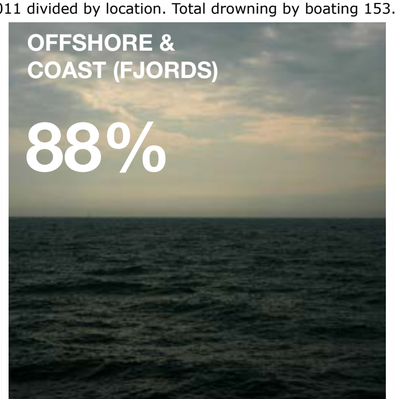
The total numbers includes both Danes and foreigners. "Danes" means residents in Denmark, while foreigners include tourists, sailors and fishermen visiting Danish waters, while the incidence rates are based on Danes only.



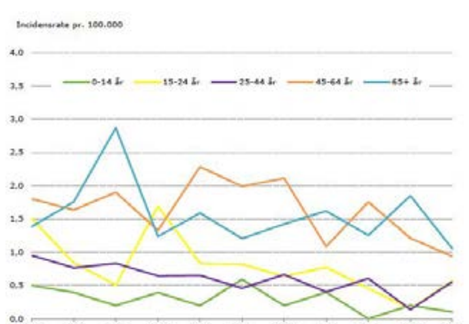


Percentage of drowning by boating accidents 2001-2011 divided by location. Total drowning by boating 153.





Drowning accidents 2001-2011 per 100 000 people, divided by age group.



Figuren omfatter alene danskere, dvs. personer med cpr-nummer og fast bopæl i Danmark.

The number of deaths are highest among 45-64 year old, and slowly falling for all groups. However, the large variation between years make it more difficult to determine if it is a generation issue, that should soon be gone.

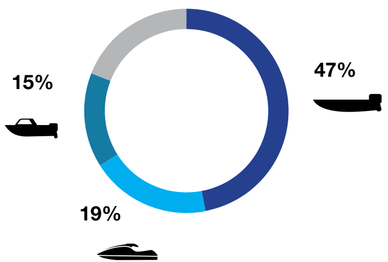
USA

USA has a large boating population, seen to number of boats the largest in the world, but not largest in terms of number of boats per capita. Therefore the data is detailed and provides a large base of information. USA also has a big range in water temperature and climate, why it is interesting to compare. Their statistics also includes non fatal accidents, and the resulting damages. In 2012, there was 651 deaths and 4515 accidents reported related to boating. Similar to the other nations I have researched, the trend is going towards fewer deaths per year.

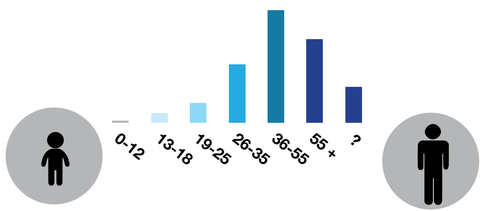
The remarkable with the US statistics is that it list in much more detail the cause of an accident. On the other hand, the statistics regarding boating accidents are based on voluntarily reports, and may be misrepresenting some groups. Also, injuries that happen while getting on and off the boat is not represented.

Percentage of lethal boating accidents divided by type of water 2012

Type of vessel involved in accidents



Age groups involved in accidents



85%

of the people who drowned in boating accidents where not wearing a life jacket.

70%

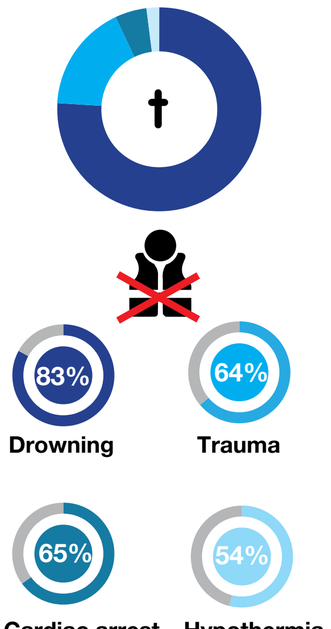
of boaters who drowned where using vessels smaller than 6,4 m (21 feet).

17%

Alcohol was the leading contributing factor with 17%

Operator inattention, operator inexperience, improper lookout, machinery failure and excessive speed rank as the top reasons for accidents

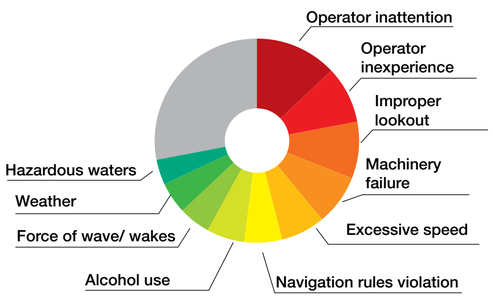
Cause of death



Percentage of deaths without life jacket

Primary contributing factor

4515 total accidents (fatal and non fatal)



When does accidents happen?

JUNE
JULY

Most accidents per month.

DECEMBER
MARCH
APRIL

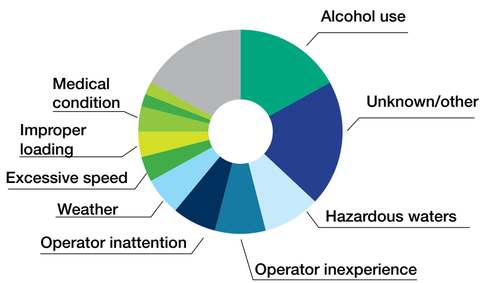
Highest percent of accidents that are fatal.

00:00 - 06:30 AM

Highest percent of accidents that are fatal.

Primary contributing factor

651 total accidents (only fatal accidents)



Alcohol as a primary contributing factor to all accidents for different boat types

5%	20% death per accident
7%	18% deaths per accident
3%	8% deaths per accident
7%	76% deaths per accident

70 - 79 F (21,1 - 26,1 C) most accidents occur but only 11% is lethal.

40-49 F (4,4 - 9,4 C) is 46% of all accidents lethal.

Collision with recreational vessel most common accident type.

Fall over board is the most common cause of drowning. Collision with another recreational vessel is equal to fall overboard in other deaths, and the biggest cause of accident.

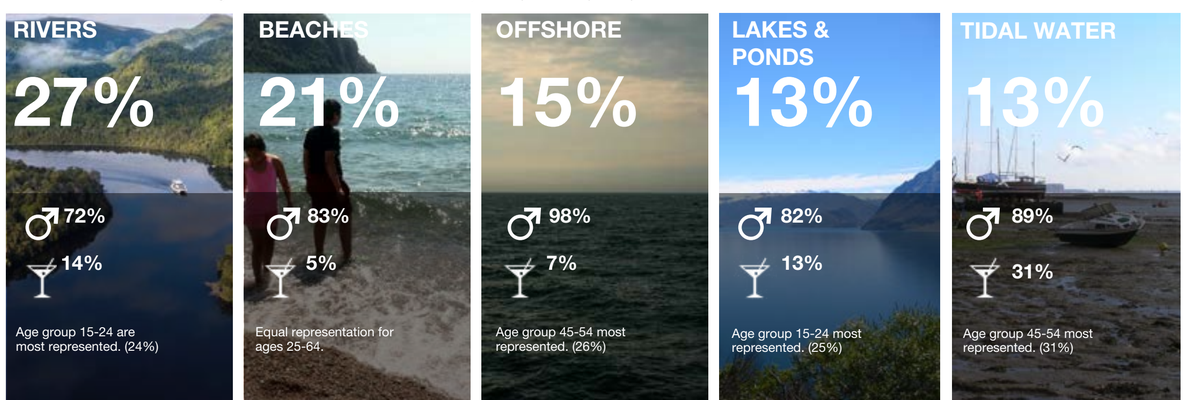
NEW ZEALAND

New Zealand is one of the biggest boating nations in the world in regards to number of boats per capita. This is likely due to the favorable climate and accessibility to water. Their statistics are similar on some points, but have significant differences. For example here is swimming the biggest cause of drowning, followed by powered motorboats where the majority of the accidents happened offshore (not close to shores and inland waters). Also only 54% of the persons drowning in all boating accidents did not have a life jacket (2013). This is indicating that a whole 46% drowned with a life jacket. This is unusual compared to the other nations I have been looking at where about 75-80% of the people who drown while boating do not have a life jacket.

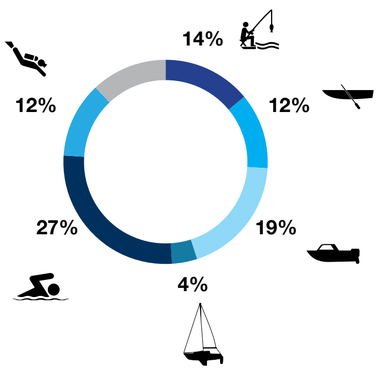
Because it is difficult to know if a victim where drinking alcohol before the accident, the authorities who analyzed the statistics believe the actual numbers are higher.

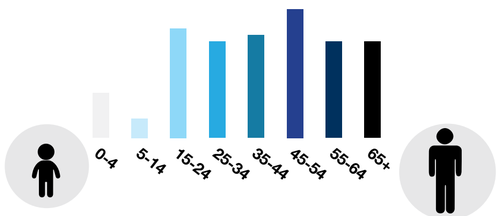
Most frequent places

Data total amount of all drowning 2008-2012 Other areas are domestic, home pools and public pools.



Total drowning average over the last five year period (2008-2012)





54%

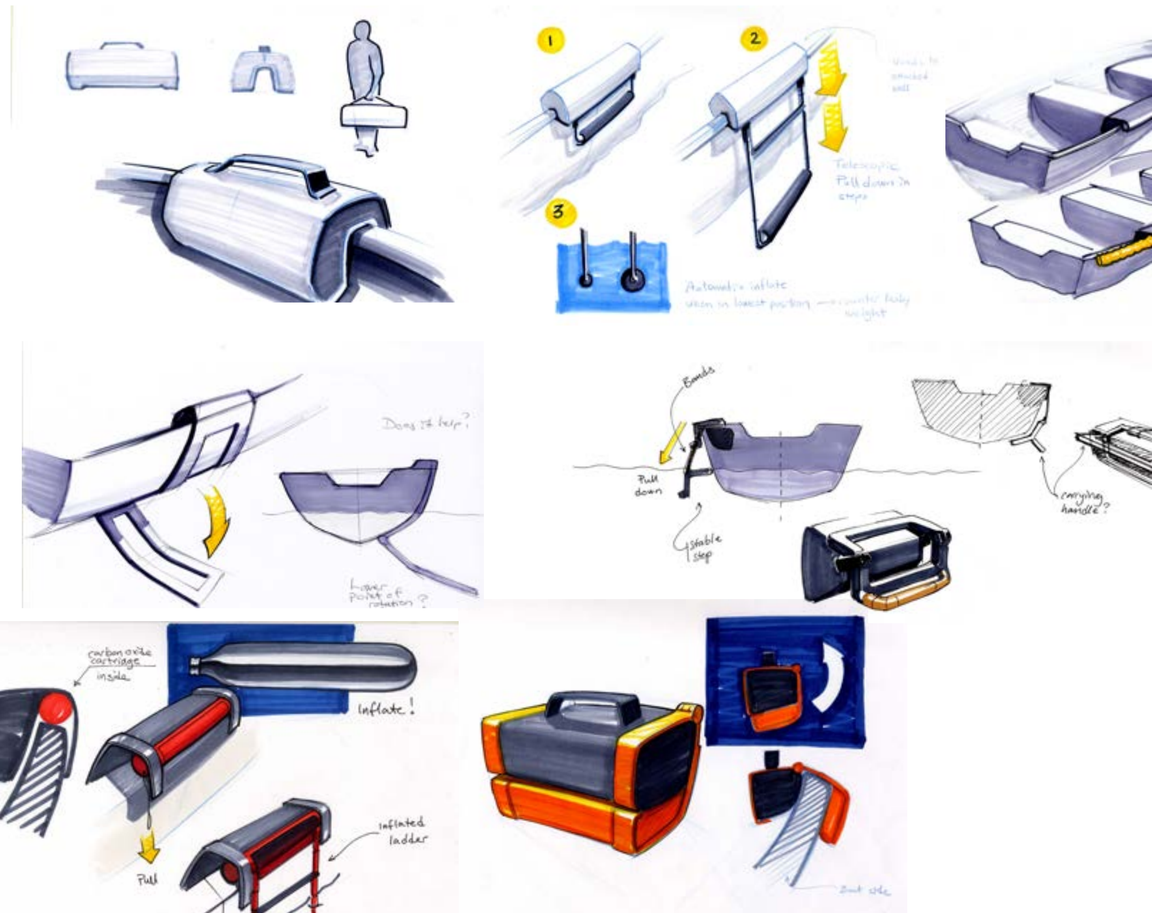
of the victims in all boating accidents where not wearing life jackets.

Carrying a waterproof way of calling for help is estimated equally important as having a life jacket.

BOATING

43% offshore
45-54 years old
Powered boat
between 4-6 m.

CONCEPT DEVELOPMENT OF TOOL BAG - LADDER



FORM DEVELOPMENT OF STEP - ADDITIONAL SKETCHES