

Innovation Journey in Energy for Smart Cities 2017-2018

How can enhance the waste transport via the water in an economically viable and sustainable way by Indaver NV

WPO feasibility study

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Brief introduction:

Indaver is trying to reimagine the transportation of waste. While truck transportation has worked for decades, the saturation of roads and cities is pushing towards change. The list of benefits for water waste transportation is really long including higher efficiency, noise reduction or increased cargo capacity, amongst others. In front of such potential gain, the project will try to reinvent waste transportation through innovation on innovative rafts, SailWaste, and the consequent changes on the waste transportation logistics.

Section 1 : What problem does my product/service solve.

1.1 What problem does our product/service solve?

Traffic jams are a common problem that arises on road during logistic delivery by vehicle. As Indaver is in charge of the waste collection, transportation and treatment for the city of Antwerpen, it needs to transit the waste from their local collection point to central waste recycling plant. As amount of waste for the city is strikingly high, around 1 Mtonnes per year, and the waste transportation is only being done by trucks, traffic jams at the entrance of the Indaver treatment plant and in the city of Antwerp in general are a common issue. The fact that the province of Antwerp has one of the highest recycling rates in Belgium can be appreciated on the figure below and, despite being something positive, it does not help on reducing the amount of trucks in circulation.

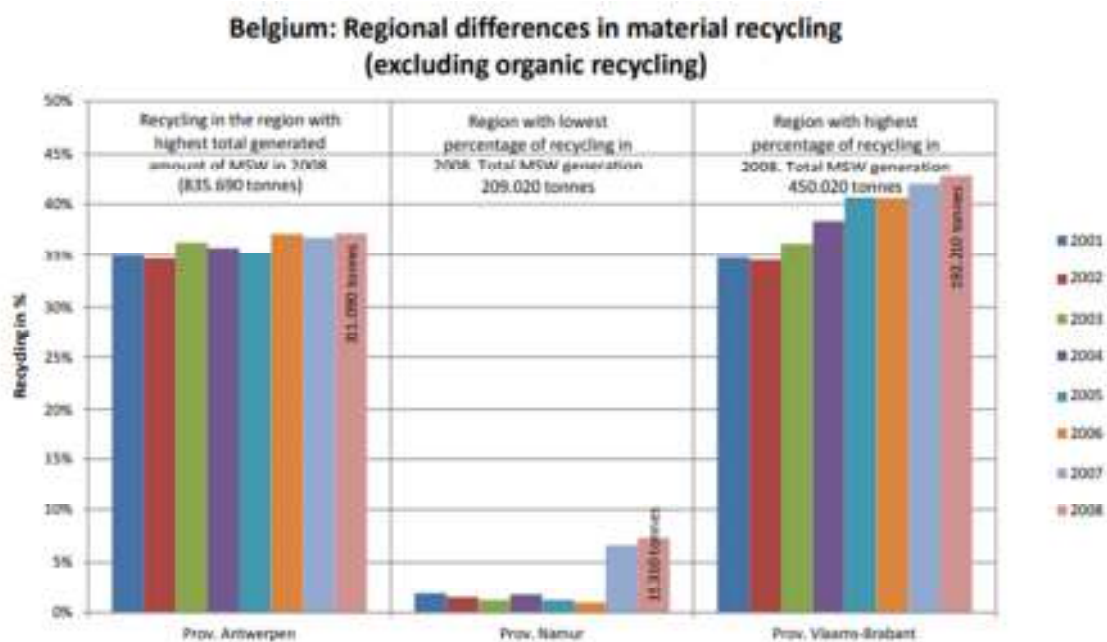


Figure 1: Regional differences in recycled waste

Source : regional differences in recycled waste, 2012 cited in Emmanuel, 2013, p. 15.

The Traffic jams at the entrance of the plant and the city itself have many negative implications that concern a number of different stakeholders. Therefore this is a project that may have a single customer, Indaver NV in that case, but that it is not only their concern. Different implications and the affected stakeholders are listed below.

- **CO₂ emissions increased during the jams. Actors involved: Government (both local and regional) and citizens (both local and global).**

It's a fact that CO₂ as a member of greenhouse gases that contributes to the global warming and climate change. However, mostly logistic delivery company and waste recycling company like Indaver still uses road vehicles that run on fossil fuel resulting in CO₂ emissions.

- **Air pollution. Actors involved: Government (both local and regional) and Antwerp region citizens.**

To some extent, air pollution is a serious issue in all the cities of the world. Therefore there is public interest on reducing the traffic jams in order to avoid its associated pollution.

- **Acoustic pollution. Government (both local and regional), Antwerp citizens, Indaver and companies on the same area.**

The fact that many cars are together on traffic jams generates an inevitable acoustic pollution that affects the people around the zone where it is produced no matter their activity by reducing their comfort.

- **Efficiency of both workers and materials. Indaver and companies using the same infrastructure.**

A traffic jam is a nightmare for a company as there are both workers and materials which are not generating profit during a certain period of time.

1.2 Which customer need does it satisfy?

As stated on the previous point, Indaver benefits from both a reduction on acoustic pollution and, mainly, an increase of their fleet efficiency. Nevertheless other actors have interest on the solution and their needs are also satisfied through indaver's project.

Section 2: Macro - Environment analysis

Macro - Environment analysis

2.1 How do macro-environmental factors affect your product, in terms of political factors, economic factors, social factors, technological factors, environmental factors and legal factors?

<p>Political Factors</p>	<p>Analysis of the political factors that will have an influence on the technology (E.g.: Directive 2009/28/EC of the European parliament)</p> <p>There's no doubt that political regulations will play a major role on the development of the project, but that role may be either positive or negative. On one hand, policies of any kind (regional, local, global) will require some quality and safety standards to guarantee that there's no waste leakage into the riverbed or any other kind of environmental damage. Anyway those factors will need to be addressed anyway to achieve a good quality project, so regulations shouldn't add difficulties to the project. On the other hand, political regulations may play a favourable role once the project has been proven and launched if there are tangible benefits both economical and environmental. Regulations that require an improvement on the quality and quantity of waste recycling should bring municipalities and national services to gain interest on the project. Some examples of already existing favourable policies are:</p> <ul style="list-style-type: none"> • Directive 2009/28/ec: This legislation encourages the development of technology for energy efficiency and energy security. • EU 2030 Energy Strategy & EU 2050 Greenhouse Gas Reduction : Set forth the targets to reduce carbon emissions for EU and individual member countries. • European Circular Economy Stakeholder Platform : A platform to gather knowledge on circular economy and bring together stakeholders. • Closing the Loop (EU action plan for circular economy) : A revised legislation to achieve 65% recycling for municipal waste and 75% recycling for packaging waste by 2030. The political factors are probably the most uncertain ones. Nevertheless, as long as the service is respectful for the environment and it reaches good quality standards, the additional constraints should be few in number while the help coming from policies can be huge. • Belgium National Scenario: Belgium is amongst the most successful countries in EU to switch into sustainable waste management. The EU goal for 2020, set forth by European Waste Framework Directive, is to reach a recycling level of 50% on municipal waste. According to EUROSTAT 2012, Belgium is on the short list of three countries that are on the right way to reach it. Not only at European level is Belgium an example on waste management. According to The World Bank statistics, Belgium is amongst the world's leading countries on implement most mature technologies for waste management. Therefore, the political scenario in Belgium is very encouraging for sustainable waste management project.
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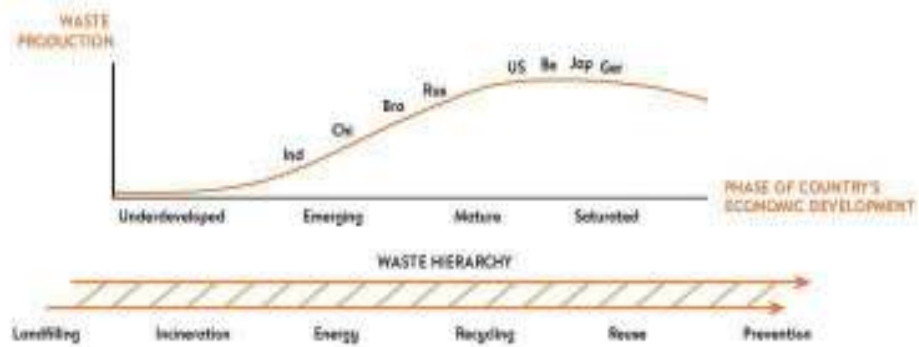


Figure 2: **Waste production phases.** Source: ING The World Bank

Economic Factors

Analysis of the economic factors that will have an influence on the technology (E.g.: oil prices, interest rates, unemployment rate, etc.)

Future changes on the economy will have an enormous weight on the viability of the project and hence, it's necessary to anticipate them. Nevertheless, as the Sailwaste project is not developed yet it's difficult to forecast the impact of changes when, for instance, it still has to be decided if Sailwaste will use fossil fuels or electricity on their engines. In any case, below there is a general overview of the main trends that will affect transportation systems and waste management in the future.

- **Electricity demand will increase.** Thereby more innovative venues and ventures to blossom and bolstering the economy of any state will be promoted.
- **Waste Market is expected to grow on the future.** This one market is one which every economy has to handle intelligently as it can lead to growth of a stronger economy by generating many jobs at the same time.
- **Economy dependency on fossil fuels will generate uncertainty.** If society adapts slowly to the fossil fuel depletion, its price will dramatically increase hence reducing the benefits of truck transportation and increasing the market share for Sailwaste. This can also be a drawback if Sailwaste are hybrid or powered by fuel engines.
- **Sustainability being the need of the hour.** Waste management has a bigger role to play on the future of nations. The better innovation in sustainable handling of waste, the more confidence you gain on your investors. Below the waste differences between European countries can be appreciated.

Collected quantities of e-waste, kg/capita

Source: EUROSTAT & Waste Electrical and Electronic Equipment Survey (WEEE Survey)

See website: www.eurostat.com

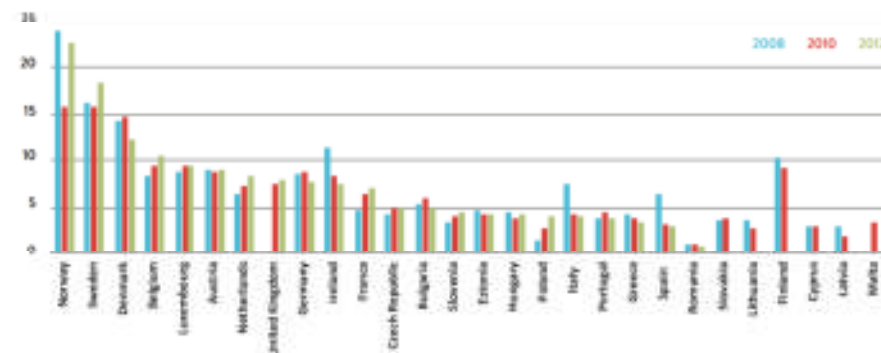


Figure 3: Waste collection per capita in different countries Source: EUROSTAT

Social and Environmental Factors

Analysis of the social factors that will have an influence on the technology (E.g.: public acceptance, ethic energy generation, etc.)

Social factors may have one of the most important impacts on the technology that we desire to apply. Despite waste transportation is more efficient and environmentally friendly than truck transportation, society is used to see rivers and water as something pure. For that reason there might be some troubles on social acceptance of the project as people will not like to see a raft carrying waste on the rivers. Other societal problems could be:

- Less dependence on the trucks might lead to unemployment in the local community even if the ships require a big crew.
- Transportation through sea requires skilled workers, so people will need to prepare themselves for longer times to work on those projects.

Analysis of the environmental awareness (E.g.: risk of disrupting animals, etc.).

While water transportation seems better than road transportation regarding direct impact on environment (less noise, less CO2 emissions, less traffic congestions...) there's a crucial factor that needs to be seriously considered. While an accident on a waste truck will have an easily solvable impact on the environment, an accident on a waste ship is something much more serious. On that case waste would start spreading through the river before it is possible to clean it. Nevertheless this can be tackled by technical means, for example transporting the waste completely enclosed on a hermetic container. Below there are some sustainable solutions to be adopted while taking up waste management:

- Prevention is better than cure, So prevent generation of waste if possible.
- Waste disposal methods to be developed/updated in such a way that we reduce the quantity of waste incineration and landfill.

Already contaminated sites due to industrial waste dumping and other reasons should be remediated as soon as possible.

<p>Technological Factors</p>	<p>Analysis of the different technologies' development (E.g.: different products development, investment in R&D, etc.)</p> <p>There are two main technological factors which are crucial to understand the future deployment of the Sailwaste.</p> <p>The information and communications technology revolution dramatically reduced the costs of mobility and accessibility. It allowed new network connections and production processes such as just-in-time production, outsourcing and offshoring, and provided a tremendous stimulus to logistics. As a result of rising demand, transportation costs fell. Ships increased in size. Economies of scale were exploited. Furthermore, there were technological advances and organizational improvements in port management – of general cargo traffic, for instance. Of overriding importance was containerization, the greatest transportation revolution of the 20th century. -> the ICT and port management affects the use of cargo ship. Now the ship manufacturing cost is much lower than in the past due to the improvement in ICT.</p> <p>The future for cargo moving overseas is taking a step towards autonomous ships. Companies have been developing real-time control centres that can organise the crew aboard the ship, and send them messages to adjust settings in order to increase efficiency. Having a control centre also increases the safety of the crew by having someone overseeing the ship who can alert them of any issues they might be having. As this technology evolves, the ability to tele control a ship will improve, hence decreasing the number crew members needed and reducing labour costs.</p> <p>The Project doesn't involve any sophisticated technology employing any fossil fuel consumption. It uses the trucks power to get translational motion and uses the steering wheel in the truck to make manoeuvre. This project involves development of a floating platform upon which the truck rests. So keeping in mind minimum retrofits and changing/ transitioning to other technology is avoided.</p>
<p>Legal Factors</p>	<p>Regulatory framework (regulatory and legal issues)</p> <p>There are different regulatory frameworks that could be applied to that project. This is obviously subject to change but right now the main regulations are the following:</p> <ul style="list-style-type: none"> • Directive 2008/98/ec (Waste Framework Directive): Provides basic definitions and concepts related to waste management. This legislation aims to achieve 50% recycling of household waste and 70% recycling of construction/demolition waste by 2020. • Regulation (EC) No 1013/2006 (Waste Shipment Regulation): This extensive and basic legislation lays down rules for controlling waste shipments to improve environment protection. It also explains the mechanism to handle the harmful waste and also export and import of waste between EU countries as well as other countries. This regulation stipulates the process of prior written notification and consent before cross border waste shipment. • At Belgium National level an Environment Permit form concerning municipalities is needed to carry out any activity related to waste management and alongside occasional inspections from Federal Environment Inspectorate. Since Indaver is already extensively involved in

	<p>waste management, those factors have already been addressed. As far as shipment of waste through water is concerned, no specific legislation exists at national level, but it's expected to appear as soon as water waste transportation becomes a main trend. The legislation mentioned above provides the complete framework for waste transportation through sea.</p> <p>The EU legislation on waste is very comprehensive and state rules and regulations for waste management and shipment include transportation through sea water. This legislation, along with its amended forms, set forth very clear goals to achieve a circular economy with aim to adopt a vertical hierarchy for efficient waste management. Such sort of regulations encourage the adoption of circular economy by sustainable waste management.</p>
<p>Additional Factors</p>	<p>Framework:</p> <p>In Europe waste is collected by trucks on the hours in which there's less traffic and general activity in order to avoid displeasing the citizens. For that reason, waste is collected during the nights or evenings, which is not a problem for truck transportation but could be for boats. Deep analysis on that topic would be required.</p> <p>Location:</p> <p>At that point it is important to state that Indaver focuses their project on their base in Antwerpen, hence the project is just analysed on the Scheldt River. Nevertheless this limited and controlled environment should be considered as an incubator for the project. If that proves feasible and reliable on that zone, then many countries in the world could benefit from water waste transportation. That could be especially useful not only in developed countries as an alternative of truck waste transportation, but as a main system in archipelagos where there's no particular waste treatment like Indonesia or Malaysia. In those countries, big plants could be built in the biggest areas of some regions to treat the waste generated in the nearby islands, which are too small to build their own treatment plan.</p>

Value chain analysis

2.2 Describe the value chain related to your product/service. Are the different players available and connected?

This product, SailWaste what we propose is used to reduce the traffic on roads. The idea inception was realised using one of the creative thinking tools during one of the sessions. This led us to think of a model where the traffic is free of transport/logistic trucks. By seeing the availability of river through the city of Antwerp and its connectivity to different port area. It was decided to use the river to decongest the road. The product is a simple floating boat which houses the truck/vehicle and uses the vehicles power to propel itself in the water and use the steering wheel of the vehicle to maneuver. There would be various river entry point constructed just before traffic bottlenecks. We are also developing an interactive app to calculate the best optimal path to the destination from the source point to reduce the travel time to save time and fuel.

At present by seeing the market struggling to mitigate the traffic challenges, this idea of product provides us with a hope of change in reducing the problem of traffic to a considerable amount. This product makes us stand unique in the market and the first one to make it to such a scale. But there are good chances of new players rise in this segment with similar proof of concepts. So this idea should be implemented earlier so that Sailwaste could capture a good amount of Market share in the upcoming market. According to the IEA Mobility database (Buhau, 2008), transportation in water using ships is 20 times more efficient than trucks.

• Do all elements in the value chain exist? If not, how are you going to tackle this?

Yes, most of the value chain elements exist. But we will have to design the floating boat for housing of the vehicle. This could also be done by outsourcing the manufacturing of the designed boat. The future upgradation of boats feature from housing to batteries to charging the vehicle could also be handled well with the present technology. The app also could be designed and released with the existing software service based companies.

Collaboration can be made with local boat manufacturer in Belgium to design such an installation. After that, relevant tests can be carried out while quality control and quality assurance can be accessed prior to deployment.

• Are the elements in the value chain already connected, as per the identified chain? Do you need to introduce new connections?

No. The elements the hover boat, batteries, etc in the value chain are now separated. There is no need to introduce new connections so far since each of the elements is available in market

- Is there any bottleneck or potential risk at any of the elements of the value chain that may affect your product, its performance, quality, price, etc.? (e.g., monopolies, resources located in one country with constraining market policies or high political instability, potential situations of under-supply / over-demand, high price volatility, etc.)

No highly potential risks are seen in each of the elements in value chain. However, dealing with such a high technology business plan requires in-depth knowledge about relevant field as well as thoroughness. It could be that there would be some MoUs signed with the municipalities to construct various river entry points. The second hindrance could be that inland maritime regulations. So far no regulations hinder the business model of Sailwaste.

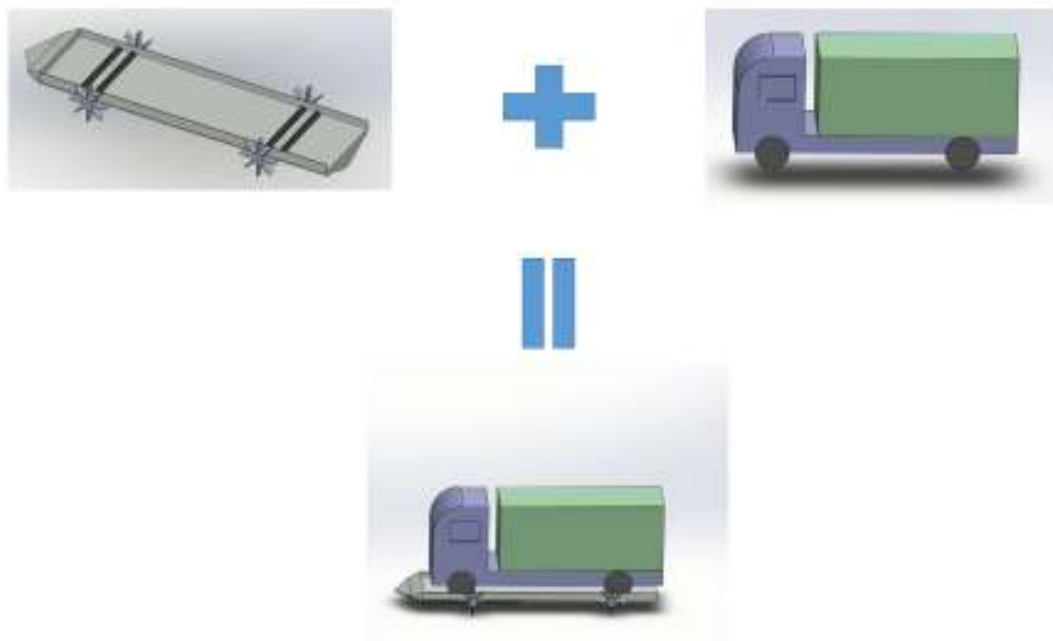


Figure 4: Sailwaste value chain

2.3 Does the value chain need changes in order to introduce your products/ services? If yes, how do you expect to deal with it?

Even if all elements in the value chain exist, it may be necessary to manage some changes in the way these elements currently operate in order to produce or commercialize the product.

Even though every element that makes up the Sailwaste is available in the market, a special treatment has to be carried out since it comes in at certain dimension, specification, etc. Configuration for each element has to be conducted to make sure it can collaborate with the other elements.

Section 3: Market Analysis

3.1 Current market size and growth in next 5 years.

As per the Port of Antwerp page, it is estimated that 47% (almost half of the freight) is handled by road. Thus the market is quite big to start with. Since the challenge comes from the city of Antwerp, its ideal to consider it as a launching market for the product. Antwerp's total traffic increased 3.3 percent in the first three quarters to 161.67 million tonnes (178.2 million tons). This if translated to 50% it could be 80 million tons of transport via road. This figures strong growth for the product what Sailwaste proposes.

3.2 Market structure and market share (%)

This type of product is quite new to the market and gives the liberty to structure the market. This product gives a new perception to solve the problem of traffic in and around the port area of Antwerp. The product launch and marketing have to be done and designed in such way that in a short span of time, we capture more than 2/3rd (75%) of the Market. Strategies to make high barriers of entry, so that we maintain the customer base and increase it eventually to 100%.

3.3 Market trends (5 years period) and % growth (by technology and geography)

As Sailwaste is an innovative product, much closer to a radical innovation than to a reengineering process, it is hard to assess the market trends in 5 years. It seems clear that even with the most optimistic expectations, the product will still be on the introduction stage of its life cycle. The introduction stage mainly benefits from limited competition and the high price that customers are willing to pay for the novelty. Its drawbacks are a small or inexistent market, high costs and economic losses without profits (Product Life Cycle Stages, 2002).

Assuming the product to still be on the introduction stage after five years, then the market trends will be mainly determined by the substitute services rather than Sailwaste and eventual competitors. The substitute services for Sailwaste include any type of waste container transportation either via water or earth based, but none of them actually solve the same problem as Saiwaste. Nevertheless waste transportation is a big and global market, so movements there are expected to happen even though it is not clear in which direction they will move. Goods or service which is close to solve the troubles tackled by Sailwaste is actually a bridge as it solves the most basic objective of Sailwaste: Transporting trucks with containers for short distances through water. From the bridge perspective, there is not much expected change on the market trends as most of the innovations regarding bridges focus on making them cheaper but without changing their essence.

Regarding the growth of the market, it is not possible to assess a percentage as there is no existing market right now. Nevertheless, there will be a clear positive trend for transportation as many cities in the world will start to look for alternative modes of transport in order to reduce the overload of their existing road infrastructure. Nevertheless, aiming at long term trends, there is the possibility of a reduction on the demand. As many cities in the world are trying to reduce the amount of cars running on their streets, there will be a moment in which the roads will be free again if they succeed. It is uncertain to speculate what will happen in such situation but three main scenarios can be considered.

- The growth of population is inversely related to the vehicle reduction: In that case, roads would remain crowded even though the percentage of drivers is reduced. In that case the Sailwaste product and service would keep an increasing attractiveness trend.
- The reduction of vehicles is successful and the city decides to partially recover the road spaces: Nowadays city roads are dominated by cars, however, as soon as the cars are banned from the roads there will be a huge amount of space to be recovered for the citizens. Therefore the space on the roads will be reduced and the Sailwaste product and service would keep an increasing attractiveness trend.
- The reduction of vehicles does not foster any other change: In that case, the trucks would be able to easily drive around the roads, hence making pointless the Sail Waste service.

3.4 How large will be the Total Addressable Market (TAM) be in the following 5 years?

As mentioned in previous section, the market for Sailwaste is expected to grow over the five years. If the aim is put over the Total Addressable Market, then it can be claimed that it will grow even more, as not only the cities which have water and traffic problems will need Sailwaste, but also the developing cities which will require alternatives. Those cities are not part of the expected market because a product (and service) in development stage is expensive, nevertheless they are also part of the TAM.

3.5 Who are your customers and what are their characteristics? (Customer analysis)

Our customers can basically be any company or organization that use road vehicle for logistic delivery. It can be logistic delivery company, waste recycle company and so on. In our case, our specific customer are the companies operating in port of Antwerp who wish to reduce the traffic jam and hence save their time and ensure timely delivery of goods. Our solution is cheap and does not require any specific modification and docking platform can be inserted at more or less any desire place. Therefore, they will certainly purchase a reliable, sustainable-energy powered boat. It is not in the case of shifting from road transportation to air transportation. While it sounds an excellent idea shifting from road transportation to waterway transportation, the investment cost as well as break event point (BEP) must be calculated beforehand to make sure that it favours the company.

3.6 Which are their needs in relation to the product/service? How are they currently covered?

The main needs for any actor in relation to the Sail Waste are always related to efficient transportation. The reason why a company would be interested in purchase our product and service is the willingness to turn into a more efficient transportation mode.

Most of the current transportation is covered either with trucks via roads or boats via water. Both models have been successful for a long period of time but they also have important drawbacks in many situations. Therefore the efficiency increase will depend on the specific situation of the original transportation mode of the company and it is even possible that Sailwaste is not better than the classic modes in many situations.

As Sailwaste is designed for short distances, the main comparison is with truck transportation, whose needs can be summarized in the three following bullets:

- Reduced time
In our current western society time is money, therefore the companies are always willing to reduce duration of their transportation. As Sailwaste is usually able to take a much more straightforward path on water than on land, it is clearly possible that the transportation by using Sailwaste becomes faster than the previous mode of transportation used by the customer.
- Reduced energy cost
Having a lower energy consumption is not especially relevant for a company unless they have a major focus on environmentally friendliness. On contrary, they are always interested in reducing the associated cost of their energy consumption, which is a solution that Sailwaste can provide either by reducing the distance of transportation or the amount of energy required during it.
- Reduced maintenance cost
The last point in which the Sailwaste product can be attractive to the customers is when trying to reduce maintenance costs. It may happen that Sailwaste is a mode of transportation that entails less maintenance costs, for example, that the roads are in bad condition or the driving regime of a traffic jam is really aggressive with the components of the vehicle.

3.7 Which market segments do you identify?

The main market segment, and the one that the project is aiming for is the group of the logistics firms. Any company involved in transportation could be interested in Sailwaste aiming to increase their productivity.

There would also be a possibility of success for Sailwaste in the tourism industry. An adapted version of the model could be used to enable individuals to enjoy the sea or deep lakes without the need of

expensive boats. A variation of that could also be interesting to the tourism industry, which could do coastal tours or low depth diving based on a Sailwaste raft instead of an expensive boat.

Another interesting market segment would be the vehicle body manufacturers. In that case Sailwaste is considering the design and exploitation of the rafts but the production is not part of its business. For that issue, it would be necessary to contact vehicle manufacturers, who own the technology, tools and knowhow to efficiently produce the Sail Waste rafts.

3.8. Which market segments do you target?

As commented in the previous section, the main market segment for the project is the logistic firms. Sailwaste is a tailored product designed for them in order to increase the efficiency of their transportation. Being that clear which is the market segment for the product and service, it becomes necessary to have a close collaboration with the logistics firms during the whole lifecycle of Sail Waste.

3.9 Are there similar products in the market? Please specify your competitive advantage.

Apparently, a product such as sail Waste water carrier is not commercialized. After thorough research, a prototype of a similar product was designed by a Turkish engineer called Yusuf Kahvecioğlu. The product's name is D.O.W which stands for Drive On Water. The D.O.W, similar to sail waste water carrier, is a marine craft that has no particular boat engine and is powered using the engine of the car. However, this prototype can only be used for cars with a maximum length of 5 meters. In addition, one start-up called Oceanbus based in Stockholm, Sweden operates such a vehicle for tourist attraction.

Sail Waste is not only offering a competitive product, but also a service. The competitive advantages of Sail Waste are the following:

- Capacity of a 20 foot container truck
- Sailwaste offers the service of building special decks along the coast
- Vehicles are able to mount the carrier smoothly and in no time
- Sailwaste provides an app for the service. List of nearby docks, estimated time, reservation of carrier/palette, fastest route calculation, etc.
- Shared service. Customers do not need to buy a carrier. The service can be used for different customers.

3.10 Which are the key players (competitors) in the different market segments?

Since Sailwaste is offering an innovative product and service, it is not clear who the key players are in the different segments. If the focus is on transportation via water, the identified key players are boat manufactures. If the focus is more on transportation in general, this will include boat manufacturers, amphibious vehicle manufacturers, and maybe logistics and transportation companies.

3.11 Comparison of the competitors' key products by characteristics

From the above mentioned key players some key players are not only to be mentioned as competitors but they are also potential customers. For example, logistics and transportation companies provide the service of transporting goods from point A to point B. Usually if the transportation means is via water, the process will need three transportation phases. Phase 1 is by using trucks to transport the goods from the sender to the deck/port. Phase 2 is by using boats to transport to a second point across the river, lake, etc. Phase 3 is by using trucks to transport to the receiver. Or the process could be using one phase which is using a truck from the sender to the receiver; however, this may require a longer route that is energy and time consuming. On the other hand, Sailwaste provides a single phase process with an optimal route through land and water; thus saving travel time, fuel cost, loading and unloading time on deck, etc.

Compared to boat manufacturers, the Sailwaste Water Carrier is a technology that is passively powered by the engines of the vehicle on it. It does not require any engines, electronic device, etc. This makes our product way cheaper and cost effective.

Compared to amphibious vehicle manufacturers, the proposed solution is used on any available vehicle. It is not required to change or modify the fleet of transportation. In case amphibious vehicles are being used, the customer will have to change all the vehicles and invest in expensive and bulky vehicles.

3.12 Define the positioning mapping according to the variables that differentiate yourself from competitors and that are valuable for your customers

As we propose state-of-the-art solution, Sailwaste, we believe that our simple technology could outperform the other solutions in terms of advantage and functionality. The features that we are able to provide are as follow.

- Optimal route calculation based on nearest Sail Waste decks (road + water).
- Easy and simple transition from land to water and from water to land.
- Passive powering using vehicle's engine.
- Very cheap solution.
- Possible charging platform of the Sailwaste Water Carrier for electric vehicles.
- Shared service and solution. No need to own a Sail Waste.

3.13 Threat of substitute products/ services

Certainly water waste transport is not the only alternative to land transport. Nowadays different systems are being applied in some of the world's leading cities such as the vacuum pipe waste transportation in Stockholm designed by Envac. A conceptual image of the system can be illustrated in the image below.



Figure 5: *Pipe waste transportation*

Other solutions to the issue may be focused on the organization, achieving the reduction of traffic jams through a better use of the infrastructure such as an increase on the night shifts.

It is also possible to solve the traffic jam issue by constructing an alternative warehouse far enough from the main plant to avoid the traffic jams but close enough to enable alternative transportation from the warehouse to the plant such as a conveyor belt.

As a conclusion, there is not a single way to address the traffic jam issue, each of them has several advantages and disadvantages. The reason why the water waste transportation has been chosen is because the company itself required it to be this way on the formulation of the challenge and this is why other alternatives have not been explored.

3.14 Threat of new entrants. Are you aware about other similar products under development?

Sailwaste aims to combine the roads with water in a simple and efficient way. The focus is mainly on vehicles for goods/waste transportation. After further research, the similar product that is being developed is focused on small vehicles with a maximum length of 5 m. This can lead to future competition for longer vehicles such as transportation trucks. In addition, such a product named Oceanbus for leisure purpose is in operation in Stockholm, Sweden.

Section 4: Value Proposition for The Customer

4.1 Why will the customer buy your solution and what will it sacrifice?

Indaver is facing a problem in transportation of waste via road. The present transportation system has some drawbacks commented on section 1.1. By phasing out some large trucks and replacing them with sustainable and efficient rafts, our customer will not only contribute to reducing CO2 emissions but also benefit from the reduction of fuel consumption, workmanship (since large smart boats can be driven by few people) and trip time, which results in an increase in productivity.

Indaver shall need to sacrifice properties and money in order to build a small warehouse and dockyard for loading the waste onto ships. It would be an expensive project with a lot of work required for the development, but certainly it would pay off after some years, especially when taking into account the fuel vehicle regulations that are being applied on many European cities. As an example, recent regulations for Barcelona state that the most contaminant vehicles will not be allowed to drive in the city from 7 to 20 during high contamination episodes (Municipality of Barcelona, 2017).

4.2 Quantify the impact of your product/service for the customer

Some of the positive impacts which can be quantified according to our research are.

1. Reduced traffic congestion in the dock area and the city by approximately up to 20%
2. Reduced transportation time by about 30% (up to 15 minutes faster)
3. Reduced carbon footprint on the road due to merely by trucks by about 50% (Fossil Fuel Free)
4. Definitely reduce fuel consumption due to shorter distance and duration of the trip.
5. Revenues from the data collected during the run of the raft.
6. Revenues from other sources such as communication.

Section 5: Product / Service definition

5.1 Specify and quantify the characteristics and attributes of the product/service to be developed in terms of cost, performance, efficiency, etc. When relevant, quantify process overall energy / mass balance.

Based on a very basic design of the product, a preliminary cost is calculated based on the weight of material used. In order to calculate the cost, it is assumed that our basic design is up to the standards and is able to support a 20 foot container truck.

1. Sail Waste Water Carrier (Pallet)
 - Dimensions: 13500 x 4000 x 2000 mm
 - Weight: 2.9 Tonnes
 - Lifespan: 10+ years
 - Transmission Efficiency: 90% and above
 - Material: Cast Alloy Steel + Waterproof Coating
 - Cost of Material: 1810 € (based on Steel price of 623 Euro per metric tonnes)
 - Manufacturing Cost: 700 € (40% of material cost)
 - Total Cost: $1810 + 700 = 2510$ €
2. Sail Waste Decks
 - Land for Free (Collaboration with the municipality)
 - Lifespan: 30+ years
 - Estimated Cost: 15 000 € (1 Carrier) + 5000 € (per additional Carrier)
3. Sail Waste Application
 - Web development: 2000 €
 - Yearly Maintenance: 500 € per year

5.2 What is innovative about the product/service? What are the differentiating features of my product/service? To what extent is it unique?

The uniqueness for the Sailwaste and its use on waste transportation comes from two main points. On one side there is the change from the traditional transportation through roads to avoid congestions and on the second side the solution is very simple since the fleet of trucks will remain the same and only rafts need to be built, which are very simple.

Finally, it is important to assess how useful can amphibious trucks become for the stakeholders.

1. Sailwaste offer a very simple and unique solution to reduce traffic jams.
2. It would consist of various sensing equipment to collect data related to water contamination, traffic congestion, weather etc.
3. The raft can be used as charging platform for hybrid trucks or future electric trucks.
4. It will allow the plant operator to effectively manage the transport either through water or roads.

The uniqueness of this project is stated below.

1. The project is simple to implement without any huge investment costs.
2. The rafts won't have their own engines, rather they will be powered by trucks. Through the rotation of wheels of trucks, a simple transmission system will transmit the power to the blade of raft.
3. The docking station will be simple and mobile.
4. Since the rafts will only have a simple transmission system, they can be modified for add-on like charging platform for electric trucks.

5.3 What will be the state of development of the product at the end of the project?

It will consist of a feasibility study with capital expenditure (capex) and operational expenditure (opex) details. A feasibility study is an analysis of how successfully a project can be completed, accounting for factors that affect it such as financial, technological, legal and scheduling factors (Investopedia, 2018). Feasibility study is currently underway by means of continuous report and communication between the mentor and us. In this report the benefit of our product, macro-environmental analysis, market analysis, value proposition for the customer and product / service definition are covered.

Capital expenditure is funds used by a company to acquire, upgrade and maintain physical assets such as property, industrial buildings, or equipment. In terms of accounting, an expense is considered to be a capital expenditure when the asset is a newly purchased capital asset or an investment that improves the useful life of an existing capital asset (Investopedia, 2018). The capital expenditure of Sailwaste is mentioned earlier in section 5.1.

Operational expenditure is a short-term expenditure required to meet the ongoing operational costs of running a business. In relation to the major asset purchases that qualify as capital expenditures, revenue expenditures include the ordinary repair and maintenance costs that are necessary to keep the asset in working order without substantially improving or extending the lifespan of the asset (Investopedia, 2018).

5.4 Proposed technology solution for product or service

Our proposed solution has following distinct features

1. The project is simple to implement without any huge investment costs.
2. The rafts won't have their own engines, rather they will be powered by trucks. Through the rotation of wheels of trucks, a simple transmission system will transmit the power to the blades of raft.
3. The docking station will be simple and mobile.
4. Since the rafts will only have a simple transmission system, they can be modified for add-on like charging platform for electric trucks.

Section 6: IPR Protection

6.1 Provide background IP

As the Sail Waste project is based on offering a service and a product to logistic firms, there is a clear need to protect the IP model. The sail waste system is easily replicable and, according to its estimated costs, would be replicable by medium and large companies. For that reason it is necessary to protect the IP of as much content as possible.

As the idea of transporting trucks via water cannot be protected, it seems that the only IP patents could be done around the raft and the multiple dock design. Regarding the former, a mechanical system needs to be created in order to connect the truck and the raft in such a way that the raft is propelled by the truck rear wheels and can be steered by the front ones. Regarding the latter, the dock design will be hard to protect as it will be a different model depending on the location. A generic dock model should be extremely adaptable as the landing points will move from sandy beaches to concrete coastal roads.

In addition to the mechanic system used to steer the raft, there is another ground for IP protection which is the logistic system to assign the different drivers and trucks to the different docks, either to sail or land. This system will be necessarily quick as it will need to adapt to the dock traffic as well as raft occupation and external road traffic. Unfortunately this is again something hard to protect further than new algorithms or methodologies. That process could be done then.

The patent of this mechanical system should be done on different scales depending on the size and expected growth of the company. If the project is successful, many competences will appear and will develop products as similar as possible with the only limitation of the IP. As the mechanical design will not use any kind of high tech on the mechanism, it will not require advanced tools for its development, which means that its intellectual property should be covered in almost every single country in the world to avoid plagiarism. Nevertheless an IP protection such as that is extremely expensive and should only be used if the company is really expecting a fast growth thanks to large external investments. Therefore the most strategic choice would be to protect the IP rights of the mechanical design only in the EU and let the competing firms to take the foreign markets.

6.2. How do you intend to protect foreground IP developed in your project?

The core technology of Sailwaste will be patented. The special technological parameters that are going to play an important role including the dimension of rafts, efficiency of transmission and maneuvering system and total weight the raft is going to bear. All these aspects will be patented to protect the product. In addition to that the logo will also be trademarked.

6.3 Provide “freedom to operate” analysis

Freedom to operate is an important aspect on the sail waste project. Due to the kind of activity which is done, transporting goods, and the channel where this is made, water, the project will have to deal with plenty of regulations. On one side those regulations will enforce the safety of the transported goods, especially when they have high polluting potential or when animal or human lives are in the cargo vehicle. On the other side the regulations will also limit the activities which can be done in a river, both because of the environmental impact and the river traffic.

An additional difficulty on top of that is the variability of the regulatory frameworks depending on the country where the business is developed. As the original customer for sail waste is Indaver, which operates on the Schelde river in Belgium, the IP rights and governmental regulations only need to be checked in Belgium and its superior entity, the EU. As the regulatory framework of the EU takes a lot of competences from the countries regarding river management, it should not be difficult to apply the same solution to any other countries within the EU with only minor twitches enforced by local regulations. Nevertheless, exporting the solution out of the EU will require larger efforts not only due to the distance and the opening of new markets but also because of the need to adapt to the local regulatory frameworks. This work should be done independently for each foreign business case and it will probably limit the expansion of sail waste to the EU market only for at least the first five years.

Section 7: Initial Business Model

7.1. Exploitation strategy definition

As first step, Sailwaste plans to pilot the project in order to commercialize the solution. The piloting project will help Sailwaste to gain trust of companies. Since transportation through water using amphibious trucks is not a conventional method, many companies are going to keep eyes on the product and a pilot project will be an excellent way to demonstrate that it's possible to use same trucks and smile rafts to enable water transportation. The INDAVER provides an excellent opportunity to pilot the project. Since Sailwaste offers logistics to companies operating in port of Antwerp and in later stage, it will extend to other companies that are operating in cities having a river, no large scale or public advertisement is needed. The targeted advertisement will be done using number of different forums like trade expos and so on. The Sailwaste offers a simple and unique solution, the Sailwaste can easily gather resources to make rafts and offer services to its partners. Hence Waste Sails has no plan to sell its technology to anyone however, at later stages it's possible to partner with some big logistics firm to benefit from their business.

SailWaste is not only a product but also a service. Since this solution involves setting up docks throughout the city, the plan is to include the municipality as a main partner. The municipality can help with commercializing the product in several ways.

- Sale of Product: As a main partner, the product/service will be sold to the municipality and advertised as a public service.
- Operation Service: Although the municipality will own the product, there will be an agreement that SailWaste will be in charge of operation for the first 10 years in order to ensure safety and reliability of the product and service.
- Subscription and usage fee: Users will need to pay a usage/subscription fee in order to use the product. As an operator, Sailwaste will gain a percentage of the fees

7.2. Initial Business Model

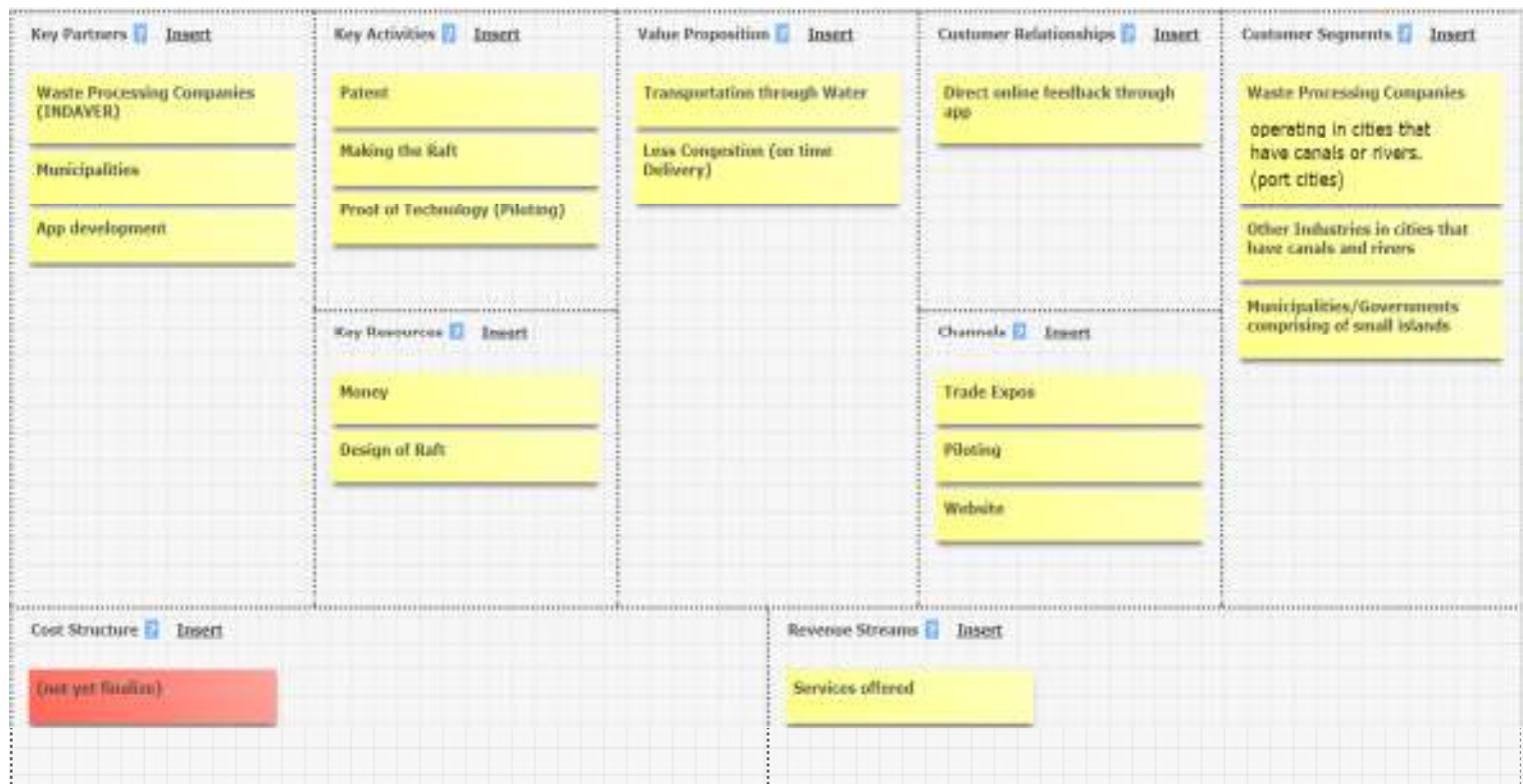


Figure 6: **Business model canvas**

Section 8: Investment and Financial Return

8.1. What investments are needed?

It is important to build several models in order to optimize and ensure safety of the product. In parallel to developing and designing a product, a team is needed to market the innovative idea and get relevant companies, users, and municipalities on board. Further studies are needed to develop a user friendly web-based application and an efficient deck system throughout the city. An investment of around €1,500,000 is required for the following 1.5 years in order to further develop the product and meet the needs of users and requirements of safety standards.

8.2 How do you plan to get such an investment?

Since SailWaste is still in an idea stage the initial funding source will mainly be from crowdfunding, friends and family and personal funds. The initial fund of around €50 000 will be used to design and build a SailWaste water carrier (pallet). However, as soon as the first prototype is released, the plan is to join a business incubator for networking and financial support. Finally, in order to raise € 1 500 000, the plan is to reach out to angel investors and venture capitals while also applying for Sustainable Transport Grants such as UN-DESA Grant on Energy for Sustainable Transport. With a relevant market need, an innovative solution, a sustainable business model, a solid team, and a well-structured strategy, SailWaste has high potential of fulfilling this journey and revolutionizing the transport sector.

References:

- ASVglobal, 2018. *ASView Control System*. [online] Available at : <<https://www.asvglobal.com/product/asview-control-system/>> [Accessed 5 February 2018]
- Barcelona, 2017. *Restriccions del Transit En Episode De Contaminacio*. [online] Available at : <<http://mobilitat.ajuntament.barcelona.cat/ca/noticia/restriccions-del-trzansit-en-episodi-de-contaminacize>> [Accessed 5 February 2018]
- Clear Spider, 2017. *How Technology is Changing The Future of Shipping*. [online] Available at <http://www.clearspider.com/technology-changing-future-of-shipping/> [Accessed 5 February 2018]
- Emmanuel C, G., 2013. *Municipal waste management in Belgium*. Copenhagen: European Environment Agency. Available at <<https://www.eea.europa.eu/publications/managing-municipal-solid-waste/belgium-municipal-waste-management>> [Accessed 5 February 2018].
- European Comission, 2016. *EU Waste Legislation*. [online] Available at <<http://ec.europa.eu/environment/waste/legislation/>> [Accessed 5 February 2018]
- European Comission, 2016. *Waste Shipments EU Legislation*. [online] Available at <<http://ec.europa.eu/environment/waste/shipments/legis.htm>> [Accessed 5 February 2018]
- Eur-Lex, 2015. *Safe Waste Shipments Within the EU and With non-EU countries*. [online] Available at <<http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=LEGISSUM:l11022>> [Accessed 5 February 2018]
- European Comission, 2018. *Circular Economy Implementation of the Circular Economy Action Plan*. [online] Available at <http://ec.europa.eu/environment/circular-economy/index_en.htm> [Accessed 5 February 2018]
- Eur-Lex, 2009. *DIRECTIVE 2009/28/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL*. [online] Available at <<http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex%3A32009L0028>> [Accessed 5 February 2018]
- Energy Observer, 2017. *Energy Observer's Historical Conveyance*. [online] at: <<http://www.energy-observer.org/actu/en/cap-sur-la-mediterranee/>> [Accessed 5 February 2018]
- IDTechEx, 2018. *Electric Boats and Ships 2017 – 2027*. [online] Available at : <<https://www.idtechex.com/research/reports/electric-boats-and-ships-2017-2027-000509.asp>> [Accessed 5 February 2018]
- Investopedia, 2018. *Feasibility Study*, [online] Available at : <<https://www.investopedia.com/terms/f/feasibility-study.asp>> [Accessed 5 February 2018]
- Investopedia, 2018. *What is The Difference Between a Capital Expenditure and a Revenue Expenditure*, [online] Available at : <<https://www.investopedia.com/terms/f/feasibility-study.asp>> [Accessed 5 February 2018]
- Jaime R, de L., 2012. *Container Ships Safety., Maritime Law UPC Barcelona*, [online] Available at <https://en.wikipedia.org/wiki/Container_ship> & <http://upcommons.upc.edu/bitstream/handle/2117/3051/seguridad%20contenedores%20_ingl%20s_.pdf?sequence=1> [Accessed 5 February 2018]
- Lacy, C., 2016. *This Solar-Powered Self-Driving Boat is Making a Historic Journey Across the Atlantic Ocean, Inhabitat*, [online] Available at: <<https://inhabitat.com/this-solar-powered-self-driving-boat-is-making-a-historic-journey-across-the-atlantic-ocean/>> [Accessed 5 February 2018]
- Mr.Solar, 2018. *RV & Marine Solar Kits*. [online] Available at : <<https://www.mrsolar.com/rv-marine-solar-power-kits/>> [Accessed 5 February 2018]
- Planet Solar, 2018. *Towards Energy Independence*. [online] at : <<http://www.planetsolar.ch/>> [Accessed 5 February 2018]

- Population City, 2015. *Antwerp.Population*. [online] Available at : <http://population.city/belgium/adm/antwerp/> [Accessed 5 February 2018]
- Product Life Cycle Stages, 2002. *Introduction*. [online] Available at: <http://productlifecyclestages.com/product-life-cycle-stages/introduction/>
- Transparency Market Research, 2018. *Global Marine Hybrid Propulsion Market: Government Regulations to promote Ecofriendly Modes Driving Demand, notes TMR*. [online] Available at: <https://www.transparencymarketresearch.com/pressrelease/marine-hybrid-propulsion-market.htm> [Accessed 5 February 2018]
- Transparency Market Research, 2018. *Marine Hybrid Propulsion Market*. [online] Available at: <https://www.transparencymarketresearch.com/marine-hybrid-propulsion-market.html> [Accessed 5 February 2018]
- World Ocean Review, 2010. *Global Shipping – Dynamic Markets*. [online] Available at <http://worldoceanreview.com/en/wor-1/transport/global-shipping/> [Accessed 5 February 2018]
- Unknown, 2011. *Waste Opportunities*. Copenhagen : European Environment Agency. Available at: https://www.eea.europa.eu/publications/waste-opportunities-84-past-and-at_download/file [Accessed 5 February 2018]

Annexes

For the smart cities week course in Barcelona

A. Application of SIT Innovation Methodology

This session introduced us to a new and very innovative perspective on proceeding towards shaping our thinking process so that we meet the desired solution by satisfying all the checkpoints. This stage mainly motivated us to generate our own main proposition and eliminate the main cause of the problem by eliminating important parts of the process/system we were dealing with. We were confident to eliminate the main component of the whole system i.e., Logistics. And came up with the idea of creating a system where the waste would be disposed at the source and would eliminate the problem of transportation and collection of waste. But this would actually kill the main business of Indaver, So the idea was modified to a solution where Indaver can explore and expand its business on creating modular solutions which can handle the waste at its source mainly for residential purposes. As Indaver are pioneers in handling the waste sustainably, they would be having the right mix of technical expertise and the infrastructure/equipment to bring any related invention to its life.

B. Application of Design Thinking Methodology

In these sessions, we were taught on how to think out of the box and define the problem before create the solution and continue to analyze the challenges and opportunities. Furthermore, we need to know what their objectives are, their motivations and their expectations. An extraordinary idea is needed to solve a complex problem, not just an ordinary idea. This enabled us to think majorly with the perspective of customer and his challenges, pains, needs. Keeping the requirements of the market and its trends, ideation was focused on how to come up with a sustainable way of solving the problem. The idea about building additional warehouses preferably near the banks of the river and around the local collection point in order to decrease the traffic congestion came up in these sessions.

C. Market Research

This enabled us to explore multiple dimensions for the possibility of marketing InnoBoat and segment general market for InnoBoat. In general, InnoBoat suits all/any companies that offer/require logistic delivery by using waterway vehicle including Indaver since they currently use road vehicle to transport waste/products/commodities from around the city to local collection point.

D. Elevator Pitch and Presentation Material

In this session, we were taught on how to explain and sell our product, furthermore, how to convince our prospective customers that our product meets their needs. Some key points were mentioned such as body language is more important than words, a clear and understandable explanation in English is indispensable for audiences especially non-english native speaker audiences. Another key point is we need to tailor our presentation to the audiences. For instance, if we give presentation to the technical department we will need to emphasize the technical advantage of our products and if we give presentation to the business department we will need to emphasize the financial advantage of our products.

E. Team Roles and Evolving Plan

In this workshop, the importance of collaboration among members were shown by explaining some concepts such as perceptual blocks, emotional blocks and cultural blocks. Moving on to the description of the 10 faces of innovation which are the learning personas (composing of the anthropologist, the cross-pollinator, the experimenter), the organizing personas (composing of the hurdler, the director, the collaborator) and the building personas (consisting of the experience architect, the caregiver, the storyteller, the set designer) We were enlightened by the various techniques used on how to recognise the team strengths and weaknesses and use them in a way to create value for the team and the organisation. The way on how to elaborate on our plan was discussed.

F. Work Plan & Next Steps

In this session, we realized the importance of making well-structured work plan. Verbal discussion means less useful if we don't make tangible plan. Therefore in this session, the creation of work plan and next steps to take were described. It gave us insight of how to advance our plan and achieve final goal.

For the BIZ Bootcamp in Antwerp

A) Value Proposition, Business Model - Kris Vander Velpen

In this workshop, we were basically taught how to make a business model. The first challenge is to choose the most important customers and organize around them. In our case, the most important customers are logistic company and waste-treatment companies that doing their business by using road vehicle in which traffic jam hinder their growth and one of them is Indaver which is the company that gave us the project.

The second challenge is what is our unique value proposition. Unique value proposition can be described as any feature or advantage of our product that we can offer to customer that the other companies can't. In our case, our unique value propositions are the integration of road vehicle & water vehicle named SailWaste. The internal combustion engine and electric engine in addition to solar PV will power SailWaste both on the road and water. This is also known as amphibious truck, once the traffic jam occurs on the road, SailWaste can shift to the river. This technology integration doesn't exist on earth yet. As for customer gains, the gains are image (reputation), tax (CO2) reduction, increase in operational range. We hope that company that uses SailWaste which is the state-of-the-art truck can boost their reputation and can be our ambassador. Increase in operational range means we want the truck to not only cater Indaver' service in particular but also the other similar companies in general. Indaver operational range is up to 15-20 km however we plan our truck can fit the range up to around 100 km or atlantic journey. The pains are accessibility, weather vulnerability and legal as we will operate our truck across the countries that have distinct regulations therefore we need legal consultation. The customer jobs are to catch up with technology of loading and unloading and basic infrastructure as our truck is not a conventional truck therefore the customer needs to adjust their equipment to our technology. As for value propositions, the gain creators are, greener transportation and tax (CO2) reduction. It is planned that in 2020, carbon tax will be applied. Hence, by using SailWaste which is greener truck the company can reduce tax fee. The pain relievers are less traffic, workforce and maintenance. As we will combine the advantage of each road vehicle and water vehicle for waste transportation it will have a smooth route, produce less traffic, employs less workforces and require less maintenance cost as less number of fleets is needed. The product & service are truck & service themselves as well as reputation in the form of breakthrough boat technology.

The third challenge is whether an innovation paradigm is being tackled and our preferred business model. We were suggested that our business model is about how we extract the value over the lifetime of our business. Since we are the only one who manufactures such a truck for logistic transportation, we plan to work on our workshop and start selling SailWaste concurrently. Thus, we can satisfy the market demand. On different note, it is said that business plan is a static model while business model describes how a company creates, delivers and captures value. In the end of this workshop we made our business model by filling in each section of business model canvas.

B) Application of Innovation Tools – Alex Kaatz

System Innovation Thinking

Essentially system innovation thinking is a differentiation of systems to look for a pattern of thinking in order to initiate innovative thinking. Closed environments were explored for different situations in order to focus on addressing specific challenges which gave us the freedom to think more specifically and out of the box and came up with some crazy ideas which are not feasible or realizable. However, we realized that this is how innovative things emerged in their nascent level. Therefore, we had to leave conventional or conservative approach to solve a problem more innovatively. This way we were also very clear about which type of market we were targeting. This session more concentrated on decoding the thinking patterns to innovate which was in itself a task of self-exploration where we challenged our capabilities in order to come up with out-of-the-box solutions.

Task Unification Tool

We were given an example of bent pipe problem by the Alex in order to identify various closed environments. And select further the specific closed environment which was relevant to the problem that needs to be addressed. Then by jotting down the internal and the external components made us explore various other perceptions which we could see or imagine before in which made the problem more solvable and gave us the most freedom to innovate.

Then the tool was applied to our challenges in order to innovate for finding the solutions. We jotted down the internal and external components which were related to the closed environment. We chose a closed environment which was related to the plant and the source of congestion. We then tried to choose the most promising alternatives and identified their benefits and challenges. The process leads us to think of an amphibious truck which could use road and water as the means of transportation. Amphibious truck can shift to waterway when roads are blocked due to traffic and other reasons.

Attribute dependency Tool

This exercise needed us to distinguish between internal variables (controllable factor) and external variables (uncontrollable factor) which gave us an insight into which variables are at our hands. We tried to identify the dependence on the various internal and external variables and tried to break their dependencies or make dependencies among the obvious and the non-obvious variables respectively. This gave us an interesting angle of viewing the problem and a unique approach to the solution. We also discovered that we could come up with a solution that Indaver could profit million of Euros with this simple solution. This tool essentially was used to develop an idea.

C) Designing & Prototyping Useful Applications Webs – Robin de Croon

Human-Computer Interaction

Introduction

This discipline is related with design, evaluation and implementation. And this discipline emerged due to the need for reduce friction between human and computers. The video about children trying to open their console illustrates how necessary to reduce the friction between human and computers. One famous quote from Steve Jobs, “You’ve to start with customer experience and work back to the technology - not the other way around”.

User-centered design

This principle describes how important user experience when developing a product is. It can be defined as “The central premise of user-centered design is that the best designed products and services result from understanding the needs of people who will use them”. Henry ford had one famous quote about how important user experience when developing a product is. It is “If I had asked people what they wanted, they would have said faster horses”. Moreover, Donald A. Norman said that “Logical analysis is not a good way to predict people’s behaviour, nor are focus groups or surveys, observation is the key”. Based on this we need to study their behaviours not opinions. In regards to the background, we need to analyse their demographics, gamer type, mobile use, etc. To design and prototype three steps are needed to be taken. First is to define purpose and personas. Personas can be used to describe who our target end-users are. We designed three (3) personas. Number one is young energetic truck driver. He is an easy-going person who likes to hang out with the other drivers. In addition, he is tech-savvy. Number two is middle aged truck driver that has family and family man. He is not a tech-savvy but willing to learn latest technology. Number three is an old person who rarely uses mobile phone that find mobile phone very hard to use. Second is to make a storyboard to illustrate how our product will engage in their lives. What scenarios that fit to their work life and defines what the personas want or needs to fulfill.

Rapid Prototyping

In this section, we designed our application prototype on the paper to give insight into utilization of it. Paper was more handy than computer in this context since we could directly write down the text and edit it if necessary. By doing prototyping on paper we can get early feedback and it’s time efficient method. Some concepts to consider are first mental model that can be described as representation of what a person thinks is true. but it’s necessarily true. Second is the confirmation bias. Third is the user is always right which suggests if the user does something wrong, it is the fault of the system designer. Fourth is memory (design implications) which implies to avoid complicated procedures for carrying out tasks. As for interfaces, it comes in different forms such as mobile interface, speech interface like Alexa, google product, offer, air-based gestural interfaces, shareable interfaces, tangible interfaces, wearable interfaces, virtual reality, augmented reality, mixed reality, brainwave interfaces. All of the steps are survey, in-depth interview, avoiding mental model, user testing, iterative design meaning it starts with paper prototype followed by digital prototype and usable product.

Evaluation Methods

All of the methods to evaluate our prototype are questionnaire, usability testing, expert evaluation, usage tracking, interviews, focus groups, participatory design and so on. Usability study can be defined as a study that analyzes how the real end-users feel about our application.

Digital Prototyping

Some applications for doing digital prototyping are Axure, Proto.io, Fluid ui, Justinmind, Form, Briefs, etc.

D) Intellectual Property Applications – Daniel Cosa

Patents are essentially part of intellectual property, others include copyright, trademarks and trade secret etc. The patents have benefits for both, owner and the public. From the owner point of view, patent ensures that invention of a person is not used by the other people for commercial purpose without the consent of owner. Once a patent is granted, after 18 months, the patent is published. The published patent is available for free for public. This ensures that innovation keeps going as scientists and students can access the patent free and can experiment and further it without any cost. A patent stays valid for maximum of 20 years with a very few exceptions. However, each year owner must pay fee for patent. Most of the time, after reaching an agreement with a firm or company, the owner allows a firm or company to use the patent in return of financial awards. This contract is commonly known as licensing.

Essentially there are three (3) possible routes to file a patent. They are national route, European route and International route. As for national route, each country has its own patent authority that grants patents after some extensive process. However, not everything that's new has right to be patented. Although the rules vary from country to country some things that cannot be patented are theories, discoveries, mathematical methods, inventions whose commercial exploitation would be contrary to "ordre public" or morality (e.g. processes for cloning of human beings), methods for treatment of human or animal body by surgery or therapy and diagnostic method (not the apparatus or equipment) and so on. The inventions that can be granted patent must have at least something new, an innovative step and some industrial applications. The patent authority determines all the mentioned criteria of an invention and then decides whether a patent should be granted or not.

The European Patent Organization (EPO) is European patent authority based in Munich, Germany. The EPO is not under European Union rather it's an independent authority which is self-financing. The EPO has three official languages which are English, French and German. Their purpose is to examine patent applications and grant patents in various countries in Europe. EPO patent application goes through various stages starting with filing where the initial application by the owner of an invention is submitted along with the claims. After that EPO investigates the novelty of patent application to ensure that the invention is new. After successfully completing searching step, a panel of three expert examiners checks the scope of protection is limited to what is actually patentable and ensure whether the requirements of EPC are met. If all requirements are fulfilled, then the EPC will make a decision to grant the patent. Once the patent is granted and someone has an objection, that person can file an opposition. Then if someone else is not satisfied with decision during grant or opposition, they can make an appeal and EPO's independent board of appeal will make the final decision.

Computer Implemented Inventions (CII) are very complicated as far as patents are concerned. The EPO follows a complex process to determine whether a CII deserve a patent or not. Further requirement for patentability implicitly contained in the EPC is the invention must be of "technical character" to the extent that it must relate to a technical field, problem and features in terms of which the matter for which protection is sought can be defined in the claim. Generally, computer programs are not granted patents except for very few special cases. The requirements are new, susceptible of industrial application and involve an inventive step. Most of the open source programs can benefit from patents as it allows them to take legal action against big firms and companies who tries to copy the code to be used for their own commercial benefits. A CII must go through a number of stages before it is granted a patent. Mostly a CII that aims to tackle a technical problem by non-obvious technical solution is granted patent. That means that it's difficult to grant patent to commonly used computer programs like Artificial Intelligence.

E) Work Plan & Next Steps

Drawn from our imagination and creativity, we came up with really out-of-the box idea which was unthinkable in the first place. However, this idea simply comprises the integration of road and water transportation means and combination of each advantage of them. We still use the same engine to power the raft and connect the steering wheel to front wheel to navigate on the water. If needed we will also employ electrical engine as auxiliary prime mover and a rotor to help navigating on the water. Such an innovation is realizable as we saw similar product in Stockholm, Sweden. This product is called Ocean Waste and basically it is non-military amphibious truck that serves for leisure. Here are some of pictures of it.



Fig. 7-10. The appearance of ocean bus

According to the crews of Oceanbus, this vehicle was built on Volvo truck with 250 HP engine and some modifications on its body and prime mover. Given the fact this idea is being applied for city tour bus, the possibility to utilize this method for logistic transportation is widely open. And we'll probably explore this possibility furthermore.

For Entrepreneurship School in Amsterdam

A) Lean Start-up & Problem Validation by Bram Kuijken on Monday, July 2nd 2018

Many start-up failures were discussed, why and what reasons these ventures have to face the failures in spite of having sometimes a very unique product. Some of the most probable reasons were due to no market need and running out of cash. The focus of a start-up should be of to make something which the market needs and not they want to build. The Formula of “learn faster” was introduced to the team. The idea of learning faster along with thinking fast and acting fast makes the start-up stand out of the competition. Lean startup principles composes “build” based on experiments, “measure” based on metrics and “learn” based on assumption. In addition, the (lean) startup mindset consists of test fast and test a lot, be prepared to fail and fail fast and fail often.

In order to know and align the vision and mission of a start-up, the team needs to interact with the customers they want to serve. Getting in touch with the potential customers always gives an idea what the customers need. This way any start-up could align their product and services with what market needs and just not what they want to make. The whole process of alignment is an iterative process which takes many iteration to arrive at a conclusive business model of the start-up.

Lean Model canvas was introduced in order to test the idea of having Sailwaste. We could identify various assumptions made, test them. Lean startup canvas model is made of problem, existing alternative, solution, key metrics, unique value proposition, high-level concept, unfair advantage, channels, customer segments, early adopters, cost structures and revenue streams. The main focus of the activity was to see if the idea really was meant for market needs rather than just doing something which would not serve the market. Basic requirements of assumptions are need to be testable, should have the potential of failing, need to be specific. The example of problem assumption is “I believe young professionals with business ideas and full time job will not start their own business because they have no time and are used to their financial security”.

Traditional product development starts with concept to development and test and finally launch. However, new method was recently discovered, customer development, starts with customer delivery to customer validation and customer creation and finally company building. In this latter method, the focus is on customer development. Next, we were introduced to Mom Test which is the test that leads to questions that even your mom can't lie to you about. The guidelines composes question about past behaviour not opinions, asking why for many times, letting them talk, don't tell customers or users what their problem is, don't ask customers or users to tell you what to build and last but not least never pitch your idea. The point is to ask questions on how the customers react to certain situations gives us an idea of their behaviour. Another method to validate business idea is by using currency test. Currency test is essentially a testing actual behaviour in which we test customers' willingness to pay with attention/privacy/money/time. Some examples of currency test are landing page where we can seamlessly manage the process of creating and publishing our online content, wizard of OZ, pre-order webshop, concierge MVP, letter of intent in which we ask our customers to sign a non-binding contract which is mainly business to business (B2B) and last but not least crowdfunding.

B) Go-to-Market Strategy by Sander Van der Blonk on Tuesday, July 3rd 2018

This workshop started off with a rhetorical question which is how do you stack which means some numbers of attributes that make a great startup. Synthesis is made up of startup synopsis, velocity, value and metrics and balanced team. Startup synopsis could be defined as what are we trying to do and what do you want to accomplish (BHAG)? In our case, we're trying to reimagine logistic transportation in sustainable and viable way via combination of water & road transportation. Velocity or forward momentum means the push to delivering concrete pieces of work in manageable chunks of (one or two-week) sprints followed by reflection on performance and sharing results with the rest of the team. Value and metrics could be defined in which successful teams know the value they're trying to deliver and metrics are tool used to give insight how successful they are in delivering value. Balanced team could be defined in which successful teams are supposed to have a varied set of skills, talents, work experiences and problem-solving styles that make sense for the challenges that they were working on.

The principle of startup growth is to grow by identifying and removing constraints. Customer Lifetime Value (CLTV) could be formulated by multiplication of number of people, trial, repeat rate, basket value and tenure. While CoCa stands for cost of customer acquisition which implies on average how much does it cost to acquire customers. Two methods to distribute our product are direct and indirect. In indirect distribution method, there are margin loss through channel partners, service partners, marketplaces, aggregators and lead generators between startup and customers.

In regards to media, there are three types of channels. They are first depth channels which can be represented by community, store, mobile site and sales. Second is relationship channels which can be represented by mail, phone, mobile, social media, loyalty program. Third is reach channels which can be represented by TV, Youtube, Print, In-store, Radio, Mobile app, word of mouth and search. One issue of customer acquisition often appears is acquisition is expensive until your channels and funnels are fully optimized. Once we reach this step we can calculate optimal our optimal CoCa / CLTV ratio. Cost of Customer Acquisition can be formulated by the sum of marketing, distribution & sales cost divided by total new customers per time period. while RoMi can be formulated by $(CLTV - CoCa) / CoCa$.

As an exercise, by 2020 our expected yearly revenue target is 10 million Euro and yearly customer revenue is 2 millions Euro per customer. Therefore, the number of active customer is 5. We determined customer lifetime is 5 years. CLTV can be calculated by yearly customer revenue x CLT which results in 10 millions Euro. Next is customer production rate which can be formulated by

- $\text{Yearly Revenue Target} / \text{CLTV} = \text{Euro } 10 \text{ millions} / \text{Euro } 10 \text{ millions} = 1 \text{ customer} / \text{year}$
- $\text{New visitors} = \text{new customer per year} / 0.1\% \text{ conversion} = 1 \text{ customer per year} / 0.1\% = 1000 \text{ visitors}$
- $\text{New visitors per day} = \text{visitors per year} / 365 \text{ days per year} = 1000 \text{ visitors per year} / 365 \text{ days per year} = 3 \text{ new visitors per day}$

At last, we were introduced to Go-To-Market Blueprint and commented on it.

C) Turning tech into business by Dap Hartmann on Thursday July 5th 2018

Business & market entry by Victor Scholten on Thursday July 5th 2018

Crafting your ideas by Dap Hartmann & Victor Scholten on Thursday July 5th 2018

This workshop took place in Delft campus where we were introduced by method of how to turn technology into business. One leading question was raised which is how we came up with out-of-the box idea. As a case study, we were asked how we can utilize infrared laser for new applications. Some Infrared laser-based applications are already on the market such as metal detector, dynamic infrared thermography and so on. In addition, we were also introduced to insight into the phases of startup that composes growth, peak and decline as well as strategy on how to increase the success rate of startup.

Furthermore in this workshop, we were taught on how to craft and come up with out-of-the box idea. Lastly, we were given a tour of Delft incubator factory.

D) Elevator Pitch and Presentation Material

We came up with a fresh idea on how to give our presentation. Instead of using power point document, we did role play to attract audiences and juries in which we demonstrated how feasible our idea is, financing for our startup, scale-up plan and so on to an angel investor. In the roleplay, Elie acted as an angel investor while the rest acted as the core members of startup Below is the excerpt of our role play

Elie : So tell me, who are your customers and which is the problem you are solving?

Indra : Our primary customers are any companies that use road transportation to transport goods from one place to the other place. Given the fact that amount of waste in the Antwerp city is strikingly high, around 1 Mtonnes per year, and the waste transportation is only being done by trucks, traffic jams occur at certain places like the entrance of treatment plant. As a result, during peak hours there are high air pollution, acoustic pollution and low efficiency of workers and materials.

In addition, we played an animation to illustrate how SailWaste will basically work and the core components of it.

E) Work Plan & Next Steps

Drawn from our imagination and creativity, we came up with really out-of-the box idea which was unthinkable in the first place. However, this idea simply comprises the integration of road and water transportation means and combination of each advantage of them. We still use the same engine to power the raft and connect the steering wheel to front wheel to navigate on the water. We plan to employ electrical engine as auxiliary prime mover and a rotor to help navigating on the water. Such an innovation is really radical and we're not sure everyone likes it. However, as one famous quote says "if you can dream it, you can do it". In our opinion, this solution is realizable as we saw similar product in Stockholm, Sweden. This product is called Ocean Waste and basically it is non-military amphibious truck that serves for leisure.

Executive Summary

In response to a challenge given by Indaver which is transportation via water in a viable and sustainable way, we came up with a bright and innovative idea that no one has done yet. Our idea has to overcome this challenge and it is to mass-produce rafts which can house any kind of vehicles including garbage trucks. We name it SailWaste. We believe our idea can be a solution to (1) traffic congestion since SailWaste doesn't use road but river instead and (2) air pollution since Sailwaste uses shortest and fastest path due to the supporting application which can be used when travelling. It definitely suits for every company that provides logistic delivery by using road vehicle including Indaver. As for the market value of SailWaste, we are still working on it since this kind of raft doesn't exist yet.