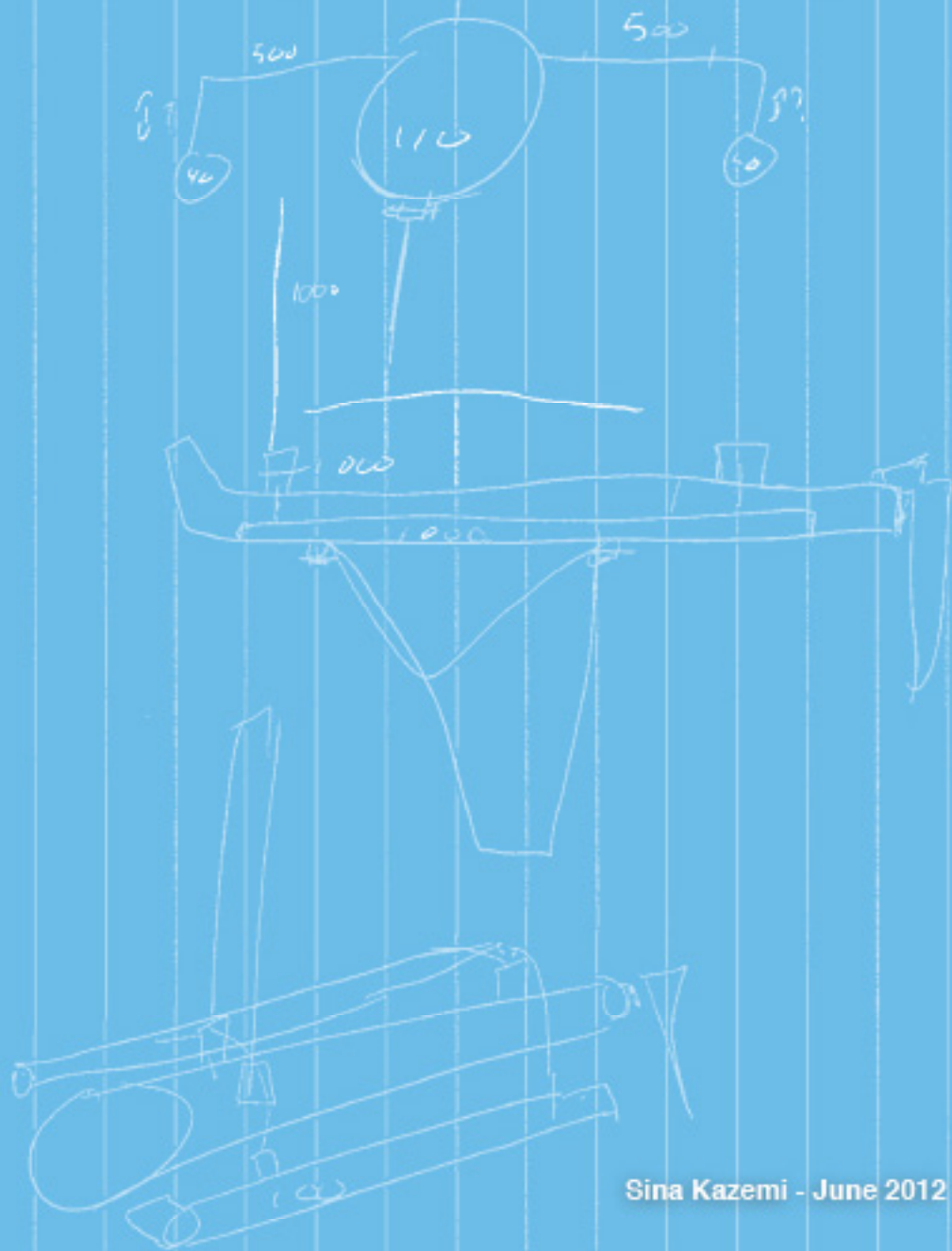


Organic Design



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Coach: Sam Nemeth
Client: Protei
Project: Wild Robots | DPD39
Eindhoven | TU/e | Industrial Design | June 2012

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Introduction

The previous project has been an exploration to better clarify my vision and to find a direction as a designer. The goal of the two years of Masters at ID for me is to develop more on an abstract or “Meta” level and with a focus. I believe that this approach is reflected in the report.

Besides this Introduction this report also contains six other chapters: *Vision, Crowdsourcing, Engagement, Evaluation, Discussion and Future*. The first three chapter take you from the abstract result of the project, the vision, to more concrete activities and explorations that have led to the vision at this point. These explorations are discussed in the Engagement chapter. Evaluation chapter contains concrete conclusions and recommendation on a practical level that can be considered by the client. In Discussion I try to bring more nuances to some statement that I make in this report, this chapter is mainly based on the comments of the client on the draft report. And finally as it is apparent in the title, my future plans based on experience of this project are formulated in Future chapter.

I hope that I can bring you a little closer to the adventures that I had.

About me

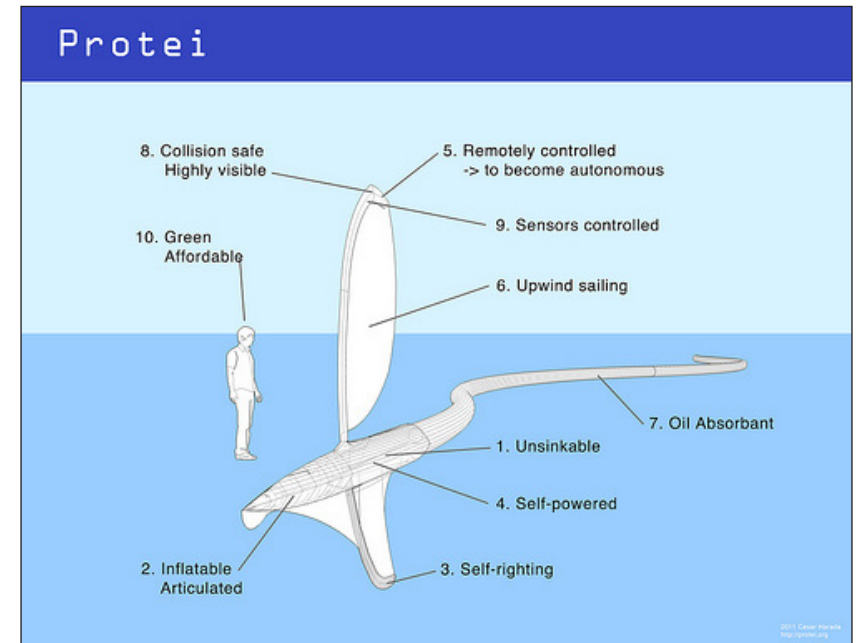
I am very business oriented. Why? Because after having spent some months working in the field and following courses at the Industrial Engineering department I have come to realize that if I have the ambition to design products which reach their users; it is more important to know how to manage the process of product design and to know how to design the eco-system in which the product exist than to define a single concept. I want to create value and not concepts. By value I do not only mean money, but also emotional and social value.

It might seem that I am at the wrong place; many people would think that designers have nothing to do with business. In contrary I believe that when it comes to radical innovations and social-emotional value creation, designers are the right crowd to be put in charge. Not only because they have broad set of skills but also because of their way thinking: design thinking. Design thinking is social, iterative, hands on and failure-friendly. These properties are needed to produce radical innovation. So that is why I think Industrial Design department is the right place for me to study and experience.

About Project

“Wild Robots” aims to develop an autonomous sailing boat. The project is complicated and has to tackle some notorious problems: it is extremely difficult to build an autonomous sailing vessel that can survive the ocean, as many have experienced the past century.

Protei¹ is the client of this project. Protei was founded by Cesar Harada² to develop unmanned sailing boats originally to clean oil spills. Naturally the applications for an unmanned sailor are not limited to cleaning oils spills. Such boat can be also used for educational and scientific applications.



Source: Protei.org

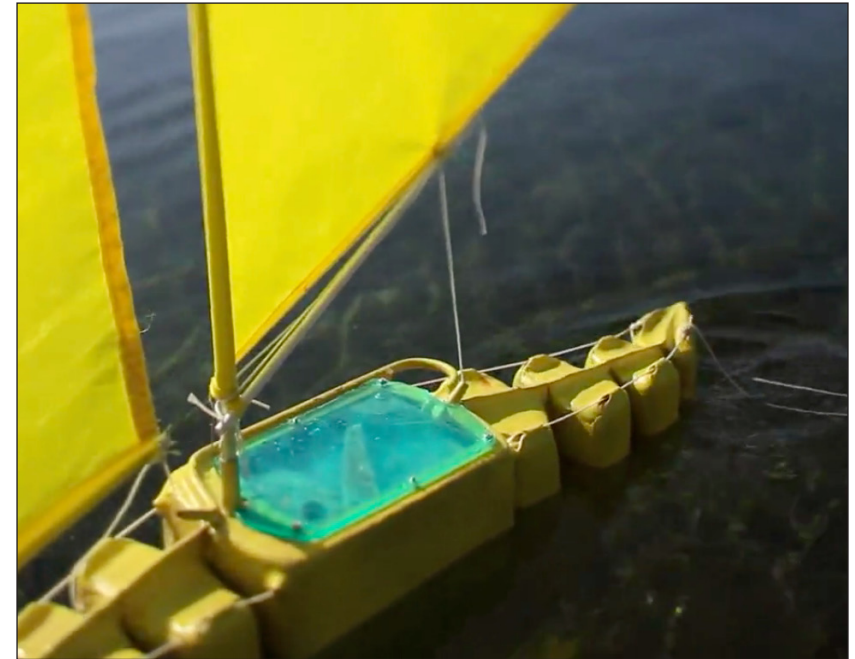
1 <http://protei.org>

2 <http://www.cesarharada.com/>

Unmanned sailing boats of Protei consist of an shape shifting hull. The goal of this innovation is to increase the efficiency and the manoeuvrability of the boats. Shape shifting hull is an innovation and focus points of Protei, which is in verification phase.

Protei aims to develop the sailors by crowd sourcing and community building. Their designs are open-source and anyone is welcome to contribute to their design process. So it is not only about building an autonomous robot but also about solving a complex problem using crowd sourcing. This aspect of the project interested me most.

The community based approach of Protei created a great opportunity to develop my vision further, deeper and also prepare for my research semester. As mentioned before, my main goal of the Industrial Design masters course is to develop my vision on organic design. The “Wild Robots“ project is part of this two year plan and offers a case to engage and understand online communities and phenomena such as crowd sourcing, open source, mass innovation and networks that I find related to organic design.



Shape Shifting Hull, Source: Protei.

Vision

The web culture

As some researchers have mentioned the current model of consumption is changing. The users will become more active in designing and making products¹. And I do not mean that there will be more user testing with the designer at one side the table and the users at the other side. Users will, in a sense, they are becoming employees of companies designing the products that they buy. There is no way to predict exactly what the working consumer of the future will be doing or how the relationship consumer work and traditional employment will be organized. But the passive customer model is unlikely to dominate any longer.¹

I believe the reason for the change in user/consumer behaviour is the idea that the whole society is entering a new era in which sharing is becoming more important and the concept of owning fades away. I think the society is moving away from the industrialised way of thinking, which tries to organise and manage by framing every aspect to the details. Industrialised thinking promotes clear structure and pushes away “chaos“. Our society is moving towards a thinking in which we embrace complexity. A society in which the interaction and the links between components in system is becoming more important than the component itself. “The culture we are heading towards is a potent mixture of post-industrial networks , the anti industrial ideology of the counter-culture and the revival of preindustrial ideas of organisation that were marginalised in the 20th century.”²

One of the dominant factors in this change in culture is the World Wide Web. Especially since the introduction of Web 2.0 that allows user generated content.¹ The term “Web 2.0“ refers to internet applications that facilitates new forms of interactive communication that go beyond

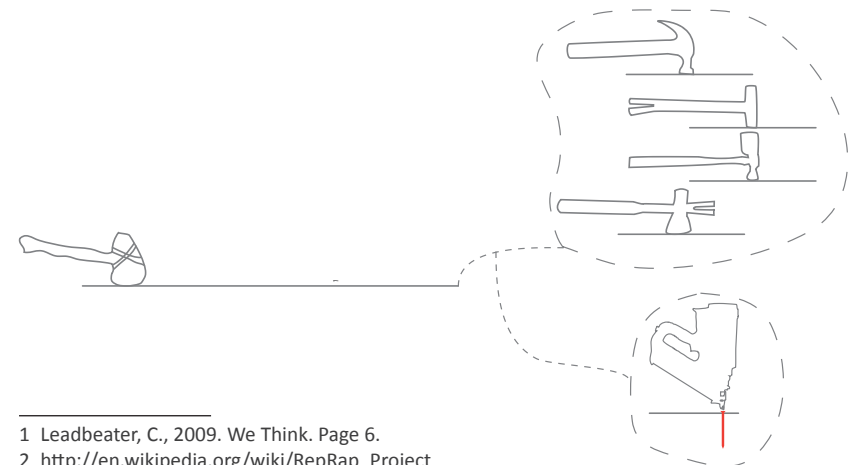
¹ Kleemann, F., Gutner Voss, G., Rieder, K., 2008. Un(der)paid Innovators: The commercial Utilization of Consumer work through Crwodsourcing. Science, Technology & Innovation Studies.

² Leadbeater, C., 2009. We Think. Page 27.

conventional sender receiver models.

The web 2.0, from here referred to as web, provides a highly interconnected and easily accessed platform for sharing ideas. The more ideas are shared the more they breed , mutate and multiply and *organically* grow, this process is ultimately the source of our creativity, innovation and well being.¹ The process of ideas growing organically is nothing new. Epic poems such as Odyssey and Iliad has been subject to this organic change and growth. Over the years people have been interacting with the poems and adjust them slightly to new environments. Another ancient example of such a organically designed object is the hammer which has evaluated to different forms by the input of an undefined group of people.

What the Web is offering us the ability to be more interactive and connected which promises even more organically designed systems. The Rep-Rap 3D printer² is a good example of such a system, it has been developed and evaluated to different branches using the Web.



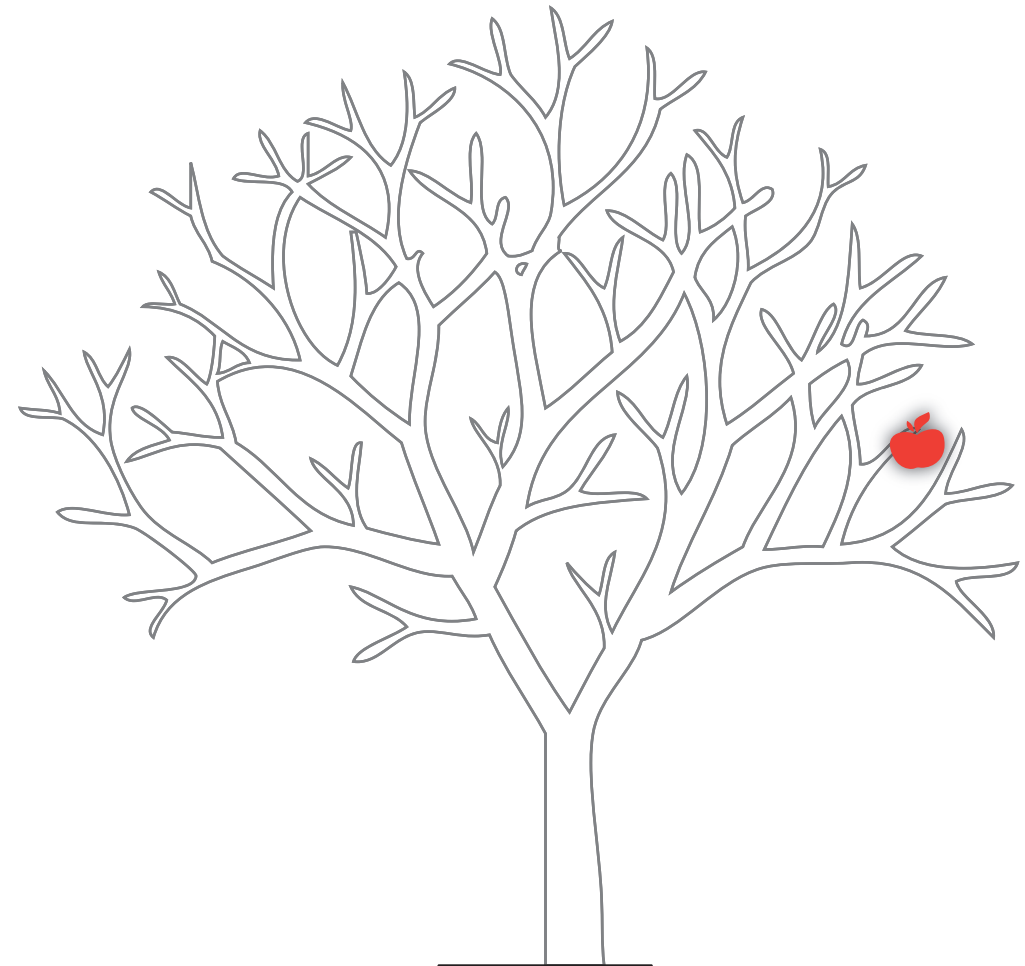
¹ Leadbeater, C., 2009. We Think. Page 6.

² http://en.wikipedia.org/wiki/RepRap_Project

Organic Design

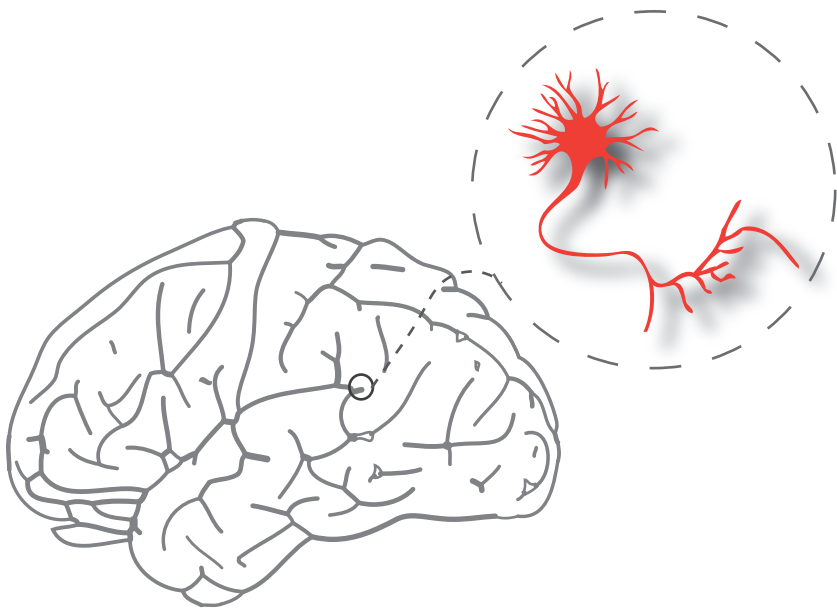
As mentioned before, the web has created an environment allowing products, services and systems grow organically. Organic design is a term also used in architecture. In architecture it promotes harmony between human habitation and the natural world through design approaches so sympathetic and well integrated with its site that buildings, furnishings, and surroundings become part of a unified, interrelated composition.¹ What I refer to as organic design is slightly different. In my view organic design shares the same goal as organic architecture: designing a product which fits and integrate into its site perfectly. However, in architecture organic design is a style of formgiving, while in my view it is more about the process. Organic design process is to some degrees uncontrolled, whereas organic architecture is usually the result of a controlled process.

Organic design is much like planting a tree. You can plant a seed and take care of the growing plant which will produce fruits. However you will never have the complete control of how the tree will exactly look like.



¹ Wright, F. L., 1954. The Natural House (New York: Bramhall House), P.3

In my vision, organic design is less controlled because it is the result of the interaction of a Network of individual contributors that is not predefined. From this point of view one can also compare it to how the brain works. The brain forms ideas and thoughts through the interaction among different individual neurons.



Designers

Designers and design students are constantly using the Web for their work. Most of the information, inspiration and tools are sourced by the web and eventually by others. Nevertheless I believe that most of the designers, at least in our faculty, are not aware of how the web is understood and affects their way of designing. And that their systems are more organically formed than they think. A simple example is the common usage of Arduino, an open-source platform, among the designers. It is almost unavoidable for designers to incorporate the web and its resources in their process. That is why that designers has to become more aware of these transitions and changes, and start to consciously engage and integrate the web in their design process and design organically.

I must say that it is the first time for me that I have decided to approach my project from this point of view. That means that you will not find a definite answer or approach for organic design or web based design in this report. It is rather a beginning and a case for deeper research and explorations.

CrowdSourcing

Definition of crowd sourcing

Integrating web in a design process is a broad statement. In essence a designer is integrating the web in the design process even if he or she is searching the Google for inspirational images. For this project I wanted to get a more deeper understanding than the obvious activities. Therefore it seems necessary to confine the definitions and the terminology to a more concrete framing. That is why I have chosen to use crowd sourcing as the central phenomenon for my project and research. Crowd sourcing refers to a job traditionally performed by a professional and distributing it to an undefined, generally large group of people in the form of an open call.¹ In this case the Web is the main platform for this activity and therefore it becomes part of the definition. That is why the definition changes in this report to: the online distribution of a job, traditionally performed by professionals, to (a group of) private individuals in the form of an open call.²

At this point I want to acknowledge that by using the term crowd sourcing I create a risk of this term being associated with activities which I do not think are not related to the progressive vision of cultural change described in the previous chapter. The term crowd sourcing has also been used to describe marketing activities that are aligned with the traditional idea of consumption. An example for this association is My Starbucks Ideas.³ This “crowd sourcing” initiative created a community for costumers to share and vote ideas to improve Starbucks’ products and services. In my opinion these initiatives are mainly aiming to market their products and brands. And even if the ideas posted by the crowd are implemented, they will result into some incremental changes which will have less effect on society than innovations aimed by Protei.

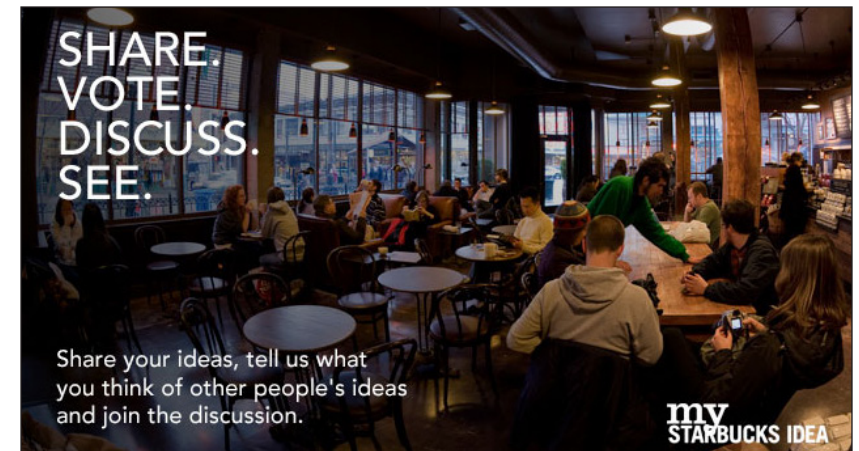
¹ Stokes, R. *emarketing The essential guide to digital marketing*. 4th Edition.

² Geerts A.M., 2006. *Discovering Crowdsourcing. theory, classification and direction for use* (Master thesis)

³ <http://www.mystarbucksidea.com>

Marketing is not the aim of crowd sourcing project. It is about innovation, designing and open hardware. That is why I decided to incorporate this distinction in the definition of crowd sourcing in this report and done during this project.

What I mean by crowd sourcing is therefore: the online integration of an undefined and generally large community in the process of creating and developing a socially relevant innovation.



Other Terminologies

Further in this report I will evaluate my engagement with crowd sourcing and initiating a organic process during last semester. In the table below you will find a set terms and their definitions used in this report related to crowd sourcing.

Open Call	A request for anyone to submit a solution to a problem or to contribute to a project.
Community	A social network of individuals who interact through a specific medium.
Web Platform	Refers to a website on which the open calls are placed and the communities are formed. This could be a self-made websites or preexisting websites such as www.wikispaces.com .
Open or Open Source	In production and development, open source is a philosophy, or pragmatic methodology that promotes free redistribution and access to an end product's design and implementation details
Contributor	A person contributing to an open source project based on intrinsic motivation. His contributions could be financial as well as intellectual.

Engagement

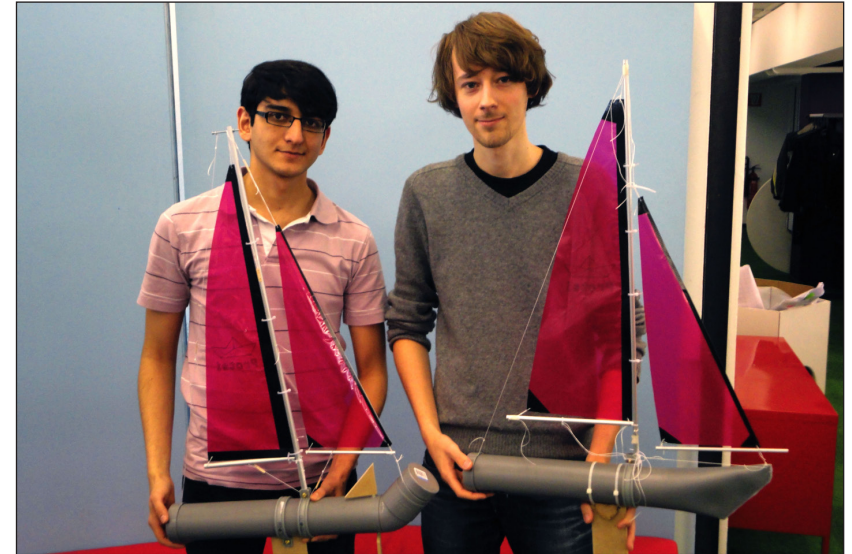
Getting Started: Open Call.

To get start the engagement with crowd sourcing we decided to make a simple toy sailing boat and share it online. I conducted this phase of the project in cooperation with Frits Stam(See acknowledgments). Our goal was to explore how we can speak to the intrinsic motivation of individuals in a crowd. Our ideal result was that others would start remaking the boat and preferably also start sharing their experience and versions online and with us.

Requirements

To reach this goals it was important to define the right requirements. In this case the boat or prototype which we would post had to lower the threshold for building. Therefore it had to be cheap and the material used for building had to be easily accessible for almost anyone on the online platform.

We expected that people who remade the boat also would improve our design, therefore it seemed logic that our design would leave room for adjustments and change. Therefore it was required that the design would be as modular as possible.



Modular PVC Boats



Web Platform

The client Protei has an website and a community. However, their web platform did not seem suitable for our goal at this phase. We aimed to reach a large audience and the online community of Protei at the time was relatively small compared to the alternative web platforms.

To share our design and place our open call we evaluated the most famous web platforms which aimed at building communities around sharing information about building tangible products. The web platform which we chose was the Instructables.com. This website includes more than two million members world wide. And contains a broad range of communities building and sharing products, from toys to electronics and food. We chose this platform because of this broad range and the large amount of users. We assumed that by enlarging our audience and the diversity within this audience as much as possible; the chance of our design being remade would increase.

Communication

Instructables offers the opportunity to post text, photos and videos. We used all three media to convey our message. What we especially paid attention to was the visual communication. We made sure that photos were made from each single detail of the making process. And we used relatively an extensive amount of those photo material for our instructions. As the famous saying says: one picture is worth thousand words. By documenting and communicating via photos as much as possible we aimed for the tacit transfer of information which in turn made it possible for us to be less explicit and therefore write less text.

Next to the photos we included a video of the testing the boat. In this way we made sure that the audience is informed about how our design works and to motivate them to build it. In the written text we tried to be as informal as possible. We incorporate some humour and were not too serious.

The screenshot shows a post on the Instructables website. At the top, the Instructables logo and navigation menu are visible. The post title is "Fun & easy sailboat [Protei] 009.1". The author is "frits297" with 17 followers. The post has 11,873 views and is rated with 5 stars. The main image shows two young men standing next to a small sailboat. Below the main image is a video thumbnail. To the right, there is a sidebar with a "Greece" advertisement and a "Related" section listing other projects like "Free Yacht Chapter 11: Dismasted! Trip Log: Outrigger Canoe" and "repairing a headsail".

Open call on Instructables: <http://www.instructables.com/id/Fun-easy-sailboat-Protei-0091/>

Results

Our publication on the Instructables was featured by the website and it received more than ten thousand views. From a promotional point of view this post was a great success. This success supports that our first open call is a good example of how such a post should be constructed.

In the post we did not only put effort in designing the boat but also put effort in making a well detailed instruction. Our open call was interesting, because the design of the boat and its possible applications. The boat is cheap and we received comments from various people that they would like to have such boat for example to clean their pool or play with their children. We were unprofessional, informal and personal this is reflected in the cover picture, the text and the video. At same time we stayed humble and honest about the imperfections of the design as they appear in the video. These factors helped us to win the trust of the audience which is an important element when forming a community.

Our open call received a large audience and some viewers showed interest. However this first open call did not pursued anyone to rebuild the boat, and if it did the makers have not shared the result with us. I think it is a bit too ambitious to expect active contribution after only one post. As also mentioned in the literature, building a community requires commitment and persuasion¹. The first open call was only a beginning.

The comments from the viewers were coming from all kind of angles. People who were interested in sailing commented but also people who were interested in toys or environment. This was of course very positive. However at the same time we were wondering whether this scattered range of interests and people that Instructables.com offered, would really help us to organize community with a dedicated core to

develop our boat. It seemed that a more focused web platform, however smaller, would be of a more help for setting a community than a Instructables which is very broad. That is why the web platform for this project was changed after the first open call.

¹ Leadbeater, C., 2009. We Think.

Keeping it simple: focusing the project

The Protei project has different aspects. There is the environmental aspect of oil cleaning. There is the naval innovation aspect of shape shifting hull and of course the challenge to make an autonomous sailing boat. In my opinion this multi-focused approach has helped the Protei well, for example in their kick-starter¹ marketing campaign. However within the protei group at ID we noticed that this multi-focused approach could also be a down fall for this project. For example why would you need sail boats to clean up oil? Why does not Protei looks for alternatives in the field of biology to break up oil spills? Why is Protei so keen on making an autonomous sailing boat from scratch while there are technologies available? And if oil cleaning is the central goal, as given during client meetings, why is Protei spends so much time and effort on making a shape-shifting hull?

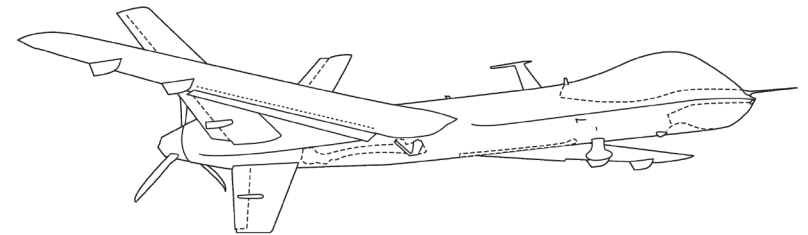
As these questions arose it became clear that by trying to solve everything under the name of oil spill cleaning, Protei was creating confusion among the contributors, at least among the contributors at ID. From that point it was clear that I had to simplify and focus the project for my crowd sourcing. It became apparent to me that clear simple goal will increase the chance for finding contributors, because it made it easier to lead and organise. A good example of such a approach is the community for DIY Dornes.² This community is dedicated to design open source, do it yourself drones. And they have succeeded to do so through crowd sourcing. I believe their focus and leadership has been a key factor for this success. As a contributor it is clear why your a part of the community. You are part of it because you like to make drones. It does not necessary matter why. It does not matter whether you will use it to detect forest fires or to play with your children. You contribute because your passionate about flying things and/or robots. You

¹ <http://www.kickstarter.com/projects/cesarminoru/protei-open-hardware-oil-spill-cleaning-sailing-ro>

² <http://diydrones.com/>

contribute because your are intrinsically motivated.

This approach seems to work. And that is also why I focused the project from one which tries to solve a lot of problems and bring a lot of innovations, to one which focuses on one point: building an autonomous sailing boat. Since the web platform for the project also had to be changed, diydrones.com was chosen as the main web platform for crowd sourcing and to build autonomous sailors. This platform offered us the right audience, a multidisciplinary technical audience which already succeeded in building autonomous flying drones.



Source: DIY Drones

I started on the DIY drones community the same way we did on Instructable. In this second open call¹, however, I informed the audience that my main goal is to design an autonomous sailor and my next step towards reaching this goal would be designing a remote controlled one. I asked the community for advice and feedback (See Appendix A for the full text of the post). The open call had the same success as the one on Instructables. The comments that I received were more technical, which was expected as DIY drone targets a technical audience. For example I received information about making the servo's water proof and a list of sensor which would be needed for autonomous sailing (See Appendix B).

1 <http://diydrones.com/profiles/blogs/trying-to-build-a-diy-autonomous-sailing-boat>

DIY DRONES AMATEUR UAVs, CONTESTS, RESOURCES and MORE

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Trying to build a DIY autonomous sailing boat.

Posted by [Sina Kazemi](#) on March 20, 2012 at 7:30am [View Blog](#)

Share More info

Recently I have joined this community. However, I am not working on building a UAV but a DIY autonomous sailing boat. It might not fly but such a boat can use the technology developed for UAVs. With a lot of help from a good friend I have been able to design a small sailing boat made from PVC, which has no electronics in it, yet. It only sails in one direction :D.

The reason we are building it from scratch and haven't bought a RC boat is because we want to make it as cheap and accessible as possible. The little PVC boat is designed very generic or modular. In that way every one who is interested in building one can adjust the size or the position of the parts as they wish to. Anyway you can see the boat and how it is made [here](#). It is an instructable.

Our next step is towards make an autonomous sailing is to make the current boat remote controlled. I think the main requirements for this step are that it should stay modular and waterproof. So the simplest idea is to put all the servos in a waterproof lunchbox, make very small holes to attach the servos to the moving parts, using thin ropes. And finally find a way to attach the box to the boat.

I will post the PVC RC boat as soon as I have successfully tested it. Nevertheless I would be very glad to receive tips or examples, which can help me to make the next step.

I'll keep you updated. And please don't hesitate to give feedback.

Cheers,
Sina.

First Post on DIY drones.

Intermezzo: Sailor kit experiment

As discussed in the previous chapters it seemed that elements such as, the quality of the open call and the way that the project is formulated and focused, can influence how effective crowd sourcing can be. During the project I had almost no budget, nonetheless I did wonder what could be done in my crowd sourcing quest, if there was a small budget available. That is why, the sailor kit experiment was conducted.

As it was promised in my first blog post on DIY Drones I designed and build a remote controlled catamaran, using many principles from the first PVC boat. In the second blog post¹ on DIY Drones the catamaran was the centre of discussion. More importantly the catamaran was the driver behind my experiment. In the blog post I wrote that I had five kits of the PVC catamaran available. I also let the community know that I am trying to go to the next step and make the boat autonomous. I asked my audience whether they were willing to help me with the software and electronics development. And whether they would like to receive one of the five kits to experiment with. I also added that as a sign of commitment they should join the autonomous sailing group² at DIY drones that I had created for this reason. The servo's and the remote controller were not included and had to be purchased separately (See Appendix C for full text). Of course I did not have five kits, this post was a little white lie for sake of experimenting.

1 <http://diydrones.com/profiles/blogs/sailor-kit>

2 <http://diydrones.com/group/sailing-drone>



Testing catamaran the remote controlled boat

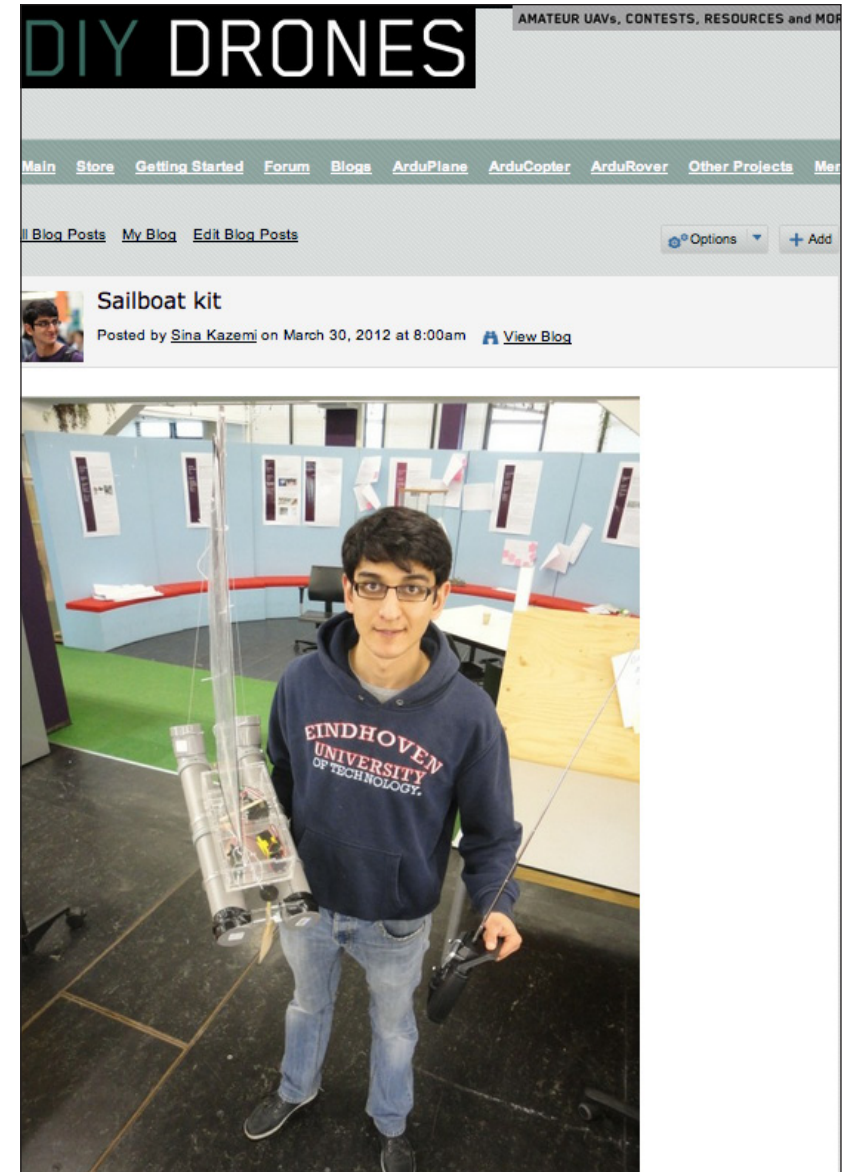


About eight people responded that they would like to contribute and that I can send them the kit. Appendix D contains the mail correspondence with one them.

It seems obvious that people are more interested when they get free stuff, nonetheless I also think that one can count on the contribution of these people especially in this case. Do not forget that the kit that they were promised contains no electronics, they still have to purchase the remote and the servo's and take the effort to put it together. In case that they had no intention to contribute and they only wanted a boat for pleasure, it would be much easier for them to buy a fully developed and tested kit.

Unfortunately I did not have the budget to send the kits. I informed the interested members of DIY Drones community about this and they did understand. One of them even offered me the budget needed for sending one kit to him. I refused this offer, because I had not enough confident in the quality of the catamaran at that moment. I promised him that I will share the next version with him. Meanwhile he has received the CAD drawings of the latest version of PVC boats, the Trima-ran.

If I would be able to send the kits, I would not expect that all the receivers would contribute. I do believe that even if one individual out of five would be inspired by the kit and would seriously contribute to the community and share their knowledge, the investment of sending five kits out would be worth it. I base this believe on my experience with Rob. One individual contributor, who's contribution within one month has been surprisingly insightful.



Sailor Kit Post

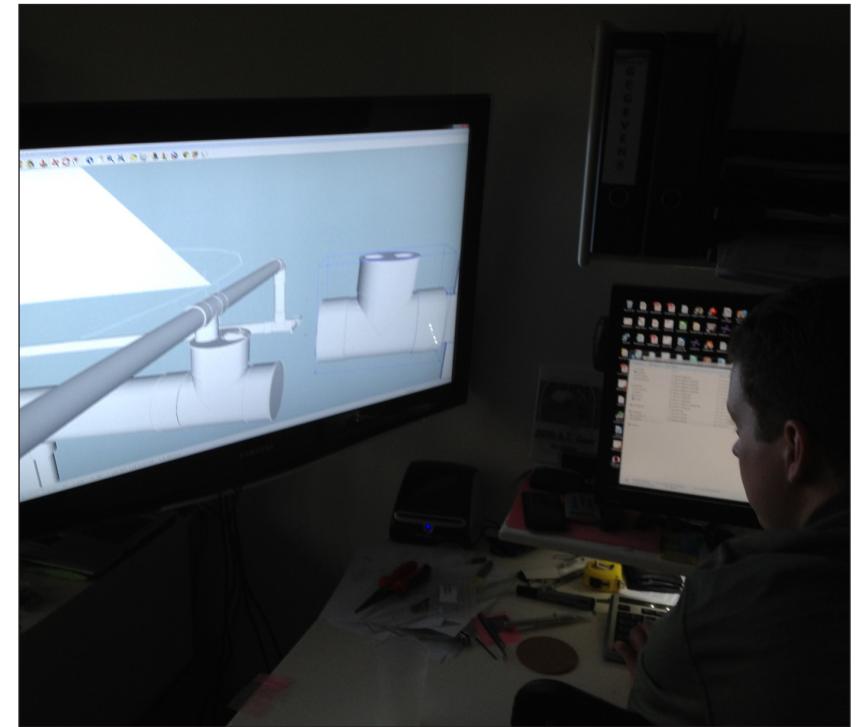
Meeting Rob

As a result of the Catamaran blog post I received an e-mail from one of the members of the DIYDrones community who lived in Eindhoven. Rob, the sender of the e-mail, offered me the opportunity to use his homemade 3D printer and electronic hardware for low prices. After discussing this offer with Rik, fellow student doing the same project, we invited Rob to the university to visit the project if he was interested. Fortunately, he accepted the invitation and from then on he became one of the main contributors to the project.

Who is Rob

Rob is in his early thirties. Technology is one of his passions. As one of the DIY Drones community members, he has built several UAVs. He also has built a 3D printer to make parts for his designs. To finance his fairly expensive passion, he has started a web shop for open hardware¹, which he maintains next to his daily job.

In my opinion, Rob comes very close to the profile of an ideal contributor. He is passionate about what he does, he is open and not afraid to share ideas. He is intelligent, skilled, and cares about quality. And he is adventurous, and maybe that is the reason why he decided to work on an autonomous sailor, while knowing nothing about sailing.



Rob working on his autonomous sailor

¹ <http://www.openhardwarestore.com/>

Evolution of PVC Boats

After meeting at the university I asked Rob whether he is planning to design his own boat and offered my help in case he needed it. He appreciated the help and told me that he is going to start making one.

As it is clear in one e-mail from Rob (Appendix E, Dutch), his idea was to design a trimaran. Although he was inspired by PVC based design he wanted to make an entirely new version, that meant no single hulls and no catamarans as they were made before. Remaking something that already was made was not challenging enough.

One of the interesting facts about Rob's design is that the main hull of the trimaran is one meter. That is not only because it is a standardised size, but also because it exactly fits in Rob's car. The trimaran can also be assembled and disassembled. This option has also to do with Rob's car. The disassembled version fits in the car and the assembled one does not. Rob's design fits brilliantly to his situation, and it could also fit others too, especially ones with an automobile.

However, what if Rob did not have a car, but a bike. Would his design be made of one piece and smaller? At this point I think we touch upon a point I made with the example of hammer that has "organically" evaluated to different forms which fit different situations (Page 13). I think the design discussion made by Rob about the size and the fact that it should be a trimaran can be recognized as a step in the organic evolution of the PVC boats.

Images made by Rob from his first mock up at Praxis.

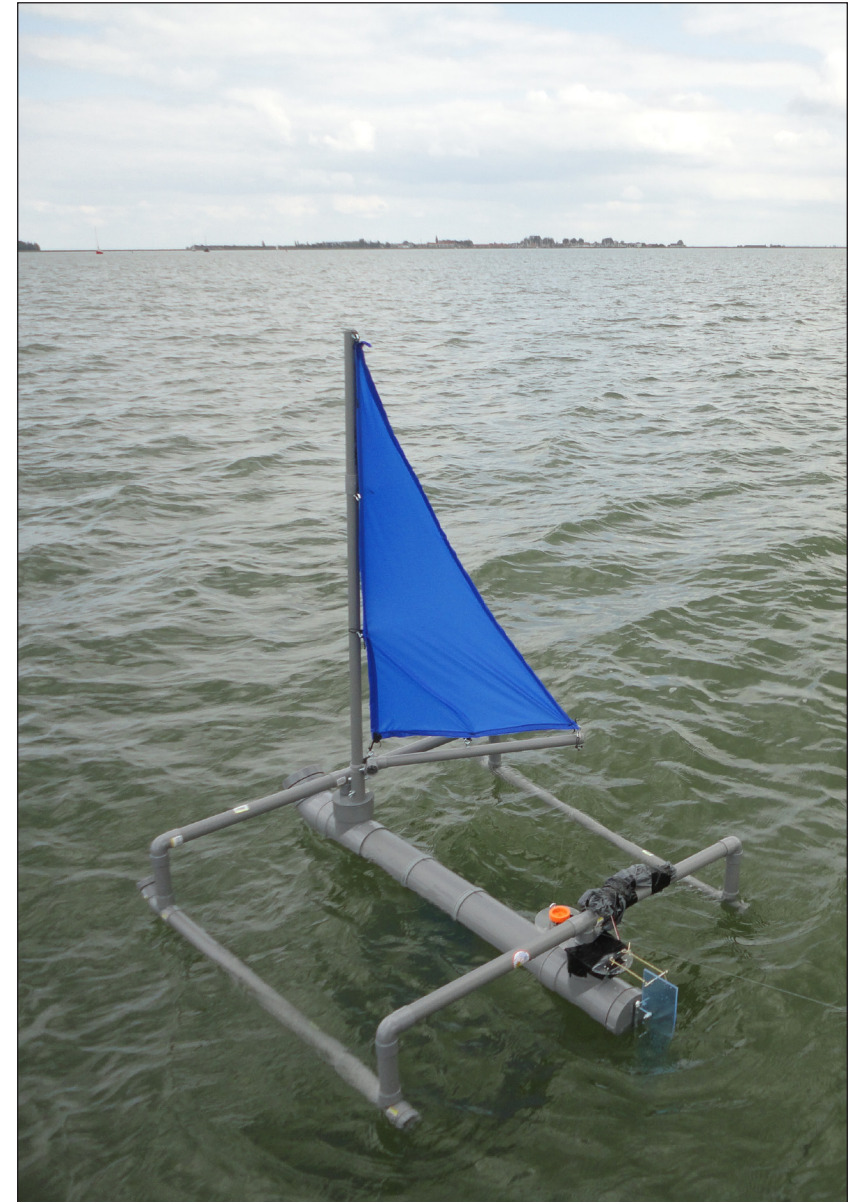


Rob unloading the Trimaran.



Power of Inspiration

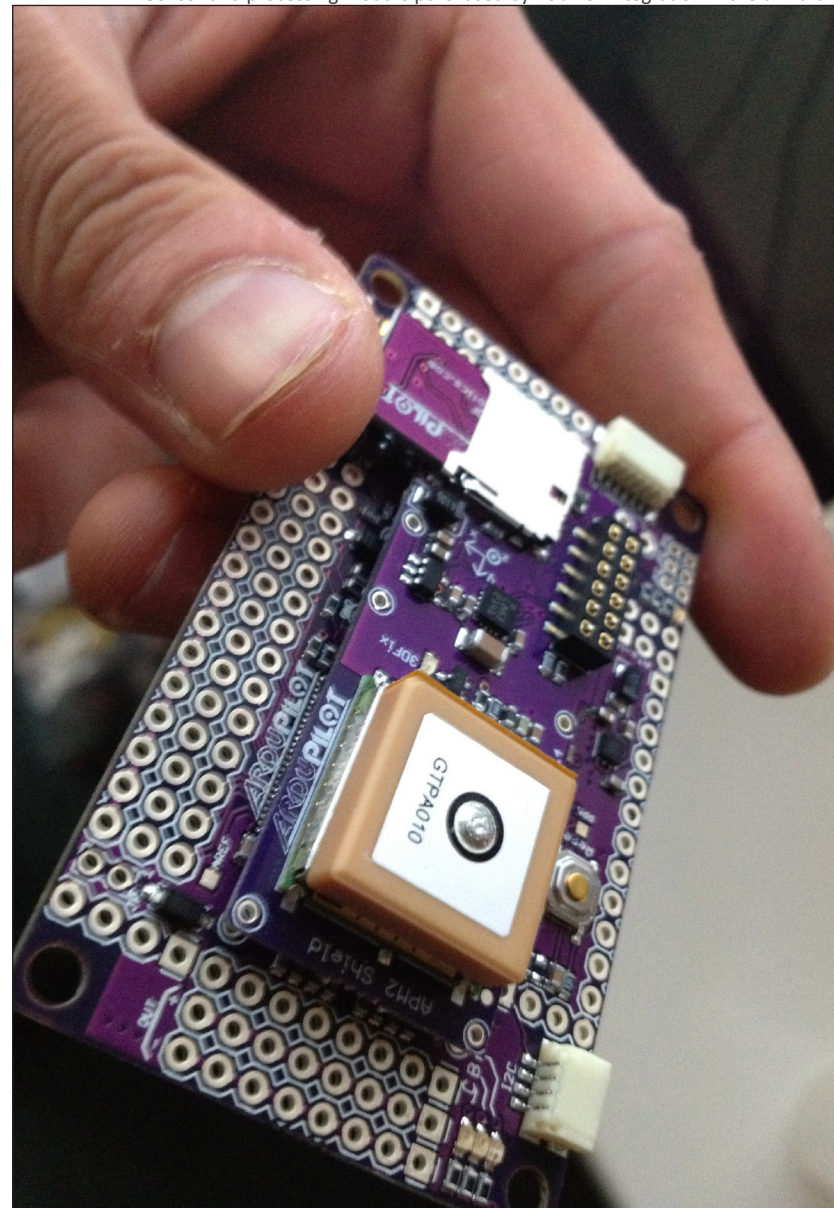
During a sailing trip on the lake Gouwzee the remote controlled trimaran was tested. Trimaran which Rob had invested more than hundred euros and many hours into, sailed for the first time. It sailed surprisingly well. It was stable and it was able to sail away and back with no problems. The quality and the care of Rob's work was more than evident. The open call on the DIY Drones had led to Rob designing and building a PVC boat, which he is planning to make fully autonomous.



Testing day.



APM2: Sensor and processing module purchased by Rob for integration in the trimaran.



In the beginning of the project the goal was set to engage in crowd sourcing and ideally the boats that were shared would be remade. Engagement in the crowd sourcing has resulted in only one contributor. Nonetheless, the contribution of this individual in terms of man hour, and knowledge is of high value for Protei community, which was confirmed by the members of Protei core team during our meeting at DEAF festival.

Protei is currently working on their own web platform for creating unmanned sailors. Soon their web platform will be home to the community of many contributors such as Rob. I hope that my experience of engagement in crowd sourcing and the insights discussed in the next chapter can be of value for development of the community.

Evaluation

The PVC design

Creating a common Language

The power of design became apparent after the first week of the project. Two main elements, which add value to the design, are modularity and accessibility. PVC is cheap, robust and largely available. The combination of the PVC plumbing pipes with the accessories available allow for modularity. There is little need for material processing. Modularity and accessibility which PVC plumbing pipes stimulates the evaluation of the boats within the community. A single hull design can be easily transferred to a catamaran or a trimaran. The size and the position of parts can be easily adjusted. These building blocks also create a common language, as most of plumbing material are standardised. The standardisation makes the communication within a community easier and more efficient. In theory you can say that one CAD file of a boat made of PVC is enough to convey the arrangement of the parts and thereby how it can be replicated.

The trimaran version uses some laser cut parts. Based on my experience with DIY Drones, instructables and Rob I believe that many contributors that can affect Protei most, do have the means to access laser cutters and even 3D printers. This means that one can rely on 2D drawings and CAD models more for communicating the open hardware. Creating a step by step plan of how a boat is made including parts which are hand-made is extremely time consuming, it took us a more than a day to make the instructions for a boat as simple as our first prototype.

I strongly recommend to mainly use CAD files and 2D drawings for transferring information tacitly. Of course some essential tips and clear given building steps are needed, however I believe we can rely on the intelligence and motivation of the contributors to make complete sense of the details and much of the building process by themselves or through interaction with each other. In my opinion an extensive and

detailed instruction can even demotivate contributors and cause boredom.

Functionality

It is imaginable that the boats made of PVC such as the trimaran will not be the final form to be lunched for tasks as cleaning oil spills. These boats can function as a research and development platform for Protei and the community. Especially because the boats are easily reproducible. Rob, for example, is going to use the trimaran to develop and test the needed software and electronics for autonomous behaviour, which later can be integrated in the final versions. In essence the PVC boats provide the platform that can be easily distributed among community members to develop different aspects for such a complex project.

Control Systems

Software and control systems have not been the focus the project. Nevertheless, they are an essential part of an unmanned sailor, whether it is fully autonomous or not. During my search online and after discussions with Rob, it became apparent that much of software and electronics developed for UAV's could also be suitable for the sailor. These systems can be at least a starting point for the development of a crowd sourced control system. It is for example possible to extent and adjust the Mission Planner software and APM hardware developed for DIY Drones for use in sailors. This approach is especially attractive because the mentioned software and hardware are well known by many potential contributors and these systems have proven to work for other autonomous vehicles.

Contributors

Participants in an open mass innovation such as Protei are referred to as amateurs, pro-ams, hackers, hobbyists, crowd, etc. It does not matter how you call them it is undisputable that the collaboration and the contribution of these people have given rise to some of the biggest project ever undertaken by man. Linux is an good example of such a mass innovation. These people are the most valuable asset in Protei organization. Up until now the community have given rise to the intellectual and financial assets, which are pushing the project forward. During this project I have tried to form an understanding of who these people are, what motivates them, how do they behave, and what do they need?

Based on the experience during this project and as Linus Torvalds describes in *The Hacker Ethics*¹, the contributors are not motivated by financial needs. They do not work on these projects to survive. Unlike some might think most of them are also not motivate because it is a way for them to socialise. Financial income and an extent to social life and peer recognition might be nice side effects, which can add to the motivation. However the main reason behind their activity is entertainment. They do it because they enjoy it, because they are passionate, and because they do what they want to do. This point might seem obvious, however it is a point to keep realising as the core organization.

For example, Protei core team is focusing on designing a single shape-shifting hull. If Protei was a conventional organization it would make sense that Rob as part of the organization would also focus on realising that design. However, in an open collaboration you cannot determine the direction that the contributors take, one only can inspire others. Rob is a good example of an active contributor. He has invested relatively large amount of time and money in the trimaran design that he

gladly shares. He was inspired by the design of the PVC boats and DIY Drones, nevertheless he decided how his version should look like and why. During one of the discussions with Rob, he mentioned that he is also motivated by the challenge of making and redesigning open source hardware. The reason why he chose to start making sailers was because he was bored with UAVs and was looking for something new.

As I mentioned before, when it comes to documentation, it is not necessary to document the building process to detailed. The contributors do not need an Ikea manual. Because of their adventures attitude and curiosity they do not mind puzzling out how something is built.

I believe that the best way that the core of an open collaboration project can do to direct the contributors, is by inspiring them. In this project Rob was inspired by the PVC boats, in a larger scale the Kickstarters community was inspired by the efforts of Protei to clean up oil spills. That is why I believe an important task of a designer in the core of an organization such as Protei is to keep designing and thereby inspiring new contributors, which in my opinion the core team of Protei is doing very well.

¹ Himanen, P., 2001.*The Hacker Ethic*.

Community and organization

Protei project is a broad, and the infrastructure (website) for Protei community should support this broadness and at the same time offer focus and clarity for contributors from different backgrounds to know what and why they can contribute.

I have worked with Rob. Next to this I received an interview (appendix F) with the head of Stanford Oceanic Group conducted by a fellow Protei student in Stanford. Rob has told me that he is motivated because he enjoys designing and building fairly complicated technical products. From the interview I understood that Mr. Arrigo, the interviewee, is mainly interested in what he can do with the boats and not necessarily how it is built. The organization of Protei community should be as such that both of the interested could contribute in the way that they want to and also can easily come in contact with others who share the same interest. This pattern of different interests was also clear within the Protei community in TU/e. Some students were interested in studying how swarm behaviour of Protei boats while others focused on building educational kits for children.

Generally I see three main areas, which Protei community could consist of. First is **Innovation** under which the shape shifting hull concept and the alternative population concept can be classified. Second is **Application** where Mr. Arrigo can contribute and where the educational kit can be explored. And the third is **Implementation**, an area in which Rob is contributing, which focuses on realization of the concepts and the boats.

This organization can be reflected in one website which for example contains three segments, each having its blog and related groups. The segmentation does not mean that they are separate. Contributors can visit and be active and interact on all three. Nevertheless it brings more focus in the community and makes it more clear for contributors

with different points of view towards the Protei.

Nor democracy nor dictatorship: Leadership.

Contrary to the name crowd sourcing, for organic designers this term is more about “sharing” than “sourcing”. The fact that a designer gets involved in crowd sourcing does not mean that he will spend less effort than in a traditional design process. Crowd sourcing does not result in less effort, it aims to develop product and systems which fit their environment best. As it was also evident during my engagement in crowd sourcing. The designer should be prepared to share and put much effort into forming a community before the community becomes self governing. This process is comparable to an engine; before an engine starts running it requires a relatively high amount of energy.

Different examples such as the development of Linux show us that even though crowd sourcing is open and flexible, it does require a core of committed contributors to be successful. Such a core requires leadership which clarifies the vision and the goal of the community. Crowd sourcing succeeds by creating self governing communities who make the most of their diverse knowledge without being overwhelmed by their differences. That is possible only if these communities are joined around a simple animating goal and the right kind of leaders.¹

The contributors of the crowd sourcing process are usually amateurs. They contribute on the bases of intrinsic motivation. Therefore it becomes even more important that the designer as the director within such a process should set clear and simple goals which target the intrinsic motivation of the contributors of a community.

¹ Leadbeater, C., 2009. We Think. Page 80.

Next to a simple goal, it is important to have the right attitude as a leader. Leading in such an environment requires an active, interesting, humble, unprofessional and honest attitude¹. This attitude should be reflected in the open call which one places.

An open organization is not democratic, nor autocracy, it is free. Everyone can publish his or her version of Linux. I can call mine Sinux, I am not sure it will be used though. However, there is only one version of Linux and what contributions are in that version is decided by Linus Torvalds. In my view the core team has this position not only because it puts the most effort in the project but mainly because it has the responsibility to keep an overview on the project.

Standards

I think in case of Protei, the organization can take the separation between the core team and the contributors around it into account when it comes to standardisation. Due to the complexity of the product, one cannot simply agree that everyone should use only a certain program when designing, while I can imagine that in an open source software project that can be the case. For example, Rob uses Goolge Sketschup, an open source 3D CAD program. He does not need more sophisticated CAD programs such as SolidWorks to achieve what he wants. That is while it makes sense that the core team uses SolidWorks to finalise the next version of Protei. This might mean that the organization should allow for two standards with the disadvantage that when design decisions are made on what contribution will make the final design, the contributions should be changed from one standard to another, which in case of Sketchup to Solidworks should not be too much effort.

1 Kaplan, M. A., Haenlein, M., 2010. Users of the world, unite! The challenges and opportunities of Social Media. Business Horizons.

Business model

The assets of a company or organization can be categorised in three¹: financial assets, social assets and intellectual assets. Financial assets are apparently the amount financial power of a company. Social assets are related to people and their willingness to invest time in an organization and intellectual assets are related to the knowledge within an organisation.

Financial assets are central in a conventional organisation. An established conventional organisation has more financial assets than social assets and more social assets than intellectual assets. However I believe that in an open organisation such as Protei the relation between these different kinds of assets is reversed. Intellectual assets are central then come social assets and finally financial assets. And because financial assets are not central, the value exchange within the organisation and with its environment cannot simply be expressed in cash.

The business of some project such as one done by Goldcorp² that use cash as a drive behind their crowd sourcing can be modelled easily. However, the business model of organisations such as Protei, which does crowd sourcing as defined in this report are, at least for me, too complex to make explicit, and that is again because the value exchange cannot be expressed in cash. It is more about intrinsic motivation than explicit motivation. It is about sharing rather than owning. The conventional business modelling literature, that I am aware of, does not provide the tools to fully model such a complex system. That is what makes it so interesting for me and motivates me to continue this project.

1 Byers, T.H., Dorf, R.C. and Nelson, A.J, 2010. Technology Ventures: from idea to enterprise. Third edition

2 <http://www.goldcorp.com/>

Discussion

The draft version of this report was shared with some of Protei's core members, Cesar and Eitenne. Their efforts to contribute to this report with their feedback was more than my exception. Some comments on the vision are not directly incorporated in the report. That is due to my need for more time to think thoroughly about the comments given and to dive deeper in the resources given. I must say that I value this feedback much and will take it into count in further development of the idea. Further in this chapter I discuss some points based on Protei's comments.

My vision sketches an almost utopian cultural change where an era of post industrialisation emerges. I do not consider myself as an idealist and do not consider the current culture of capitalism as negative or evil. What I try to convey is my observations of change in nature of how we do business, set up our organisations and innovate. My vision as a designer is still in development and I suppose it always be. As I develop this vision I hope to gain more depth and to be able to show more nuances and subtleties in the way it is described.

During my engagement with crowd sourcing I decided to take DIY Drones as my main web platform due to its success. As Cesar mentioned in his comments, DIY Drones success is partially because contributors can easily access toy aeroplanes or helicopters to modify and build UVAs. For Protei that is a challenge, there are no toy boats with a shape shifting hull. I agree with Cesar. At the same time I think by predefining directions, however general, we can separate different aspects and crowd source even without a shape shifting boat. For example we can define work and test cheap wind sensors with a toy or PVC boat. That is why I proposed the Innovation, Application and Implementation deviation. This deviation does not mean that contributors have to choose from one. It is just a tool to clarify and organise contributions and not contributors.

Future

I approach design holistically and care about system and ecosystems around products. During this previous semester I have stumbled upon a project, which has offered me a very interesting case, Protei's ecosystem. I am motivated to continue in this project in the next semester because it helps me to form a better and deeper vision as a designer and offers me an adventure in the unknown.

At this moment I can only see the pieces of the whole. The system is not defined and clear. It is about Internet, it is about open source, it is about a new form of business, etc. That is why I think in the future I have to take a new perspective to bring these pieces together. After a small literature study I believe that Network Thinking can be the key to understanding and explaining such a complex system and my vision.

The community that I was involved was not only based on internet. I discussed with my fellow students. I visited and shared ideas with Rob at his house. I talked to experts at other faculties. All these connections "outside internet" had effect on the design, while the focus of the project was mainly the connections on the internet. That is why I think by taking a more broader perspective and thinking in Networks and not necessary in the medium which supports it, the internet, will shine more light on organic design.

Acknowledgment

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***Frits Stam** for introducing me to the principles of sailing and the world of open source.*

Appendix A

Open call on DIY Drones, March 20th 2012

Link: <http://diydrone.com/profiles/blogs/trying-to-build-a-diy-autonomous-sailing-boat>

Recently I have joined this community. However, I am not working on building a UAV but a DIY autonomous sailing boat. It might not fly but such a boat can use the technology developed for UAVs.

With a lot of help from a good friend I have been able to design a small sailing boat made from PVC, which has no electronics in it, yet. It only sails in one direction :D. The reason we are building it from scratch and haven't bought a RC boat is because we want to make it as cheap and accessible as possible. The little PVC boat is designed very generic or modular. In that way every one who is interested in building one can adjust the size or the position of the parts as they wish to. Anyway you can see the boat and how it is made in the link below. It is an instructable:

<http://www.instructables.com/id/Fun-easy-sailboat-Protei-0091/>

Our next step is towards making an autonomous sailing boat to make the current boat remote controlled. I think the main requirements for this step are that it should stay modular and waterproof. So the simplest idea is to put all the servos in a waterproof lunchbox, make very small holes to attach the servos to the moving parts using thin ropes. And finally find a way to attach the box to the boat.

I will post the PVC RC boat as soon as I have successfully tested.

Nevertheless I would be very glad to receive tips or examples, which can help me to build the next step.

I'll keep you updated. And please don't hesitate to give feedback :)

Cheers,
Sina.

Appendix B

Sensor (combinations):

TireSandals has worked out a set of suggestions on what a autonomous sailor should include. It seems a good starting point.

ArduPilot(originalversion)

ArduPilot board and a row of breakaway headers GPS module (Mediatek or uBlox 5+adapter and cable recommended)

FTDI cable for programming

Four female-to-female servo cables to connect ArduPilot to your RC system

[Optional] Two Xbee modules for wireless telemetry. This one in the air and this one with this antenna on the ground/laptop side. You'll also need two Xbee adapter boards. You can connect the airborne Xbee adapter to Ardupilot Mega with jumper wires.

Specifically needed for a Sailboat - a sailboat only absolutely needs a wind vane the rest is optional

Wind vane - sensor for wind direction (applicable potentiometer for about \$45 that has ball bearings for low friction and 360 degree range <http://www.usdigital.com/products/ma3/>)

Anemometer - sensor for wind speed (may be able to use the same sensor as the wind vane, though a photo gate would be a lot cheaper)

Compass - need something that compensates for tilt like this one \$150 is a little pricey for a compass... <http://www.sparkfun.com/products/8656>

Triple transducer - to measure speed through the water, temperature (not sure how that is important), and depth (mapping applications or not running aground)http://www.airmartechology.com/uploads/catalogPages/cat_145.pdf

Appendix C

Second Post on DIY Drones, March 30th 2012

Link: <http://diydrones.com/profiles/blogs/sailor-kit>

Since my last post I have been working on building a cheap RC sailor. And I must say that the feedback I got from the community has been very helpful. So special thanks to people who showed their interest and gave me tips.

My aim is to eventually build an autonomous sailor, and a RC one is just a step in between. The “Catamaran” which you see in the picture is radio controlled and I have tested it on water. However there is more work to do, the final RC boat will be even more cheaper and better. The reason for that is because I want to provide an accessible platform, which is easily built and is not as expensive as a toy boat. In that way anybody interested can start developing autonomous sailors.

Within two weeks I hope to have the final RC version and I will share the instructions with you.

I am also going to prepare five kits with all the materials and instructions you’ll need to build one, excluding the electronics.

So, if you are interested to get involved mail to sina.sailorkit@gmail.com and I will ship one of the kits to you. You don’t need to pay.

If you have received the kit, I would appreciate if you also join the autonomous sailor group and share your experience with the community.

Note I can only provide five kits :)

Cheers,
Sina

Appendix D

Example Mail Correspondence as result of Sailor Kit Experiment

Ernani Reis, Mar 31 to Sina Kazemi

Dear Sina

Please count me in the sailboat kit.

If there is anything I can do, please let me know. I have experience in mechanics, electronics, software, and a few other things.

Thank you
Ernani

Sina Kazemi Apr 4 to Ernani

Dear Ernani,

I have bad news, I could not arrange the budget for the shipment of the kit. So I cannot send it to anyone, unless you leave in the netherlands then I can deliver it myself :D. However, I will make an instruction of how it is made and I will also make a video. I hope these instruction help you to make one yourself. It will be very simple to make. I will share it as soon as I've got it. I hope we can stay in contact, and sorry for the inconvenience.

I really could use some help in electronics. I am a industrial designer myself so I do not know a lot about advanced electronics and programming. So it would extra helpful if you make one of these boats and install some sensors to see how we can make it autonomous. I was thinking of very simple sensors at first. Maybe only a compas at first. Btw, very are you from. Do you live in Europe?

Cheers,
Sina

Ernani Reis ernani, Apr 4, to Sina Kazemi

Sina,

I do not live in Europe, I live in Brazil. Never thought that you would pay the shipment, anyway, is too expensive.

Compass is a relatively expensive sensor, traditionally. Recently ST launched a 3xacceleration and 3x magnetometer, with digital output, I just got samples, cost about \$10 each. GPS is always a good sensor, costs about \$30, for a simple one, about the computer, I think should be arduino, simple, reliable, cheap and easy to program.

“advanced electronics” maybe fancy, but isn't as fun as it sounds (in my opinion), functional and simple to understand and fiddle with is fun.

An effective sensor arrangement, I think, would be GPS + compass + acceleration (ST part)|, or GPS + Z gyro (there are cheap single axis, I don know where to find them).

Ernani

Appendix E

Rob's e-mail talking about designing a PVC Trimaran (Dutch)

Hoi Sina,

ik heb aan een trimaran zitten denken omdat er al een gewone boot en een catamaran is. Heb wat gelezen over catamarans en een idee bedacht aan de hand van pvc. Vanavond ben ik bij de Praxis wat gaan puzzelen met stukken. Het personeel keek me beetje raar aan, maar had dan ook bijna een hele trimaran in het gangpad staan.

De opbouw op de fotos is met 40mm buizen en 110mm buizen en de middelste buis is 1meter lang, maar heb verder nog geen lengte of breedte bepaald. Ik weet nog niet of daar bepaalde verhoudingen voor zijn die goed werken. De zijkanten wil ik demontabel houden en ook de zeilmast. De buizen schuiven vrij stroef in elkaar. Per zijkant kan nog een plaat gemaakt worden, mbv de beugels (die ook op een foto staan) om dingen op te plaatsen.

Verder ook wat fotos van prijzen voor onderdelen, zodat ik die niet hoefde te onthouden.

Heb nog niet bedacht hoe ik t roer etc wil doen.

Fotos:

[Attached photos of the first trimaran mock up]

Rob

Appendix F

Interview with Kevin Arrigo, Head of Stanford Oceanic Group.

Takeaway: Stanford Oceanic Group collects data and analyzes the ocean for research. They will find value in OpenH2O if it helps them identify providers of the technology and equipment they need for their research, for example the optical equipment makers. To take it a step further, instead of asking these providers “what do you have that I can use in my research?” it should be “what does everyone have that I can use and suggest improvements to build on top of it?” In the end, the researchers provide the motivations for the equipment makers. The value is that OpenH2O is a marketplace for buyers and sellers, where the buyers can tell the sellers what they want, thus enabling innovation through community collaboration.

Q: What does the Stanford Oceanic Group do?

- Going out on ships, making measurements, analyzing water samples
- Use gliders, automated underwater vehicles
- Explore environments that are icy
- Will go to companies to buy optical instruments to do certain things
 - (How do you know where to go?) word of mouth, not that many companies building oceanic equipment
 - Google search: “oceanic equipment,” “optical equipment,” “gliders”
- Biosphereical instruments - san diego
- Satlantiac - novascotia
- Wetlabs
- Hobilabs

Q: What would make you buy these products to help your research

- It cost money to develop and build things
- Demonstrated ability to work

- Price
- Would want to buy and own the product

Q: Feedback on OpenH2O and Protei?

- Protei and OpenH2O is a bit unclear
- No real community like this exists
- Gap in terms of people who want to develop vs those who need
 - OpenH2O can serve to fulfill that need
- The word has to get out
- Needs to provide a clear message that people can identify with, can find it useful

Q: How would OpenH2O benefit you?

- Help move my research in the right direction
- Make a measurement easier or possible

Q: How would you contribute to the community?

- Providing motivation for building the technology and equipment
- If it's not built yet, would want to collaborate to develop the product

Q: Would you use Protei?

- Would use it if:
 - Samples more than surface
 - Temperature for fluorescents, currents
- Currently no, doesn't do anything with oil spills
- Remote sensing - having a fleet measuring ocean temperature
- GPS, upload data
- Capability to measure subsurface, gliders
- Sensors

Q: How can we talk to more people like you? Who else is this data valuable to?

- Set up a booth at a meeting of oceanographers
- Talk to all kinds of people
- Will find lots of commonalities - what can be measured, what can't
- Not a long list of what people want
 - Could even help physics
- Contact societies/groups/organizations
 - Ocean sciences meeting in Utah
 - TOS (The Oceanography Society)
 - American geophysical union (ocean section)
 - American society of Limnology and oceanography
 - NSF (National Science Foundations)
- Argo buoys program - drifting all over the ocean, everyone gets data from here; expendable
- Not many people fighting over data, but you want to get it published

Q: How could we form a partnership?

- Wouldn't necessarily form a partnership with the Stanford Oceanic Group because they are more of just a collection of scientist
- Research is done with individual researchers, not institutions
 - Some people might disagree and not care about this
 - Easier/better to do this as individual researcher
- Lots of collaboration going on
- Oceanographic societies would be interested in something like this