Protei progress report, 2014/07/28

Foreword by Protei & Scoutbots CEO Cesar HARADA in Hong Kong / contact@cesarharada.com

How can I answer a simple question such as “How is Protei doing?”. We have come a long way. From a small garage in New Orleans during the BP oil spill, through the storm in the Pacific ocean and now in Hong Kong since last year. It has been 4 years. We are finally about to deliver all our Kickstarter rewards, as we promised. We are turning the page and starting a new chapter of this great adventure with Open Technologies, to explore and protect the oceans, together. This report should give you a good overview of our current situation, future strategies and hopefully make you want to engage more with us, as a sponsor, investor, partner, buyer, community or team member.

This is a google doc, please ask questions and add comments.

Table of contents

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1. Where is Protei today?

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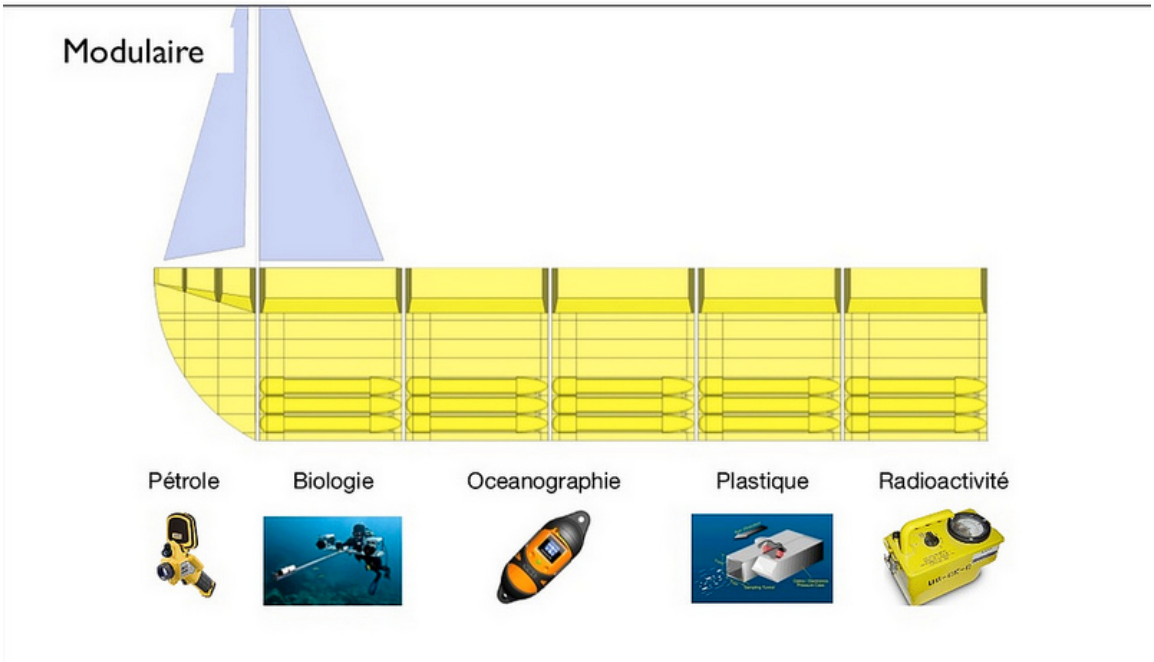
Technology : shape-shifting hull, maneuverability, energy, modular

More than ever, we are confident in the value of the shape-shifting hull with tens of hours of testing. We have built many more prototypes and each of them only confirms that we are working in the right direction. We hope that we will soon be able to demonstrate on a large scale that the shape-shifting hull provides :

- improved trajectory control while curving into a “C” profile (that’s the way fish turn)
- capacity to slow down a boat with “S” profile (that’s the way fish stop)
- improved hydrodynamics and stability in maneuvers
- absorption of wave impact (environmental noise)
- conservation of point of sail, hence reduced energy consumption

This last point being critical when you know that the world 16 largest ships emit as much CO2 as all the cars in the world and that 90% of the world trade is transported by sea. This meaning that if we can improve sailing science and the industry, even a little, it has tremendous environmental, health and economic potential. What is comforting us is also that since less than a year, Boeing and NASA have started developing similar technology of “shape-shifting wings” that “could enter service after 2025. NASA is aiming for structural weight reductions of 25% and aspect-ratio increases of 30-40% for cantilever wings.” So beyond ocean science and ocean clean up, which are our primary goals, wonders await.



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Another important development of Protei architecture is the “modular boat” : we are starting to build boats as we would build trains, each module carrying a different payload. If a long “train” broke apart, it would become 2 functional shorter “trains cars” as each module being independently wind powered.

Overall we are doing a historical upgrade in the science of ocean navigation (wind and engine powered). Sailing is the oldest collective transportation system, that existed before the invention of the wheel, yet I would argue that the biggest improvement to sailing in the past thousands of years are :

1. the centreboard, to reduce side-drift and significantly improve maneuverability
2. multiple hulls, with the development of the catamaran, trimarans etc.
3. hydrofoils, that allow a boat to plane on top of the water, instead of displacing a lot of water
4. the shape-shifting hull, our dynamically controlled hull, Protei.

So, we won’t ever give up. This is too important.

Products, prototypes, concepts

Protei 011.1 rotating mast (product), small for lab testing and hobby market

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We are very proud to say that we are now manufacturing a product, Protei 011.1 with a rotating mast that we sell online for 1200 USD ready to sail, or 700 USD in kit. So far we have sold ten units that we are building now. It is a little boat -less than a meter in length- so it does not allow us to sail in the big open ocean, but it is small enough to test in many towing tanks, rivers, lakes, streams, pond and is easy to ship around the world at moderate cost or transport in a standard suitcase. See Technical drawing, and how it curves.

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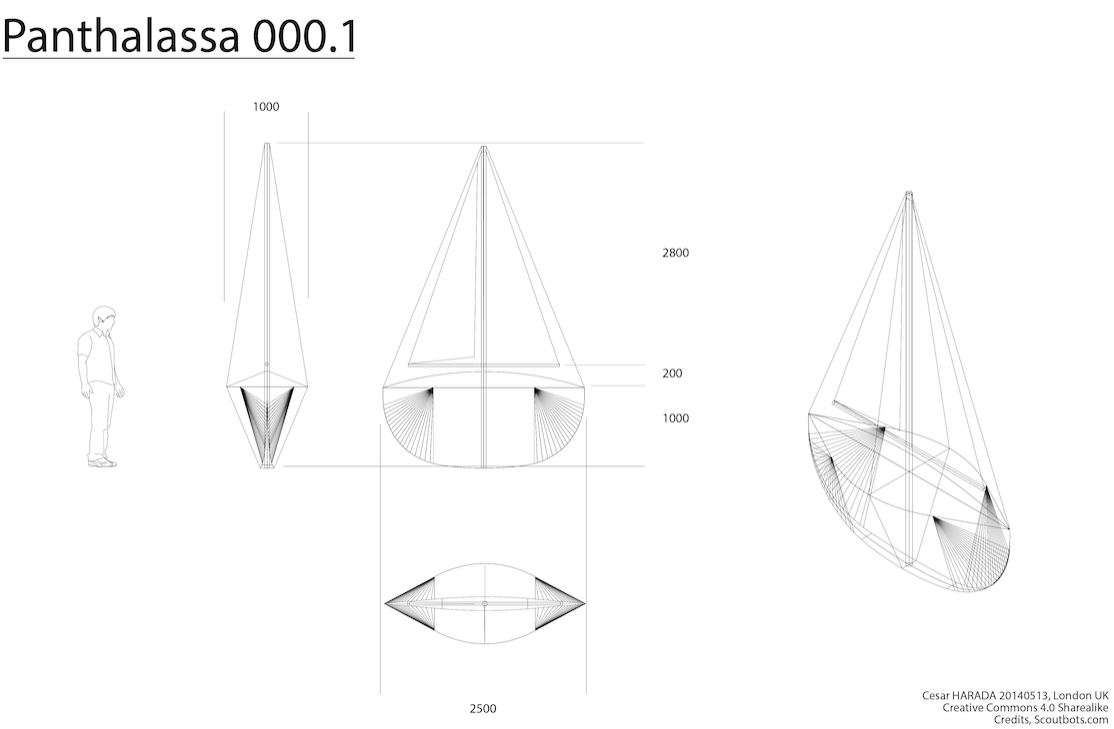
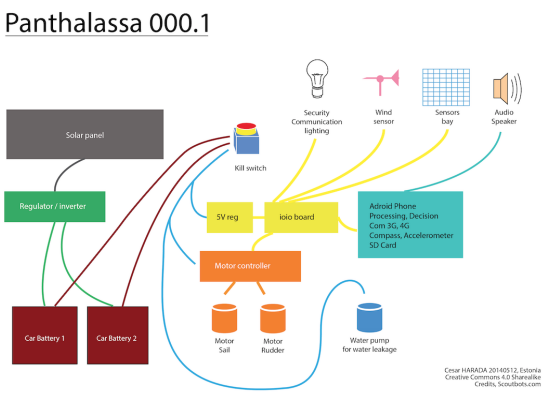
Panthalassa (concept), medium size for ocean science

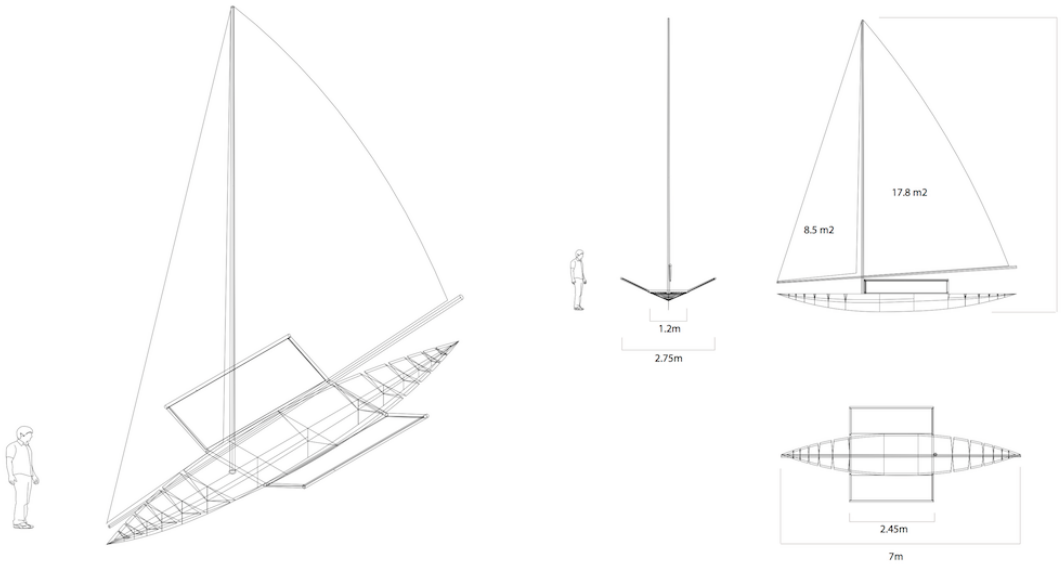


This image shows the design concept for a 2.5 meters autonomous self-righting sailing robot with 2 rudders, one at the front, one at the back, and a rotating mast. It is a very simple, low-cost and rugged design, very much an ocean buoy with a sail. The payload will be about 50kg, and it will be controllable via an android-phone for our first tests near shore. The overall hardware parts will be under 5000 USD for an estimated retail price of 12'000 USD. We will need to buy a lathe to build this machine and move into a bigger space. I have a simplified schematics for the electronics below.

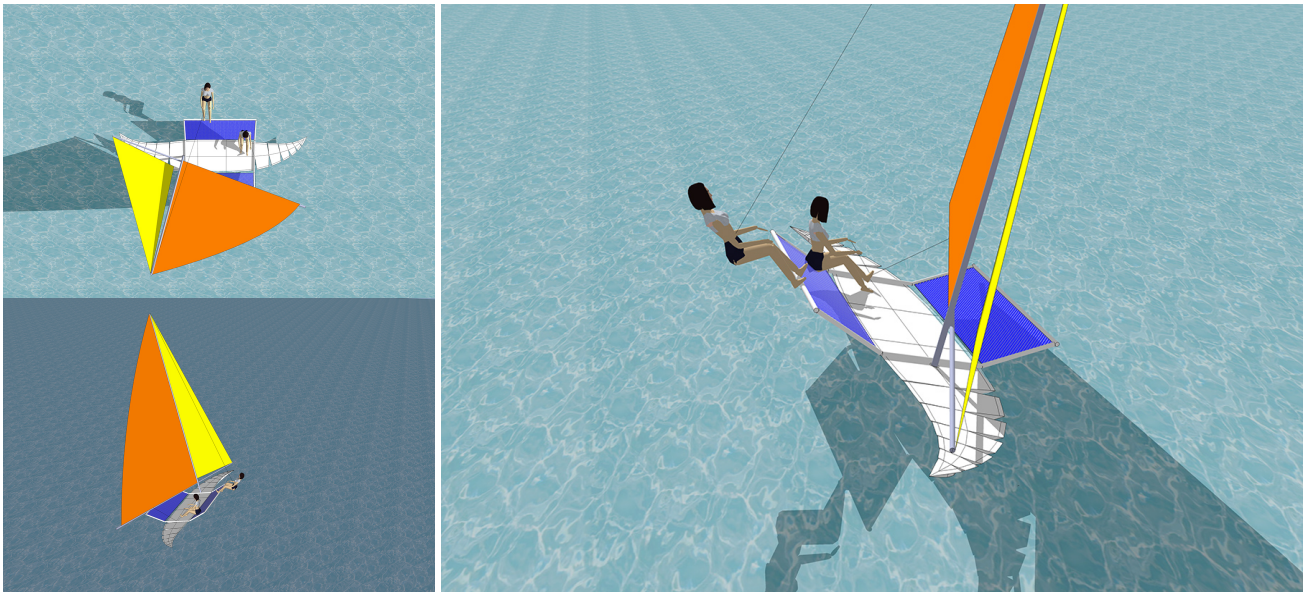


In this early prototype stage, we would use only conventional parts : regular marine-graded solar panels and accessories, car windshield wipers motors on worm gear, Android phone and ioio breakout board, windsurf mast on bearings, fiberglass hull construction… If we make this machine longer -4m for instance- it could be a truly competitive blue water vehicle for ocean science (see "Competition" p.17).

Protei 2 passengers (concept), large for leisure sailing



We had several requests for a two-passengers Protei. This is our initial design concept. A 7m dinghy, with a segmented hull equipped with overlapping fish-like flexible scales, generous sail surface area, 2 large trapezes, and a very small closed hull volume, like a windsurf or a moth to easily plane. There would be no rudder tiller but sheets to control the “trim of the hull”. The design will continue to evolve over time.



Windtrain “Baltic” (functional prototype) for research and hobby

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Protei headquarters in Hong Kong are still about 1 hour away to the closest windy ocean test site. We are so frustrated with the commute that we started developing a land-based Protei-like robot that we called “Windtrain”. And doing so, we made another surprising discovery.

Think about this physical phenomenon : when you are trying to park your car, you need to put a lot of effort on the steering wheel. By opposition, when you are driving on the highway at great speed, the smallest push on the steering wheel could get you off the road. That means, the greater the speed of the vehicle, the less energy is required to steer it.

In the context of a modular wind-powered vehicle, the more modules you have, the greater speed you can achieve. So in theory, the longer the Windtrain is, the less energy is required to control it. In practice, we managed to sail a 3.5m long Windtrain with the same motor with which we controlled a 6m long Windtrain. Please watch the videos here :

1. 3.5m Windtrain “Baltic” test in Tallinn Estonia
2. 6m Windtrain “heads or tails” test in Science and Technology Park Hong Kong.

What I like about this machine is not that it is a cool-looking machine, but that is an extremely energy efficient vehicle : I only need to control the angle of the front wheels, and that is it. A 6m vehicle - longer than your car - uses less energy than your phone when it rings. I think that’s awesome. We’ve discovered that on land, but now can we do this in the ocean? If you think about it, isn’t that how clippers work? Many masts! These boats have been our cargo ships for centuries and provided for the world we have today. Land sailing is not new as our Swedish friends in the black rock desert remind us! Modular land sailing is new.

Windtrain could become a new product for us that is simple to develop, cheap to manufacture, that more people could play with (because more people have access to road than ocean), and the science we would learn and the revenue it would generate could also contribute to Protei development.

Underwater radioactivity Sensor with Safecast (functional prototype)

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In October, we will go for the 3rd time to Fukushima, to measure radioactivity underwater.

In 2012, I cycled alone from Tokyo to Sendai all along the devastated coastline, measuring radioactivity with a borrowed geiger counter and a dosimeter on the ground, looking for the best place to launch Protei. I produced a radioactivity map of my cycling journey which I submit to Safecast.

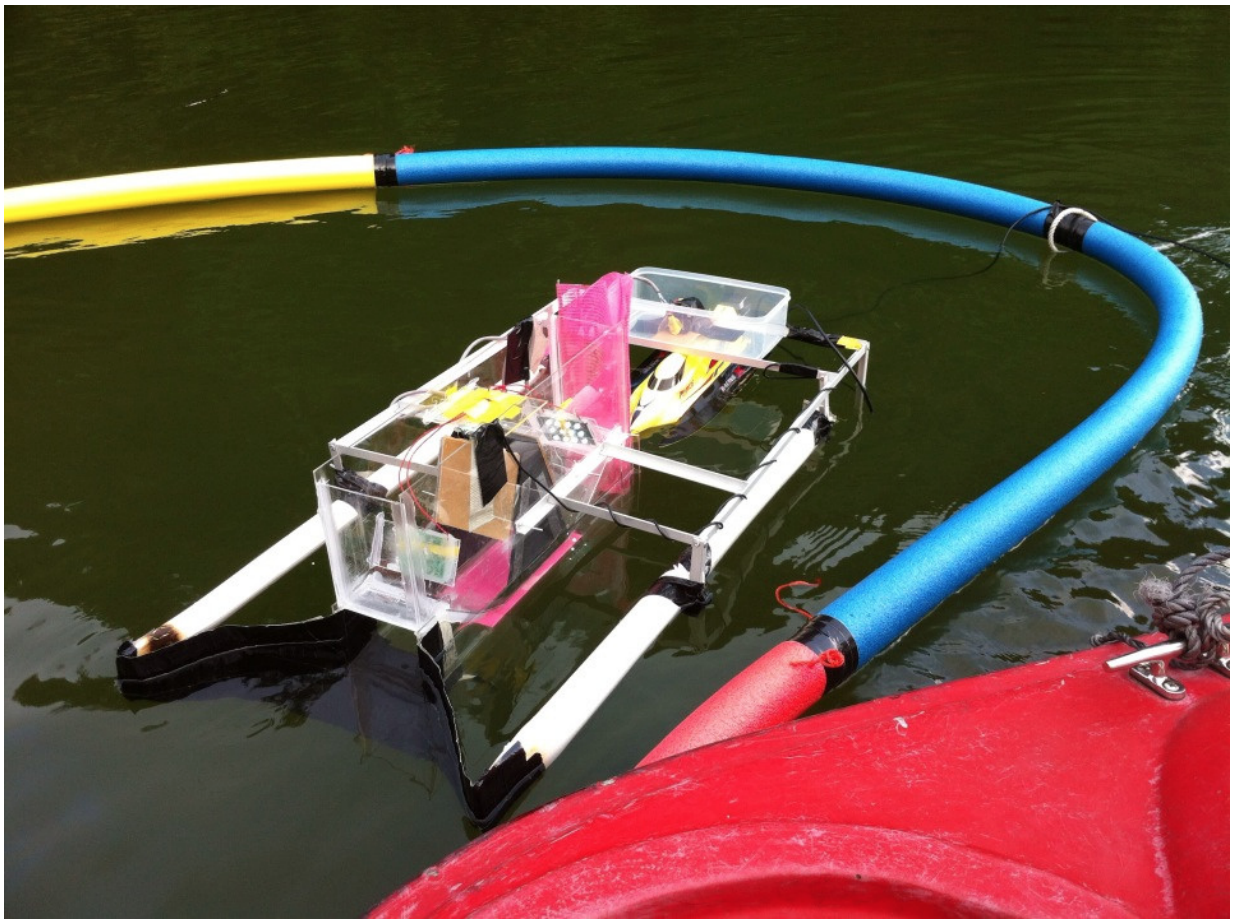
In 2013, Gabriella Levine, Joe Morross (Safecast) and myself drove from Tokyo to Fukushima and back to Kyoto and measured radioactivity underwater near the crippled powerplant. At our surprise, we found detectable levels of radioactivity in the water with a low sensitivity instrument.

In October 2014, we will go again and try to make a map of underwater radioactivity, especially of seabed that is not very well understood. We have a lot of work to improve our instruments.

Today the situation in complicated in Japan. The Fukushima power plant is currently leaking the largest amount of radioactive material in history into the Pacific ocean. Japanese energy supplier TEPCO and government representatives claim that there is NO harmful amount of radioactivity that propagates beyond Japan national waters. On the other hand, more than 70 US navy sailors who carried humanitarian activities in 2010 from a 100 miles away at sea from the power plant, have become plaintiffs, demanding 1 Billion USD for having developed various forms of cancers or giving birth of a baby with several genetic mutations. To make it more obscure, Japan has recently passed the State Secrecy Law that would allow Japanese authorities to jail anyone for 10 years who reveals sensitive information about Fukushima.

We are reasonable people, we will not expose ourselves to harmful levels of radiations, and we will comply with all authorities instructions. We do not want to develop cancer or go to jail, we want to peacefully contribute to science. Our goal is to provide independent radioactivity measurements to help Japan rebuild it's fishing industry and repopulate the Tohoku coast safely. Half of my family lives about 100km away from Fukushima and I really want them to live healthy, happy and prosperous.

Plastic optical sensor (early prototype)



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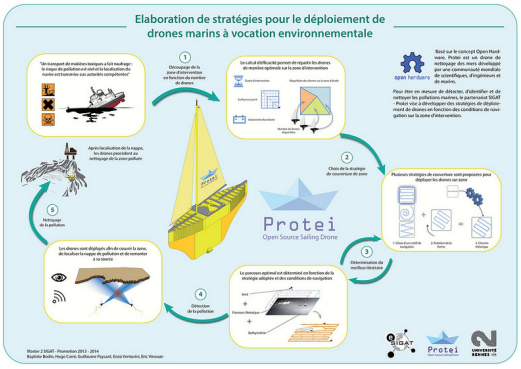
With a small group of very smart young students of the Hong Kong Harbour School, we have developed and tested a mobile plastic sensing robot. We have shared all the details about our machine on Instructables - a website where inventors share what they make. The machine is far from being reliable or automated yet, but we have the opportunity to make extensive testing of our improved device during a 5 day sailing journey around Lantau Island in Hong Kong from October 29 to November the 2nd. Although our device is crude, it is a critical and worthwhile research area. In the last few weeks, what we thought we knew about plastic pollution in the oceans has been challenged to the point, we have to admit now, we don't know where more than 99% of the plastic in the Ocean is located. The entire scientific community is having to re-consider all their assumptions and a optical plastic sensor could play an important part in solving this enigma. We are working on establishing research partnerships with Prof Wong in CUHK (Chinese University of Hong Kong) Computer Science Department and are being advised by Dr Pompea from the US National Optical Astronomy Observatory.

Writing, Education, field work planned

I have been writing a short paper on “Open Hardware for the Environment” for the French Editor Eyrolles that will be published in a few months, in French. I will continue to develop the content and illustrate that manuscript in English and I have found a publisher and distributor for the english version, for print. I have no clear deadline for the english publication yet.

In the last year, I have been giving workshops, seminars and lecturing at Chinese University of Hong Kong, Hong Kong Polytechnic University, Hong Kong Design Institute, International Christian School. I now have a fairly good overview of the top local universities.
From late August onwards, I am teaching an Invention class focused on environmental issues every saturday at the Hong Kong Harbour School. I am treated very well, as I was allowed to build an equipped workbench and recently was given a larger room to teach. The school also purchased a 40 feet 2 mast schooner (similar to this one) that I will be allowed to embark on to perform ocean science with the local students. I love teaching, it relaxes me, stimulates my imagination and allows me to share my passion for the ocean and creative technologies. Teaching only one day a week provides me with the stable income and visa, which a start-up does not. This makes me feel financially safe and forces me to take a healthy step back at least once a week from the business, to reflect.



We have recently completed a 6 month research project with Geo-data students at SIGAT Universite de Rennes 2 who worked on a software workflow so that multiple robotic agents collaboratively generate a map to make real-time strategic decisions. They did an impressive 100 page report in French following our bi-monthly meetings.
We have 4 students engineers in Paris France, ESPCI Paritech who will be researching the hydrodynamics of the shape shifting hull under the supervision of our partner SoScience for the 2013-2014 academic year.
We had 2 Hong Kong interns from the VTC network working at our headquarters who have been instrumental in developing all the recent prototypes.
One French Engineer from Ecole des Mines de Nantes with a major in Naval Architecture interned 6 months at our HQ and will soon complete his report on comparative study of a regular monohull with rudder VS a flexible hull maneuver capacity.
We have 1 student finishing his master thesis at the end of the summer on the hydrodynamics of an oil boom at TU Delft in the Netherlands advised by Etienne Gernez.
We documented the 2013 Lamma Island Oil Spill in Hong Kong and assisted with clean up operations.
We continue to build educational partnerships and documenting them on our wiki.

We are now preparing for 2 imminent expeditions :

- Early October 2014 : Fukushima Japan: Underwater radioactivity sensing, focusing on the seabed.
- Late October 2014 : Lantau Island Hong Kong, 5 days sailing collecting Plastic debris optical data.

Both expeditions will incur expenses and we are looking for supplementary funding for these 2 expeditions and further ones.

New Office and workshop. Why we moved to Hong Kong.

Protei office in Hong Kong. : https://www.flickr.com/photos/worldworldworld/14004560962/sizes/l
Protei workshop in Hong Kong : https://www.flickr.com/photos/worldworldworld/12853230455/sizes/l

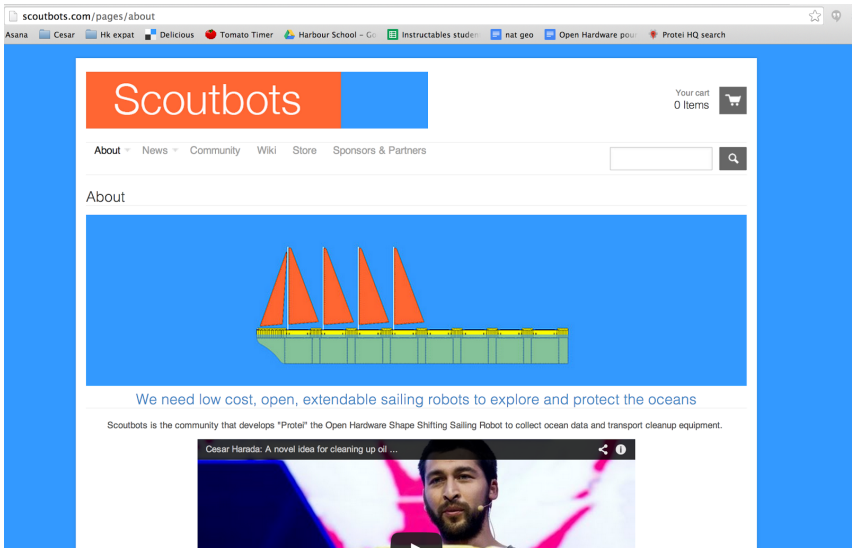
I have built our office and workshop in the New Territories. It is a great little building in a former chicken farm, but it is quite small and far from the water. We are looking to relocate into an industrial building by the water.

It is after sailing around the world for 4 months unreasonably at sea and visiting many of the world largest industrial harbours that we decided to settle down to Hong Kong for the following reasons :

1. **Geography** : surrounded by warm waters to test our robots year round, with a historical sailing culture and vacant shipyards.
2. **Fabrication** : The best place in the world to manufacture electronics, just a few kilometers away from Shenzhen. We have secured partnership with Seeed Studio, which is China's largest and fastest growing Open Hardware manufacturer and distributor.
3. **Issues to address locally** : We are at the center of the world's most densely populated area, with the most unaddressed environmental issues. Think about water pollution in India, China, Vietnam...
4. **Business** : Hong Kong is a leading city in the world's most powerful economy, and Asia's international business hub. It is safe and welcoming to English speaking foreigners, it has excellent tax conditions, hard working ethics, yet widespread copycat practices, which fits perfectly with our open-source culture. It also has free internet - unlike mainland China.
5. **Research** : A great academic infrastructure so we can find and retain talented engineers. And it has a vibrant creative industry.

There are very few soft robotics companies out there and we are the first marine robotics company in Hong Kong. The potential in the region is enormous.

New Website, Ethics, Values, License, Development method



Please check out our new website, www.scoutbots.com, where we sell Protei and other accessories. You will see our core values, and order of priority as we define ourselves more as an environmental business than a social business that has become such a buzzword.

Our work is now correctly licensed, and makes our partners feel safer when they work with us, thanks the precious advice of our Intellectual Property lawyer Andrew Katz, one of the authoritative editors of the CERN Open Hardware license we use.

We are proud of our rapid-prototyping method that we briefly describe on our people's page, for which we must thank Tom Chi for his teachings from prototyping Google Glass and Self-driving cars.

We have a wiki that is filling up day after day and our community is growing to be more than 50 international members. A lot of work needs to be done to organize the content in the community website to make it a vibrant and creative space. We will soon hold our first Google Hangout to discuss how to curate our content.

Media, Sponsors, Partners, Shareholders

Last week Protei was on Thalassa, on French National TV prime time. That day alone, we reached 2.4 million views. The TED talk I gave has now exceeded 700,000 views. Gabriella also reaches to crownds, and yesterday we had a full page article in the South China Morning Post which is widely regarded as Asia's equivalent of the New York Times. The media page is temporarily under construction on our website.

We have with 3 main partners : OPFLEX Solutions (USA), SOW Asia, Videotage (Hong Kong).

We have secured grants and sponsorships with 4 companies : Ocean Exchange (US), Seeed Studio (China), Shuttleworth Foundation (South Africa), Clean Five (France). We have used the sponsorship and grant money up until a few months ago. Since then, we are functioning with our own revenues and the funds we personally invest in Protei INC (US company) and Scoutbots LTD (Hong Kong company) every month. We are now looking for new sponsors as we are confident to gain increasing media coverage.

2. What is the potential of the shape-shifting hull? And of the company?

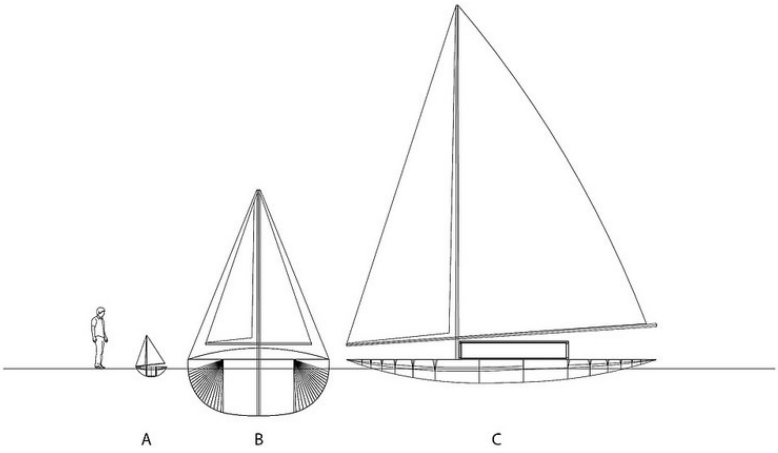
Applications

Asking what can be done with an autonomous vessel is the same as asking what could be done with self-driving cars or trucks : the possibilities are literally endless. We are primarily interested in ocean science and cleanup, but the technology of the shape shifting hull - as any high performance autonomous vessel - has a wide-array of applications :

- **Ocean data collection** :
    - Regular physical oceanographic data, temperature, salinity, acidity, turbidity, current, waves, wind, sun, cloud cover, sea-level, bathymetry…
    - Marine biology, Coral reef, fisheries, marine protected areas
    - Space Science, scintillation, ground verification of satellite data, study of the magnetic activity of the sun
- **Ocean clean-up** : Plastic, oil spills, excess algae, jellyfish, heavy metals...
- **Communication relay** : Land-sea (mobile phone antenna), sea-sea, space-underwater (satellite to submerged instruments, radio waves above water and acoustics underwater);
- **Distributed mesh networks:** low-cost global networks for data transmission on the ocean to distribute GPRS / GSM signal or wifi at sea;
- **Industrial** : anti-poaching / overfishing, mining, dredging, wind, solar and wave power site scouting, advertising, delivery of drugs, geo-engineering...
- **Security, Military**, surveillance, border control, intelligence, submarine activity monitoring (we do not support military or other malicious uses of our technology)
- **Cargo** : transporting solid, liquid and gas goods
- **Gaming :** Unique interface to allow gamers, kids and civilians to monitor and clean the ocean from the comfort of the home in a competitive but fun gaming interface
- **People** : unmanned and manned expeditions, leisure / hobby, remote tourism, professional transportation, researchers, isolated islands

Possible sizes of units

The shape shifting hull is a physical principle that can be scaled in size, or scaled in the number of units deployed to act as a fleet / swarm of robots.



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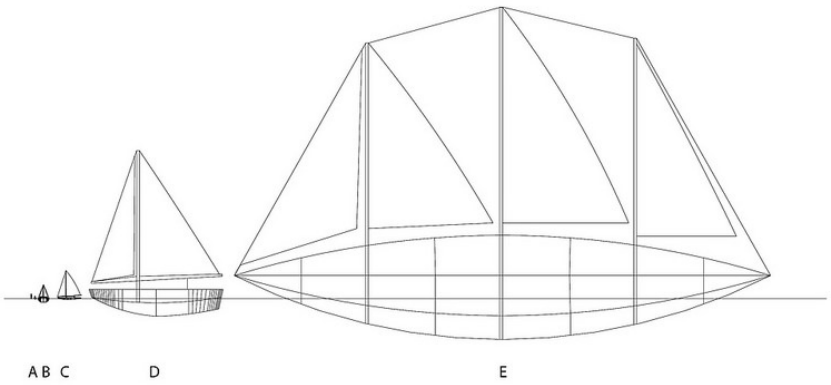
Below are some hypothetical sizes, materials and use-cases :

- **<1m for lab testing and hobby market "Protei" : (A)** small enough to be tested in towing tanks. Polycarbonate spine, EVA foam hull. Current retail cost is 1200 USD ready to sail with accessories and transport box.
- **>4m for ocean research " : (B)** large enough to sail against strong currents. Parts cost estimated at about 5000 USD. Retail price will start at about 12'000 USD.
- **>6m for leisure sailing : (C)** Leisure sailing for 2 sailors. Foam and fiberglass sandwich construction (similar to surfboard), stainless steel hinges.
- **>30m for transportation : (D)** superyacht / small industrial vessel. Aluminium hull, brass washers and stainless steel bearings.
- **>40m for cargo transportation : (E)** "Zeppelin-size", pressured air shape controlled. Could transport very large payload with very low risk, very low energy and financial cost.



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Markets

For prototyping, it makes sense to work at the small scale so we can iterate quickly. But as I explained, we expect the technology to be scalable in size and accommodate many different possible applications - and therefore markets. We have listed markets that would be the most responsive to a sailing robot.

- **Kids** : The low-cost toy market is immense and the sales of toys could support the company, grow a young community, support education, but at the expenses of our credibility, ocean research, and human resources.
- **Hobby market** : The hobbyists are willing to spend time improving / hacking and sharing their experience and designs online. They are great community members, and they are willing to pay the price and wait some time to get delivered quality products.
- **Citizen scientists** : These are a small but growing active market of enthusiasts that make relevant use of our technology; they're rather extreme users, that are eager to improve and share. They often work on on-going news-covered events so they may be the best evangelists of our technology.
- **Ocean Science** : Ocean scientists working in the industry or in academia will become our main target when our technology is more mature. They need our surface vessels for many applications. The finances available from this market greatly varies from one client to another, but most of them can add their own sensors to our boats, and publish their findings, which in our eyes is the best promotion of our technology. It may be a small market regarding number of boat sales, but it has a very big environmental, health, social and economic potential.
- **Industrial** : Fishing, oil & gas, telecommunication, cargo, industrial transport, civilian transport.
- **Military** & **Illegal** : We do not, and will not support any illegal or malicious use of our technology.

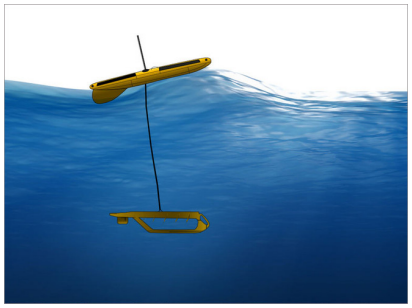
We are now targeting the Hobby and Citizen Science market. When our products are more stable and large enough to carry significant scientific payload, we will move towards ocean science and industry. If the community call is strong enough, we will also move towards education and kids.

It is a very hard task to evaluate the volume of each of these markets. For instance, 90% of world trade transits by ships, and 70% of the planet surface is covered by water. That's the size of the market. Trillions of USD and most of the earth's surface to be served. Again, developing low cost, safe, open-source, low energy wind-powered autonomous vessels has great potential impact for the life of everyone.

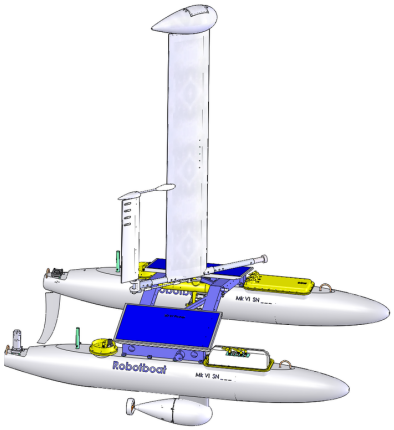
I am often asked : "If you give all of your designs away, how do you make money?". I wrote a blog post about it, and many others have answered this question. Just as Open Source software companies like RedHat have now over 1 Billion USD turnover, I don't think it is any longer necessary to explain how open source can be profitable.

Competition

Of the renewable energy powered ocean surface vessels that exist, there are currently only 3 commercial solutions :



- **Waveglider** : http://liquidr.com/technology/waveglider/sv3.html
  Started in 2007, Waveglider has proven extremely endurant (although slow) and versatile, but is extremely costly, approximately 250,000 USD for the machine and about 7000 USD per month of operations. As a consequence they serve mostly the oil & gas industry, the military, and the world's best-funded ocean institutions. In April 2013 Liquid Robotics had already raised privately more than 85 million USD and about the same amount in public research grants, supported by a 120 person team, which exemplifies that there is an immense market for surface vessels. Protei is following in Wave Glider's footsteps, winning a prize they won (Ocean Exchange Navigator grant), but we are going for low cost, open source and wind-powered robots.



- **Robotboat** : http://www.automarinesys.com/technology.
  They have a lot of hours at sea, but few Robotboat units are in operation in my knowledge. They claim to be a low cost solution but they do not disclose their retail price. In case of storm and capsizing, the mast needs to be pivoted down to right the catamaran. I understand the mechanical process but this design is quite vulnerable to rough seas with all its appendages in my opinion.

- **Saildrone** : http://www.saildrone.com. The saildrone is a high performance machine, but the cost of operation is 7000 USD / day. The boats currently goes out to sea, but the technology is under development and not yet commercial. Since Saildrone is developed for high speed, they are not optimized for the low cost or open source market that we target.

There are other sailing robots like the Harbourwingtech X1 (supported by military), The Scout Project, Roboat, Vaimos… are either impossibly expensive or solely academic projects with no declared commercial ambition.

Protei / Scoutbots have several advantages on these market competitors :

1. **Low cost** : With a 4m long, 50kg payload of equipment, we are looking at a 12'000 USD retail priced machine. We need to add on top of that the communication cost (which can be as low as 25 USD / month for coastal science in the 3G range), the sensors being specific to each mission. Protei is very much cheaper than any of our competitors - thanks to the low cost of goods in China and our open source decentralized R&D.
2. **Modular larger payload** : The shape-shifting, modular architecture allows us to increase the weight of on-board payload, or payload pulled behind the boat.
3. **Rugged design** : The ocean is one of the toughest environments on the planet - so why try to oppose its force? A flexible hull bends, it does not break (it is our hope for now and needs more testing). A monohull with a lot of ballast self-rights more gracefully than any multihull boat.

4. **Open Source** : Open Source allows us to work seamlessly with Industry, academia, governments and makers. Using android phones on our boats opens us the world largest mobile app community, many of which are in developing countries (our target).
5. **Global Innovation Community :** decentralized development, that's a direct consequence of being Open Source.
6. **Fast prototype development method** : Over the years, prototypes after prototypes, hackathons after hackathons, we have developed ways to build and test our sailing robots in record time. In a fast changing landscape, this may be our long term advantage.
7. **Mission and ethics** : being open-source and for the environment attracts and retains good hard working people. So we will stick to that. Instead of focusing where money is (oil & gas and military) we are addressing the issues people and scientists are concerned with.
8. **Hong Kong and China** : WaveGlider, Roboboat and Saildrones, almost all of them are Americans. China has become the world most powerful economy and Hong Kong is it's international business hub. Just across the border we have Shenzhen that is the beating heart of the world's electronics and mechanical manufacturing. This part of Asia is the world most populated area, and it's got the greatest unaddressed environmental issues, water pollution being a major one. We are where we make things, near the problems of clients.

3. What is Protei's goal?

Protei's mission is to explore and protect the oceans, that means collecting oceanic data and being capable of transporting equipment such as cleanup tools.

Our main success indicators are :
1. **Environmental impact** (data points, metric tons of pollution collected)
2. **Social and health impact** (CO_2 offset, projected health improvements)
3. **Technological progress**, learning, sharing knowledge (sailing performance, tested ideas, derivative projects that sprout from Protei's shared designs and documentation, new sensors developed)
4. **Financial success**, for the communities we work with, for ourselves

Our indicators are directly connected to our ethical order of priorities (1 Nature, 2 People, 3 Technology, 4 Money). We want to be the model for OSHW (Open Source Hardware) companies for the Environment.

To achieve success, our goal is to develop :
- **Product** : Best autonomous sailing robot, combining industry standards in an innovative technology and product.
- **Community** : Open Source culture with the best global community
- **Accessibility and relevance** : Low cost and easily replicable so our technology can be deployed in developing regions
- **Centralized hub of knowledge** : Online database containing resources and knowledge about ocean science and cleanup.

On the middle term we are focused on data collection and pollution clean up, but we are aware that this technology has tremendous potential as communication relay, transporting cargo and people safely with low energy and environmental impact.

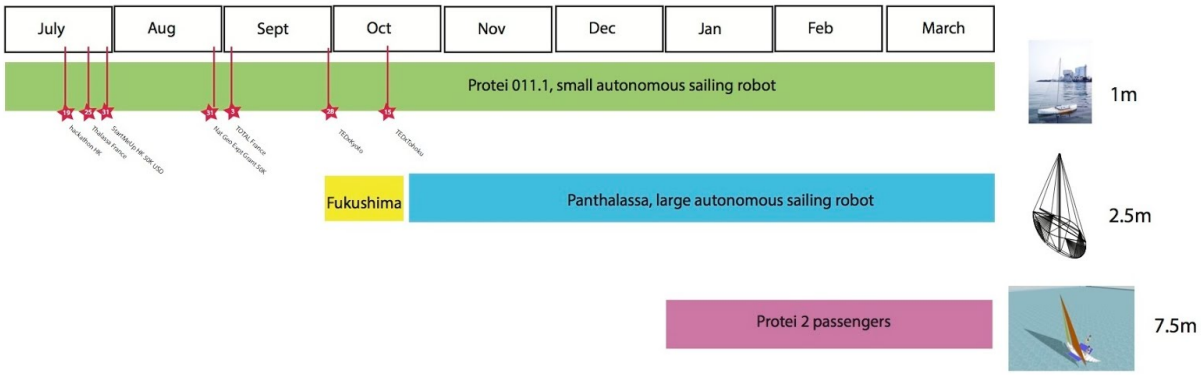
Full stack company, hardware, software, data, analysis

We want to become a full-stack company eventually. We are starting by focusing on hardware but in the future, we would like to provide the full chain of actions, so we can provide “full-service”. Which means :

1. **Hardware** : boats and accessories
2. **Software** : on the boat (embedded Android App), on the server (web application), on the client side (Computer web portal, mobile device app, multi-player video game)
3. **Data** : ocean raw data sets, real-time and archived
4. **Analysis** : analyse data, publish papers, industrial and governmental report to inform decision makers

Once we have a good grasp over the full stack, then we can provide a “full-service” for ocean data, clean-up, services, transport of cargo and people.

4. What’s the timeline?



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We will progressively shift our main focus from one project to another over time to explore the potential of our technology:

- **Aug, Sept**: Ship all the Kickstarter backer rewards. Improve Protei 011.1 with rotating mast (on the small boat) and improve sales. Set up and staff a small scale fabrication line. Prepare Fukushima field trip. Invite collaborators to power our sailing robots with Android phones.
- **Oct** : Fukushima underwater radioactivity sensing. Late October : plastic sensing sensor development.
- **Nov, Dec** : Panthalassa (medium size boat) also Android powered, a larger rugged unit to carry heavier payload. In 2 months I believe we can build 2 early prototypes.
- **Jan, Feb, March** : Protei 2 passengers, for leisure sailing.
- After we have explored our technology at these different scales, let’s discuss what is most relevant.

The reason why we are going through these different prototypes so quickly is because we may have the financial means to expand the team, relocate close to the water, have enough budget to buy the materials for building these machines. We have potential funders lined up. If we receive a large amount of funding by mid fall, we can accelerate our growth and progress. Alternatively, if a new sponsor, a grant, a donation, a client to buy the boats, or a mission was coming in, we could move forward with the proposed strategy or faster.

To work better and faster

To reiterate, what would allow us to work faster and better to achieve our goals would be

1. **Space** : Moving to a larger workshop by the water, so we build and test very fast.
2. **People** : Growing the team, including an electric engineer, Software developer for Android, Naval architect with a strong interest in Biocomposites, Business development person to write grants and drive sales (doubling as marketing and community developer).
3. **Money** : Having sufficient capital to buy tools and materials to build and test the boats.

I want to go back to a weekly test schedule as we have done in the past to develop Protei 011.1:

- monday : create, design, discuss
- tuesday : buy materials
- wednesday, thursday : build
- Friday morning : test in the ocean
- Friday Afternoon : write report and share our experience with the community online.
- Saturday : rest while the broader community studies the report and proposes improvements and new ideas.
- Sunday : meetup online with the global community to discuss these new ideas.

Repeat this cycle, until the technology is performing highly and reliably enough to make a public release, going from prototype to product.

We have worked in this week cycles very successfully, producing up to 3 robots / fabrication techniques in a single week (crazy man, Pop corn, Dino). Or 2 robots in one week, one that has a fixed hull and another one with a shape-shifting hull of the same size to compare performance (image on the right). I want to increase the team size so I can drive production for sales alongside fast paced R&D. This 1 week turnover works very well on small 1m long boats. For larger units, we can stretch that same method to 2 or 3 weeks if necessary. With open hardware, even after the technology has become a commercial prototype / or beta product, the development continues with the wider community tests and feedback.

5. How can I get involved?

- **Sponsorship** : right now sponsorship is the way to support us that gives us most freedom, and exposure for you. Depending on the level of sponsorship, we may be able to address some of your strategic concerns, and contribute to your company development.
- **Buying boats** : That is very straight forward. You pay us to build and perhaps operate boats for you.
- **Modifying and Documenting :** Add your own sensors, modify Protei for your own needs, collaborate online, and document your work. This is essential for our community contribution to grow a knowledge base around ocean sensing.
- **Investment** : We are happy to work with investors that understand that our success criteria are Environmental, Social, Technological, Financials. We are currently financially stable and we are looking to grow slow and strong. This is a new technology, a new market that we are looking to build. It is going to be a long term investment.
- **Advisory board** : We are currently putting together a small team of world class advisors around those expertises #Ocean #Robotics #OpenHardware #Innovation #Entrepreneurship.
- **Staff** : we will soon advertise for interns / volunteers (employees if we are funded enough)
    - Electric Engineer, with passion for robotics
    - Software developer, with experience in Android and real-time apps
    - Aeronautical engineer / Naval Architect with interest in bio-composites
    - Community and Business development, sales. Helping with general administration
- **Introductions** : If you know anybody that could be one of the above, please introduce us.

6. Conclusion

We are living a very exciting adventure. We are starting to sell our first products and we can see ourselves becoming very competitive soon in a huge market that can have a global impact. We are at the right place, at the right time. Will you join the adventure?

If you have any questions please comment on this document. I am available by :

- email : admin@scoutbots.com
- phone (Hong Kong time zone): +852 9610 8167
- skype : cesarminoruharada

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