



PhysioPlux

Eva Maria Veitmaa, University of Twente, e.m.veitmaa@gmail.com

Matteo Mainenti, KTH Royal Institute of Technology, mainenti.mat@gmail.com

Petter Jakobsson, Université Paris-Sud, petterjakobsson.gbg@gmail.com

Ming Yao, KTH Royal Institute of Technology, yyaomingm@outlook.com

EIT Digital Summer School I&E students project report

Longer Independent Living, Lisbon, 30 June - 13 July

The EIT Digital – European entrepreneurs driving digital innovation & education

EIT Digital

www.eitdigital.eu

Table of contents:

List of tables	2
List of figures	2
Executive summary	3
Problem and solution	4
Business modelling and planning	7
Business modelling	7
Business planning	12
Business development process	15
Self evaluation	20
References, web links	245

List of tables

Table 1. Cost of a device per month	14
-------------------------------------	----

List of figures

Figure 1. Physiotherapy cycle	6
Figure 2. Comparative competition matrix	11
Figure 3. Market adoption list	13
Figure 4. Design thinking & co-creation process	17
Figure 5. Concentrated & polycentric population growth	18
Figure 6. Startup financing cycle by Gonalo Amorim	19

1. Executive summary

Background

The world is expecting an unprecedented aged society where the burden of taking good care of those people is heavy. The best way to solve it is preventing. Physical therapy as a specific problem in this context, if tackled well, can prevent people suffering from chronic muscular-skeleton diseases. That could alleviate the burden of the whole society in future because around half the population are suffering from muscle pains which can drag their work performance or even prevent them from working. Beside the direct cost, the indirect cost is up to 5x more.

Proposition

PhysioPlux is a Portuguese company which already has a relatively mature product equipped with advanced technology to help both patients and doctors conducting physical therapy activities. With the help of their product, more patients can be helped and better effect can be guaranteed, plus, the cost could be lowered.

Market

We've chosen the US market as our first target because it is the largest single market for rehabilitation industry. Also because they have around 18,000 private physical therapy clinics that are capable of paying for new medical devices. Furthermore, it has a roughly \$30Billion market size in this area which account for around ¼ of the global market.

Acknowledgement

Thanks for PhysioPlux providing us an opportunity to visit their office and offered us a set of product for demonstration.

2. Problem and solution

a. Case, case provider and context of the case

The physioPlux case was presented to us by Plux and Fraunhofer Portugal [1]. The case revolves around a biofeedback technology that uses electromyography to measure muscle activation levels and provide biofeedback to the user. Biofeedback is a technique in which the user is connected to sensors that observe and give back information about the user's body [2]. Based on this information, the user can control and change the measured body function (e.g. heart rate or muscle contraction). Biofeedback is often used to improve the general physical performance or for treating a certain health condition.

Currently, this technology is being used by Plux to facilitate the recovery process in physical therapy. The noninvasive sensors can be attached to the body using special EMG stickers. PhysioPlux sensors can measure every close-to-surface muscle on the body, but work the best in case of treating a shoulder, knee, or pelvis injury. PhysioPlux sensors provide biofeedback via a corresponding mobile app interface.

Some products from the physioPlux line include physioPlux Clinical, physioPlux Trainer, and physioPlux Go. For our project, we decided to focus on physioPlux Clinical and physioPlux Trainer.

PhysioPlux Clinical is designed to be used by physical therapists in a clinical setting. With physioPlux Clinical there exists the possibility of measuring up to 8 channels of EMG. These sensors are not completely wireless, but instead connect to a hub that gathers together information from all of the different measuring points. The gathered data is presented to the physical therapist via a tablet application interface. The therapist can use that biofeedback to analyse and diagnose the injury. An appropriate treatment for the injured patient can be prescribed via the same application interface. In addition, the app provides the therapist with a communication channel with the patient as the therapist can change the prescription of exercises the patient needs to carry out independently based on the feedback given by the patient throughout the recovery process.

PhysioPlux Trainer is a set of sensors that the patient can take home with them to carry out the exercises the physical therapist has prescribed them. The sensors measure the activation levels of the injured muscle and provide the user guidance based on the therapist's prescription via the mobile application interface. Based on the biofeedback, the patient can adjust their way of doing the exercise, so as to train more effectively and efficiently.

Combining guided training sessions at the therapist's office with the independent exercises carried out using physioPlux Trainer, the treatment time becomes 50% shorter. Clinics using physioPlux report a 75% decrease of recurring injuries.

PhysioPlux is currently being used in a variety of physical therapy clinics in Europe, including Portugal, and is undergoing clinical trials in the Netherlands.

b. User's problem/need and market

Despite having a great technology, the company struggles with the wider commercialisation process of physioPlux. When trying to spread further from Portugal, many clinics in other European countries were not interested in collaborating.

To be able to work together with insurance companies in the Netherlands, additional clinical trials in the Netherlands were needed to demonstrate the viability of the technology. However, clinical trials are time-consuming and expensive. Therefore, it is not feasible to carry out clinical trials in every country physioPlux wishes to expand to.

On the other hand, 33% of the world's population is affected by musculoskeletal conditions [3] and, thus, creates the potential customer group of physical therapists. Clinics, however, have a limited amount of resources available to treat those in need. This causes the rooms in the clinic being constantly occupied and the therapists having a high workload, but despite all that, the waiting lines for an appointment still drag into months. In fact, 91% drop out of therapy due to long waiting and treatment times [4]. Discontinued recovery process raises the possibility of a recurring injury, which in turn means a higher workload for the clinics.

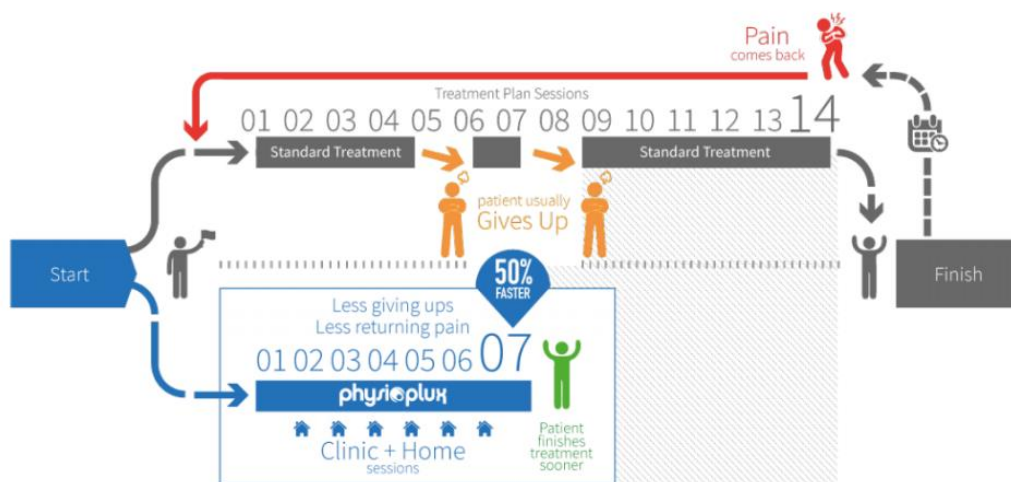


Figure 1. Physiotherapy cycle

In addition, having to wait for treatment and having to commute to the clinic for the treatment, needing to do it over a prolonged period, and having an injury come back lowers the satisfaction level of the patients. This can be detrimental to a clinic's reputation and, as a result, the customer base, in case of a patient blaming the clinic for their failed treatment.

To conclude, the two main problems identified in the field of physical therapy are the low throughput of the clinics and the threat of reputation damage. These are the aspects we decided to focus on during this project.

c. Solution proposed

Since physioPlux is already an existing application for that specific biofeedback technology, we did not see it necessary to reinvent another product based on the same technology, especially since physioPlux is already facing some difficulties in their innovation process.

Due to the disunity of the European market and the difference in regulatory requirements between various European countries, we decided to focus on expanding physioPlux to a more unified market. We chose the USA as the next market to enter due to it having the same healthcare system for all states. Hopefully, proving that the technology works as promised in the US will also help gain credibility in the eyes of European clinics and, thus, enable entering various European countries without having to go through extensive clinical trials in each country separately.

The reason for settling on the USA was mainly its high treatment prices due to the country not having a national healthcare system [5], the prognosis of the country having 40,800 unfilled positions for medical professionals by the year 2030 [6], the increasing number of patients enrolling in private healthcare plans [7], and health insurance providers focusing more on incentivising healthy behaviour [8].

In addition, we see the medical institutions of the USA as a leader and influencer in new technology adoption. Being approved by the clinics in the USA is highly beneficial for the reputation of physioPlux in the whole world. As a matter of fact, physioPlux products already have the FDA approval which was also an influencing factor on choosing the USA as a next logical step in commercialising physioPlux.

d. Nature of the innovation in the proposed solution

In this case, the nature of the innovation was not coming up with a new product or service or a new domain to apply the existing technology in. Instead, we chose to go with market innovation - finding a new market for an already existing product. This was due to the fact that the product is already in use in some European markets, but not as widely as it should.

e. Role and impact of ICT technology in the proposed solution

In the proposed solution, the biofeedback technology physioPlux products are based on, is not changed. Instead, it is taken as a basis for expanding the existing technology to new markets. However, since the biofeedback technology in itself is what we were working with, it played a major role in the proposed solution.

In addition, we use ICT technology as the main provider of the sales and marketing channels - an enabler for reaching the potential customers in foreign markets.

3. Business modelling and planning

3.1 Business modelling

Business model

In the focusing we will focus on the main points of our Business Model Canvas, starting from the customer segment. Our customer target are both private clinic and physiotherapists , since our technology's main objective is to give to the customer a precise feedback related to the analysis of the movement of the person wearing the sensors, so we decided this that target would be the one that could profit the most from buying our product, plus we the decision was taken also on data gathered on the US market of physiotherapy, which will be explained in one of the following section of this paragraph.

Our customer relationship will be based, after the beginning of the monthly subscription, in a continuous support, which will be able to help the customer whenever they need. Not only we will help them when they need technical support, but in the monthly subscription it's included also a constant update of the version of the software, which will never be out of date. Plus, if any of the purchased devices might have any problem, we will provide assistance substituting the broken sensor with new ones. Thanks to this service we hope to keep our customer fully satisfied with our product. Moreover, giving them the possibility to decide upon the number of rented devices we will give them the possibility to manage the number of possible customer per time at their best.

Our key partners are the following:

- Insurance companies: We believe that the end-user of our products (the patients of the physiotherapists) might be able to use the utilization of our sensor as a proof of their wealthiness, which is a factor that could be noticed by the insurance companies, charging them of a lower insurance fee.

- Exercises library developers: Since our product to work need the library containing all the exercises we thought that the developers of these might be the perfect partners for us, since without their help our product wouldn't be in the stage where it is now. Plus, thanks to the feedback from both patients and physiotherapists about the precision of the software we might be able to give to the developers precious information to improve their programs.
- Research centres: Our technology is at the moment utilized for research on physiotherapy. This is a chance for us to spread the word on our product , so that the better the results from these researches are, the more our product will be spreaded among the experts in this field.

Our plan at the moment is to reach our customers raising the awareness on the data that we gathered about the increasing amount of people damaged by musculoskeletal conditions and letting them know that our product is an improvement in the field of physiotherapy for the reason explained in the value proposition part. We thought that the best way to get us known by the community of doctors and researchers is through the event like conventions or fairs in which we will be able to show our technology and its result to our future customers. Plus, another interesting point in which our targets gather are the online community, in which they share opinions and ideas on their job. We believe to be able to reach more and more customer taking part in those forums or website, being able to convince more and more experts to try PhysioPlux.

Our revenue stream will be based on the monthly subscription to rent the devices. In fact we will charge the customers 100\$ for every PhysioPlux Trainer and 150\$ for PhysioPlux Clinical. We decided to use a monthly subscription since we believe that thanks to this method every physiotherapist or private clinic might be able to manage the quantity of devices rented depending on the quantity of patients that they have to manage at the same time, so that they might be able to return some of the rented devices in case that they will have to deal with less patients at the same time, or to order more in the opposite case.

Value proposition

The technology developed by PhysioPlux has several advantages for their clients and to the world of physiotherapy in general, since the following points will be the main motivation to encourage the experts to adopt this new way of visiting and take care of the patients. The most important of these advantages is the possibility to have the patients training from home, thanks to the differents components of our technology (the sensors, the software and the remote cloud) any patients will be able to perform different exercises without having to reach the studio of the physiotherapist.

Moreover, thanks to the sensors and the real-time feedback, our technology will be able to provide informations to the end-user of the technology, letting them know if the exercise is executed in the right way, as it is supposed to be done based on the software informations. These informations inside the software relative to the exercises' execution come from a library containing data provided by several physiotherapist to ensure that the exercises are executed in the same way as they would be executed at of the studio of the doctor.

Another point very important in our value proposition is the technology used, which changes completely the approach to the execution and the analysis of the information, in fact most of the technology inside of the HealthTech environment just track the movement made by the patients and give a feedback. Our technology instead is able to read the EMG signals created by the muscles during the execution of any

movement. Thanks to this type of input we are able to understand if the end-user is executing the exercise giving the right amount of pressure to the right muscles, avoiding the risk of utilizing different set of muscles, which would ruin the result of the treatment in course.

Speaking about the functionalities for the physiotherapists, from the result of the PhysioPlux Clinical (composed by a full set of sensor able to cover a body-part of the user) the doctor is able to find the issues of his patients in a faster and easier way. Afterwards, thanks to the support Software developed by PhysioPlux the physiotherapist will be able to assign the mandatory exercise on the profile of the designed patient and check his/her improvement or execution of exercises at home directly from the studio, avoiding to find a gap in the usually busy schedule of a physiotherapist for an extra appointment.

Our technology promises to decrease the amount of session needed to recover from an injury by 50%. In fact, data show that usually a full-recovery lasts 14 weeks after the patient can stop the treatment, but thanks to the utilization of our technology this number gets decreased to only 8 weeks, decreasing also the possibility of the injury to come back after a long time, which sometimes can happen in the traditional physiotherapy. This means that one of our proposed value are the decrease amount of session needed by every full treatment, which increases the throughput of patients of every doctor, which will be able to manage more patients at the same time without decreasing the quality of the service.

Market segments

As explained the the sections above, our main target will be physiotherapists based in the USA. We chose the USA for several reason, first of all because of the lack of a national healthcare service. This means that people will have to pay to receive the desired treatment, which most of the time will come up with a large expense of money. Typically a session from the physiotherapists costs from 50\$ to 350\$, so we thought that since our product's first aim is to reduce the number of session, this was the best market to have the highest possible ROI. Plus, there are several data helping our proposal for this market. It's calculated that the 82.8% of retirees in 2017 made use of private healthcare, each one spending in average 5000\$ for medical expenses in a year, this means that more and more elders in the latest years decided to choose the private services, which will be a perfect end-users for our sensors and they might also save on their money, depending on the utilization that the physiotherapist will do of our product. Moreover, since one of our value proposition is the increment of the throughput for every doctor, we found data regarding the number of physiotherapists per patients, which is 2.6 doctors every 1000 patients, which makes us come back to the topic stated in the paragraph regarding the Problem, which stated that it's hard for a physiotherapist to handle a high number of patients per time. Lastly, the percentage of American switching from public to private healthcare increased by 20% in the latest 13 years [5].

Competition

Our competitors all act in the field of physiotherapy, giving to doctors and patients different types of devices and opportunities. In the following we are going to explain the differences between our product and theirs. We based our differentiation mainly on the technology utilized, the price, the possibility to have a digital library containing the exercises to execute at home, the wireless capacities and the possibility to have a real-time feedback.

Our first competitor is SwordHealth [9], a company that developed a device which gives the possibility to the patients to exercise and rehabilitate at home, thanks to the utilization of a specific device which gives them a real-time feedback. This description is very close to the product that we want to sell, but it doesn't take care of certain details, for example in this product is possible not to receive the physiotherapist's opinion, which makes the rehabilitation managed by the patients only, probably with worse results. But the most important lack of this technology is how they receive data from the user, in fact they don't have any type of EMG sensor, which are able to give the best feedback, they provide only a movement feedback thanks to some belts which the patients have to apply to their body and thanks to the movement executed they get to know if it's done in the correct way or not. Unfortunately only the position and direction feedback is not enough to give a good feedback about muscle rehab, since a movement can be done correctly even without utilizing the right set of muscles.

Another competitor already established in the rehabilitation field is ReWalk [10], which provides an exoskeleton that is able to help the end-user to ease their movement and helping them to rehabilitate from injuries at the same time. This type of technology doesn't provide any type of sensor but it's spreadly used among physiotherapists, but even if it might help them reaching the final objective, the price of this exoskeleton is way higher compared to PhysioPlux, moreover the utilization during the physiotherapy session needs the help of the physiotherapist, which has the job to keep a constant and closer attention to the patient utilizing ReWalk. This is why with our technology we aim to reach the same results, keeping the physiotherapists less busy as possible so that they can focus on more patients at the same time.

The last two competitors are JTech [11] and MyoTrac [12], which both developed a technology able to read the EMG signals from the body of the patients, giving a real-time feedback of the effort put on the muscle of the users of the sensors, which helps the physiotherapists to understand where the treatments for the patients need to be done. These two technologies unfortunately don't allow the end-users to bring the device at home and don't have any type of software library for the exercises, plus the price to buy one of these it's overwhelming compared to the price to which we sell our PhysioPlux.







	 ReWalk Robotics	 Traditional physiotherapists	 Jtech	 MyoTrac INFINITE	 SWORD HEALTH	 physioplux
EMG	✗	✗	✓	✓	✗	✓
Wireless	✓	✗	✗	✗	✓	✓
At home usage	✓	✗	✗	✗	✓	✓
Realtime feedback	✗	✓	✓	✓	✓	✓
Exercise library	✗	✗	✗	✗	✓	✓
Price	N/A	\$50-350 per session	\$2000 one time cost	\$3000 one time cost	\$500 per month	\$200 per month

Figure 2. Comparative competition matrix

Market potential of the proposed business

At the moment, the total Physical Therapy market in the USA is calculated to be worth 30 billion dollars [13], while the outpatient market for private clinics covers 12 billions of this amount. In the USA are present 18.000 private clinics and a growth of 7% per year is estimated. This is the actual potential of the market, but going deeply we can understand that there are three main factors which feeds the growth of the market which are the aging of the population, that increases the possibility to have patients, the anti-opioid campaigns, that makes people look for new type of treatments to reduce their pain, and the new type of technology , like ours, which allows the people to have a better treatment with a lower waste of money [14].

Benefit/competitive advantage of the product or service

As we stated in the previous sections, one of the competitive advantages that our product has is the possibility to give a real-time feedback with very precise information which come directly from the EMG released by the muscles during an exercise. This type of precision and technology is an advantage compared to our competitors, but we don't only want to give more possibilities to our customers, we also want to give them all of this to a fair price. In the price of the monthly subscription it's included also our customer support for helping the customer or to give maintenance in case of problems with the devices.

Plus, we include in the price the possibility to be always updated on the new version of the software containing new type of exercises which can be executed by the patients in an easy and intuitive way. All of these possibilities and advantages are included in the offer of our product, which comes with two months of free trial, so that a physiotherapists can try and successively believe our value proposition and what differentiate us from the rest of the competition, so that after the trial period they will start to pay for our monthly subscription for a prosperous and continuous collaboration with us.

Ethical, societal, sustainability considerations and impacts of/on the proposed product, service, business

Our main ethical impact on the society is the giving to the people the possibility to reinvent the way they rehabilitate from injuries or musculoskeletal condition. In fact, thanks to our device our customers will be able to spend less money and time to have a full treatment. We already said that most of the patients drops out the clinic for the long and never ending number of session, this is why we want to give them the possibility to train from home and from the data that we gathered from the previous utilization of the device we realized that not only the time needed for the full treatment is reduced by 50% and the possibility of the disease to reappear is decreased.

3.2 Business planning

Global market trends

As projected by a model invented by American Physical Therapy Association [15], in coming decades, USA will have a huge gap between the need and supply of physical therapists because of aging demographic. Unfortunately, it is not only the pain of US, but also the pain of the whole world. According to United Nations [16] , The potential support ratio, which compares numbers of working-age people aged 25-64 to those over age 65, is falling around the world. In Japan, this ratio is 1.8, the lowest in the world. An additional 29 countries, mostly in Europe and the Caribbean, already have potential support ratios below three. By 2050, 48 countries, mostly in Europe, Northern America, and Eastern and South-Eastern Asia, are expected to have potential support ratios below two. Aging as the biggest drive behind the need of physical therapy, makes it a great burden for our society. But as a result, the rehabilitation industry may be expected to have a considerable growth which is already happening. As mentioned in section 3.1, there is a huge market of physical therapy in the US. If we only look at the rehabilitation equipment market alone, it is still a huge number. As mentioned by Zion Market Research [17] the global market is expected to generate revenue of around USD 16.44 billion by 2024, growing at a CAGR of around 6.56%, which is a promising opportunity for us.

Market access approach

Since we are targeting to private clinics who have the strongest willingness and power to pay for our product, we'd try to reach them by making stronger connection with them through clinical trials and attending events such as medical summits and conferences. Insurance companies as an unneglectable role, are also a important resource of revenue to us. We should establish good partnership with them by providing proofs from our clinical trials to gain their trust. Another learning from the visit to CUF Portugal is that physical therapists are key consultants to clinics when comes to buying new medical equipment, which also means strong connection and trusts should be established between us and individual physical therapists. To gain their trust and prove our product, formerly mentioned free trial period is a vital component of our go to market strategy.



Figure 3. Market adoption list

IPR aspects

Our next step is to enter US market because it is a huge and a single market which will make it easier for us to protect our products with patents. Another aspect that should be better built is our brand PhysioPlux. We can be distinguished from competitors by stressing it is the combination of AI algorithm and EMG sensors made PhysioPlux unique and better. As we own the trademark and patents, there is no risk of violate others' rights. Because of the high technology barrier, others can barely fake our product which means IPR won't be a hindrance in front of us.

Financial forecast

We've chosen subscription as our pricing model and a free trial period as our base go to market tactic. And because of the fact the manufacturing cost of our device is relatively high. Our revenue and CAC will be mainly contributed by these two factors respectively. The forecast below is for the first year entering 1000 clinics in USA market.

	Cost	LifeCycle	Cost/Mon
Hardware	\$100		
Other	\$50		
Total	\$150	12mon	\$12.50

Table 1. Cost of a device per month

Since during the first 2 months trial period, we'll provide 20 devices per clinic on average. The free trial period cost for one clinic will be:

$$20 \times 12.5 \times 2 = \$500$$

For the marketing and sales team dedicated to acquiring new customers, the salary is:

$$25,000 \times 12\text{month} = \$300,000$$

Thus, CAC is:

$$300,000/1000 \text{ clinics} + 500 = \$800$$

Based on the assumption that a clinic will need 30 devices in average, retention rate is 10% and LT is 24 months (including 2 free months). As our pricing policy will provide lower price for large order, we assume the mean monthly fee is \$80 per device. The LTV will be:

$$(80 \times 22\text{month} - 12.5 \times 22\text{month}) \times 30\text{devices} \times (1000\text{clinics} \times 10\%) / 1000\text{clinics} = \$4455$$

However, by maintaining long term cooperation with some vital clinics, the LTV can keep growing since we're selling our PhysioPlux device as a service and keep charging monthly. If we can have 1000 stable yearly subscriptions to our product, the revenue can be approximately expected to be:

$$30 \text{ devices} \times 1000 \text{ clinics} \times \text{average } \$80 \times 12 \text{ months} = \$29\text{M}$$

Contingency planning and risk assessment

There is a risk of losing huge amount of money at the starting point because of our free trial policy and the expensive producing cost. For example, if we drastically have 200 private clinics to attend our free trial plan at the beginning. Since on average, a clinic might need 30 devices, the cost will be:

$$200 \times 30 \times 100 = \$600,000$$

Beside the cost for hardware, we also have to pay for sales employees and cover other costs. It wouldn't sustain. To avoid burning too much money at a sudden, we have to expand carefully and always be aware of our cash flow, constantly adjust expanding speed according to current sales performance.

Strategy for funding

To enter the first 1000 clinics, we'll need \$3million in total for manufacturing PhysioPlux sensors. We're aiming to raise an initial \$1million to start producing and cover marketing fees. After acquiring some initial customers, we can proceed manufacturing after getting money from them. Although larger capital will help us expand faster, but it would be harder to get that much amount of money. One million is already enough to get started and help us expand at a reasonable speed.

4. Business development process

Business development process initialization

In order to initialize the business development process, we had to develop an understanding of the specific use case that was assigned to us. After attending two different presentation sessions, one at Fraunhofer and another at Plux (founder of the product) we could better understand the previous development process of the product, how the founders had carried out the process of understanding and

defining the problem and designing the solution. In advance of attending the meeting at Plux, we discussed and prepared a set of questions to ask after the presentation. These questions were formed and chosen to better understand the challenges that Plux had faced in terms of entering the market, selling the product and generally finding potential customers.

Brainstorming & market segmentation

Since our technology was quite far developed and already working, we were forced to start thinking about how to progress from the current position and thereafter enter appropriate markets. To do this, two extensive brainstorming sessions were carried out. The first session intended to gather as many ideas as possible — which were not only limited to the existing problem/solution definition by Plux, but also about different problems that our technology could help to solve as well. The bank of ideas were discussed, simply tested and funneled down into three main customer segments, named;

- *Office and workplaces*
- *Sport Centers and gyms*
- *Rehabilitation*

By segmenting the market, we could identify the bases for segmentation and determine the vital characteristics of every segment. The second brainstorming session intended to generate ideas related to how our technology could be utilized in these three contexts.

Targeting & positioning

After segmenting the market we started to evaluate the commercial value and potential of the segments. During this phase we conducted market research to understand the **market size, expected profitability, growth opportunities, potential barriers** (legal, political, etc.), **problem fit** and **alignment to the summer school topic** — Longer Independent Living. The three segments were inserted into a comparative matrix of the above mentioned terms.

At this point, we selected one segment that were to be our main focus — *Rehabilitation*. This decision was based on two main reasons. Firstly, the market research showed most potential within the segment of rehabilitation, compared to the other segments. Secondly, the advancement of the technology — in terms of development, features, design and functionalities — were strictly focused towards the rehabilitation of musculoskeletal conditions and injuries.

We realized that since the technology was already in alignment and designed for rehabilitation, it would be more beneficial to develop a business plan that involves customers and users within this field. We therefore developed a detailed plan for positioning the product. In addition, we developed a marketing mix to take advantage of the segment.

External actors

Throughout the business process, several external actors were involved for different purposes and reasons. The most important actors were the following;

2. Catarina Oliveira (Plux)
3. Dr. Nick Guldemond
4. Val Livada
5. Anita Silva
6. António M. Cunha
7. Gonçalo Amorim

Catarina Oliveira (Plux)

One of the most important external actors that we interacted with during the summer school was Catarina Oliveira. Catarina is employed by Plux and was our key contact person from the company. She assisted us greatly by supporting us with information about the technology in addition to lending us the hardware for PhysioPlux.

Dr. Nick Guldemond

In the early stages of the summer school, we were fortunate to be offered a presentation by Dr. Nick Guldemond. Nick provided insights about changes in the healthcare system and how we can redesign systems to be more user-centered. The presentation emphasized the relevance and importance of designing sustainable and efficient healthcare systems. One of the most interesting and valuable points were related to how these systems can be designed in cooperation with users.

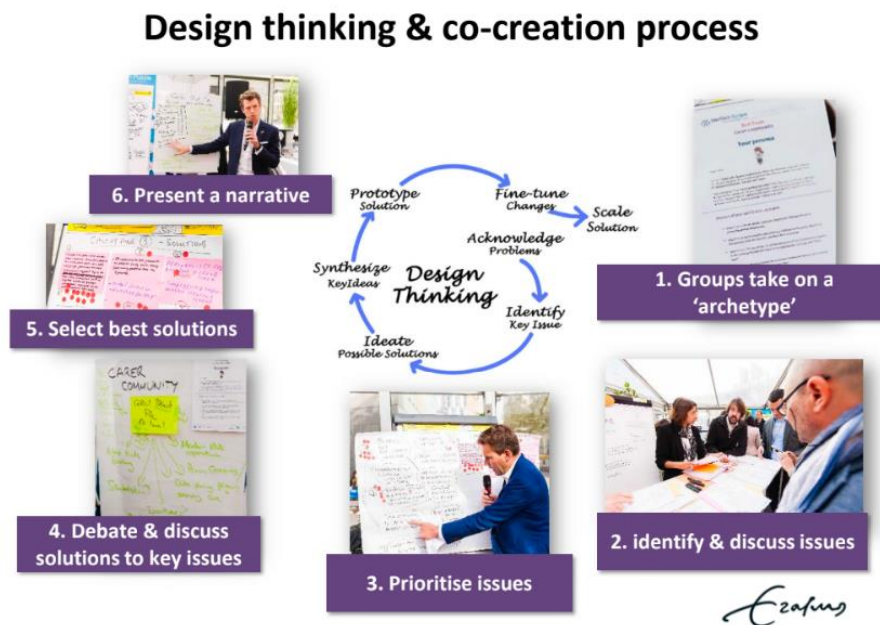


Figure 4. Design thinking & co-creation process

Val Livada

Val Livada introduced us to business modelling in the life science and healthcare sector, along with prospects and expectancies of trends within these fields. Interestingly, the most valuable take-aways from Val were related to trends in venture investing and key requirements for healthcare devices and services investment.

Anita Silva

We were lucky to be offered a session with Anita Silva. Anita guided us into practice non verbal communication such as eye contact, posture, gestures, movement on stage and facial expression. This turned out to be very valuable in advance of the final pitch.

António M. Cunha

Another very interesting presenter was António M. Cunha, who shared his experience and knowledge about real cases of health digitalization. António’s presentation laid emphasis on which role digital transformation plays in industries and in an aging society. An important aspect was to which roles emerging technologies may play in the future in addition to their societal impacts.

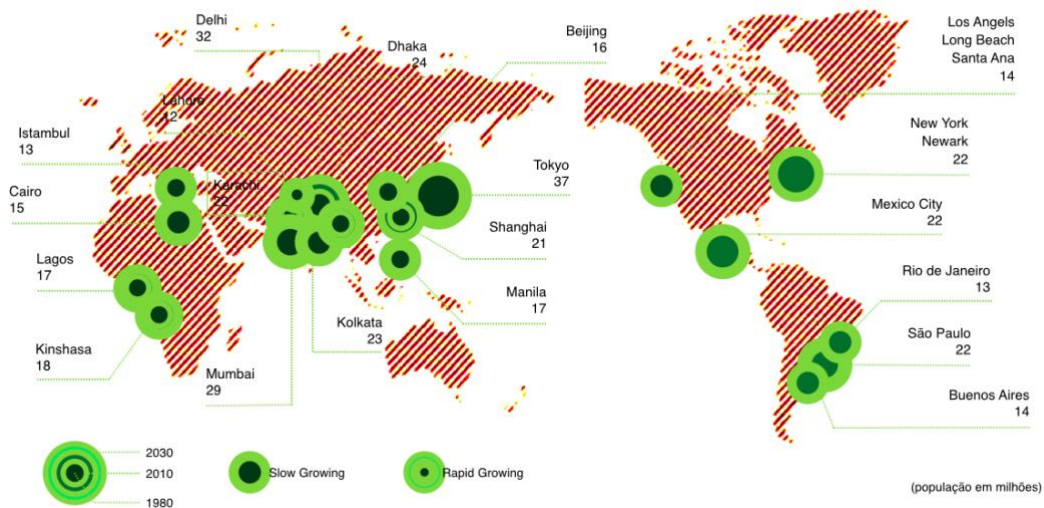


Figure 5. Concentrated & polycentric population growth

Gonçalo Amorim

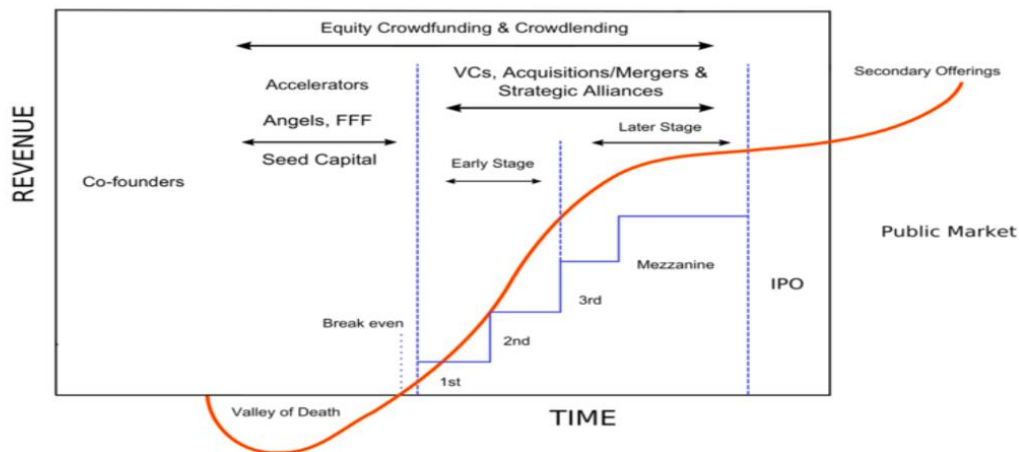
The last but not least person to share valuable insights was Gonçalo Amorim from BGI. In general, Gonçalo provided great support and positivity throughout the whole duration of the summer school. In addition to this facilitation, Gonçalo spoke about how to create finance strategies for new ventures — focused towards longer independent living. A major part of the final pitch and business deliverable required us to present financing plans.

Many of us did not have much knowledge about how to calculate and form strategies for planning finances. Therefore, Gonçalo's help was very valuable to us. After the session, we could more specifically calculate how much money we would require for the initial investment, how we would use the capital, which milestones we had to set and how to calculate COCA & CLTV.

CROSSING THE DESERT: THE VALLEY OF DEATH



Startup Financing Cycle



Source: Epicenter, 2016. Funded by the National Science Foundation and directed by Stanford University and VentureWell

Figure 6. Startup financing cycle by Gonçalo Amorim

Challenges & solutions

Even if the greater part of the business development process went smoothly, we did face certain challenges. The most difficult and demanding challenges we faced were business- and finance related. As all of the group members had technical backgrounds, we were only slightly familiar with the steps required in a business process and even less how to complete them with exceptional results. When these challenges were faced, we naturally got stuck and started discussing the issue without anyone actually having any real knowledge about the matter.

We realized that this was a problem, and to solve it, we encountered the issue by quick-and-dirty online research to understand how to find a solution. Luckily, one of the group members, Mafalda, could support us with some knowledge as she is currently pursuing her Bachelor's Degree in business.

Conflict management

As in any project that involves multiple individuals, we faced various challenges throughout the business development process. These challenges were mainly revolved around how to distribute roles and tasks

which were required in order to follow through with the business development steps. We quickly realized that the most efficient approach was to let each group member introduce oneself by presenting the background, interests, goals and motivations. In advance of each important and operative decision, each team member was given the opportunity to present their ideas and thoughts related to the decision. The different propositions that were presented were thereafter discussed with a business-oriented approach.

Fortunately, we managed to carry through with the project without facing any major disputes — much due to the positive and goal-oriented approach from the group as a whole. For future projects, it might be beneficial to assign a leader-role for one project member, but this depends much on group dynamics and overall willingness to collaborate.

Future work & next steps

As PhysioPlux is already quite established as a technology, the technical development is not prioritized for future work. However, future work would include improvement of the smartphone and tablet applications. This work should be focused towards improving the user experience of the applications, as they currently are not well tested with end users. The problem that Plux are facing is that they currently cannot find the right customers and to enter promising markets. Therefore, our contribution in the future should mainly be focused towards doing more research about new markets, new customers, other forms of business models, other possible fields with other users etc.

5. Self evaluation

a. Eva Maria Veitmaa

The project we carried out in summer school over the course of these two weeks went (perhaps surprisingly) smoothly. At first, I was a bit afraid of us not having assigned specific roles for the team members. My previous experiences have shown that having an appointed leader in team work becomes highly necessary at the point where the team needs to make decisions, and especially when the opinions of the team members differ greatly. However, this time we did not have many conflicts and the ones we had were solved via asking for an external opinion from the mentors and lecturers of the summer school.

All team members put in more or less equal amount of effort. I would especially like to point out Mafalda for whom the summer school was not mandatory, but who passionately cared for the success of the venture nevertheless. The expertise areas of different team members became clear during the business development process. Once it was obvious what each of us felt comfortable with doing, the workflow was much smoother and I believe that everyone felt more at ease doing the things they were experienced in.

My main expertise lied in pitching and presenting the idea - I was chosen as the pitcher for the final presentations in front of the jury of experts. In addition, I stayed longer one evening so that I could

understand the needs of our targeted customer better and communicate my findings to the rest of the team the following day. I also participated in the focus group session to gather valuable insights about possible application domains for our technology from the seniors. Furthermore, I was the one to talk to Catarina Oliveira to ensure that we would have the equipment present during the final demo day.

During these two weeks, I learned a lot about business development with a special focus on market innovation. Before, I had mostly dealt with coming up with new applications for a new or an existing technology, so trying to find a new market for an existing product in an existing market was a fascinating challenge.

The company visits provided a practical perspective on how the market situation actually is and how the theory should be applied in a real-life context. They taught a lot about longer independent living and using technology to achieve that goal. I especially liked that we were given the opportunity to participate in a focus group study and talk to actual potential end-users of our technology.

On the other hand, I wish I had had the opportunity to organise the user study session myself. This is something I enjoyed learning during my course program in the University of Twente and would like to practice further. Especially because the focus group study we participated in was poorly organised - the facilitator was biased, did not let the participants finish, and was unable to ask questions relevant for our projects.

In general, however, the summer school provided a great opportunity to learn more about longer independent living, the problems healthcare systems face, what the current situation is and how we as future innovators and entrepreneurs can help to make it better in the future.

b. Matteo Mainenti

In our team I really felt a balance between our different skills and workload, in fact there were topics in which someone was less or more prepared than the others, but on average everyone had a good preparation in respect of what we had to do to develop during the whole project from the beginning to the end. There weren't any "strictly defined" roles in our team, but fortunately everyone could give support to the part that anyone was more fond of, this made the roles selection implicit and more natural. Plus, having a more experienced member from the BGI made our work much easier, since we could double-check every decision taken and focus more on what we thought we were lacking.

During my past year at KTH, I had the possibility to take a Marketing course as a choice between the elective one and I have to admit that during this summer school I had the chance to show and utilize all the expertise acquired during that period. In fact, my part of the project was mainly focused on finding the best way to sell our product, how to create the channels with the customers, finding which were our competitors and why our value proposition were better than theirs in the customers' perspective.

During these two weeks, thanks to the very interesting and supporting seminars I had the possibility to learn from very experienced people many things like how to start your company, how to finance it, where is the actual HealthTech field going at the moment and most importantly all of the things related to the

financing, which I felt I was missing in my background and that I had the possibility to successively utilise during the development of the project, thanks to the help of the other members of the team.

A special mention goes to the lecture related to how to act during a pitch session. I think that the best part of our course is learning how to show to the investors our own ideas and to make them believe in what we believe, this is why I believe that the seminars related to the pitching techniques have been helpful for most of us.

The only thing that I felt I lacked during this summer school was the possibility to exploit my background about technology, since in my team I was the only one in the Embedded System track I thought that my knowledge could have been used better, but unfortunately we didn't have the possibility to focus on that, otherwise I would have enjoyed more to create something more complex and more relatable to the final purpose of the project, since the proposed technologies were very basic from my experience and I already had the possibility during my bachelor to work on something very similar to the ones proposed.

The possibilities given by this summer school were numerous, from my point of view. Simply the fact to be able to join a team with different knowledge with team members that studied in different parts of Europe in different ways has been very stimulating and I felt very enthusiast to be able to work with such a great group of students. Also sharing opinions about the different projects within the different teams has increased my knowledge and made me able to show my background skills in the entrepreneurship field.

c. Petter Jakobsson

The members of our team during the Lisbon summer school came from different backgrounds with various skill sets, knowledge and expertise. Initially, we tried to gain an understanding in regard to what each member were best at in terms of technology and business. Secondly, we could assign different roles to each group member depending on who was most appropriate for the tasks.

With a background in digital design, I contributed to this project by applying a user-centered approach to the business-modelling process that we pursued. By using a Design Thinking mindset (and techniques, for that matter) I could assist the other members of the team by providing an understanding of the user journey. The user's pain and gain points of this journey, which involved multiple stakeholders, were taken into account when designing and planning fundamental aspects such as go-to-market strategies, competitor differentiation, market penetration etc. After this summer school, I understand that Design Thinking can be implemented into any business processes or innovation. I realize that the concept of Design Thinking is not restricted to the design process — but can be utilized in any kind of development process. Personally, I believe this could be advantageous in business settings because the methodologies and approaches from Design Thinking entails new ways of looking at problems and how to solve them.

One of the most valuable learnings I gained from this process is related to developing strategies of how to enter appropriate markets for a specific product. This is interesting and even more importantly as these strategies clearly defines the identity of PhysioPlux and shows how we differentiate ourselves from more established competitors on the market. The founders of the product, Plux, stated that they initially focused

on how to launch the product and put offerings into the market to reach market penetration, revenue and profitability expectations.

From my perspective, these are fundamental aspects. However, instead of only focusing on how to launch the product, it might be beneficial to direct focus towards the entire lifecycle. In the end, it became clear that the choice in mode of entry could dispense a unique value proposition. Plux, the client and founder of PhysioPlux, the founder and client of the project, has previously had a hard time positioning themselves into the market due to various reasons — which leaves them vulnerable and unstable as a business. If possible, I learned that it is safer and more efficient for this company to form strategic alliances by cooperating with more established businesses. Forming cooperative alliances with other companies would in many ways be beneficial.

In general, the project that we carried out during the summer school has been valuable to me in terms of learnings and self development. However, the theme of the summer school, Longer Independent Living, could have been a bit more directed and nished. It seemed like *longer independent living* could be anything related to improved health. This led to that we rarely discussed and designed the business-model for an aged population, but rather into anything that could improve the health of the users.

d. Ming Yao

It was my pleasure to experience such intensive two weeks during which I had many chances to re-learn entrepreneurial knowledge which I truly found helpful and inspiring, especially the financing part of business on which I've paid a lot time and thus gained better understanding about it. That also happened to be one of my main contributions to the team during this cooperation. Calculating numbers like CAC and Revenue required lots of assumptions with which I was not comfortable because of the lack of information and subsequent uncertainty. But it eventually helped me better understand the business and forced me to think more about details although the final numbers might not be precise enough.

Another aspect I focused a lot was data. I've searched a lot information that might include data we can make use of. Such as societal facts, industry prospect and statistical facts about the problem we were about to solve --- muscular-skeletal injuries.

Also for the go-to market strategy, I've contributed to come up the business model and pricing policy, though the final result is not exactly the same as what I proposed which I failed to sell to all my team members. Still I believe it is a better solution but my speech skill is not good enough to express ideas crystal-sharp and persuade others effectively. That's what I miss in the team work because it seems I happened to be the one who felt most comfortable with numbers but I failed to persuade them with my numbers when deciding pricing model.

One of the most useful simple techniques I practiced during this journey is taking notes throughout each session thanks to that I was quite familiar with most key information we need and was able to remind my teammates every now and then in case they forget or misinterpret something.

The process and organization with which we worked together was a bit loose. In general, everyone participated in almost every aspect of the project. The dynamic was peaceful but lacked some passion. We worked together very smooth but lacked some efficiency. I think it is because there was no explicit organizer and jobs were not distributed to different people according to their expertise, which is good and bad at the same time. If had another chance, I personally would prefer making jobs split to different people and gather them at the end. That could help us work more efficiently together and work in a deeper level at different aspects.

To conclude, it was a good time, I've learned a lot. If not knowledge, at least different people that I didn't know before. We've also done something together. If not that valuable to the society, at least valuable to every individual of us because of the time and effort we spent. Longer independent living is really a meaningful topic. My learning from it is that maybe I can not be a hero to help our society at a large scale. But at least, it is possible to help myself live better in decades to come by living better from now.

6. References, web links

[1] Fraunhofer Portugal, 2019, Online:

<https://www.fraunhofer.pt/en/home.html>

[2] Test-procedures: Biofeedback, Mayo Clinic, 2019, Online:

<https://www.mayoclinic.org/tests-procedures/biofeedback/about/pac-20384664>

[3] Musculoskeletal conditions, World Health Organization, 2018, Online:

<https://www.who.int/news-room/fact-sheets/detail/musculoskeletal-conditions>

[4] Evidences, Physioplux, 2019, Online:

<https://www.physioplux.com/how-it-works/evidences>

[5] Healthcare statistics, Medalerthelp, 2019, Online:

<https://medalerthelp.org/healthcare-statistics/>

[6] Reassessing the Data on Whether a Physician Shortage Exists, JAMA Network, 2019, Online:

<https://jamanetwork.com/journals/jama/article-abstract/2613209>

[7] 2018 Annual report of the boards of trustees of the federal hospital insurance and federal supplementary medical insurance trust funds, CMS.gov, 2018, Online:

<https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/ReportsTrustFunds/Downloads/TR2018.pdf>

[8] 5 key trends for the future of healthcare, World Economic Forum, 2018, Online:

<https://www.weforum.org/agenda/2018/01/this-is-what-the-future-of-healthcare-looks-like/>

[9] SwordHealth, 2019, Online:

<https://swordhealth.com/>

[10] ReWalk, 2019, Online:

<https://rewalk.com/>

[11] JTECH Commander Powertrack Muscle Dynamometer MMT, Pro Healthcare Products, 2019, Online:

<https://www.prohealthcareproducts.com/jtech-commander-powertrack-muscle-dynamometer-mmt-replaced-by-the-jt-cm305/>

[12] MyoTrack Infinity, PhysioSupplies, 2019, Online:

<https://www.physiosupplies.eu/biofeedback/emg/myotrac-infinity-software>

[13] Physiotherapy Equipment Market Size, Share & Trends Analysis Report, Grand View Research, 2019, Online:

<https://www.grandviewresearch.com/industry-analysis/physiotherapy-equipment-market>

[14] 2019 Physical Therapy Industry Primer — Part 1, Jakari Care Insights, 2018, Online:

<https://blog.iakaricare.com/2018/01/31/2017-jakari-care-physical-therapy-industry-primer-part-1/>

[15] A Model to Project the Supply and Demand of Physical Therapists 2010-2025, American Physical Therapy Association, 2017, Online:

<http://www.apta.org/WorkforceData/ModelDescriptionFigures>

[16] World Population Prospects 2019: Highlights, United Nations, 2019, Online:

https://population.un.org/wpp/Publications/Files/WPP2019_10KeyFindings.pdf

[17] Global Rehabilitation Equipment Market Expected to Reach USD 16.44 Billion By 2024: Zion Market Research, Globe News Wire, 2018, Online:

<https://www.globenewswire.com/news-release/2018/12/07/1663558/0/en/Global-Rehabilitation-Equipment-Market-Expected-to-Reach-USD-16-44-Billion-By-2024-Zion-Market-Research.html>