AARHUS UNIVERSITY

PABS - Patient Anti Bacterial Sleeve

An Innovation Project

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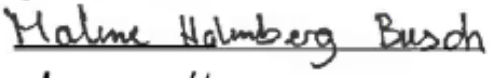
Malene Holberg Busch	201408211	
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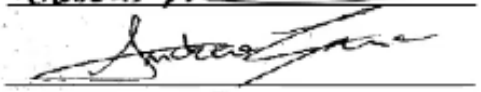
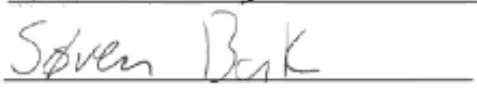
Andrea Cavagna	201811471	
Søren Bak	201504559	

Contents

1 Introduction

The following report was made by a team of master engineering students at Aarhus University from different study lines. It explains and discusses the process of becoming a team and the whole innovation process from a general challenge (health care) to a specific task, ideation and finally a complete business model. The theory behind the innovation tools is explained as a part of the reflection process which is the main purpose of the report.

2 Team Creation

A group consists of several people brought together for a common purpose. For a group to become a team it is crucial that there are not too many members of the group as that does not allow team-role relationships to form. A team is a limited number of people selected to work together for a shared objective in a way that allows each person to make a distinctive contribution. Our group consisted of five people which is the optimal number of participants according to Laughlin, Hatch, Silver & Boh if the complexity of the task is huge. However, not only the amount of group member but also the diversity in the group is of great importance to solve the given task. This becomes clear in the process, as the great amount of diversity in the team becomes a necessity when the team has to perform according to Tuckman's Model from 1965. This group had been put together across different kinds of engineering ensuring a great amount of diversity where all use our individual expertise can be used to contribute to the project. As this was fulfilled the conditions were optimal to go from being a group to becoming a team. This required to go do something together. Specifically, there was taken a look at Patrick Lencioni's Triangle Model for Teams as used in lecture 5, which provides some areas which need to be covered. The areas were: 1. Absence of trust, 2. Fear of conflict, 3. Lack of commitment, 4. Avoidance of accountability and 5. Inattention to results.
In order to address these areas, the following was done: The team went to the Åboulevarden and drank a beer and ate some nachos together. Here the focus was to get to know each other a little deeper than just professionally and sought to become willing to be vulnerable and put ourselves out there. This was also done to become more personal to each other as this would make it easier to criticize each other in case of disagreements in the group. The team also discussed the different levels of ambitions in the course from each group member as it was important to know all need to put in the necessary amount of commitment to make this project. The last two options were not addressed as they were not found necessary to discuss in relation to this project.

The first hand-out were given after lecture 5 which took us through a process of how to obtain a focus. While working with this it was discussed in the team what direction to go and everyone had their say. In this way, all came to the conclusion to continue with the topic of hospital infections. Hereby everyone believed in the topic and investigated it further, which lead to our final area: infections carried through electronic devices at hospitals. The process is further elaborated in the focusing section.
Throughout the entire process, a lot of web searching has been done and hereby implemented the knowledge obtained from various sources. Also, an interview with hospital personnel was made. The interview had a crucial impact on the final path that was chosen. Through these interviews, the problem, hospital infections carried through electronic devices, occurred.

3 Focusing

The group was handed the general challenge: Health Care, which is a wide topic with many different opportunities and challenges. To be able to define concrete challenges, each group member contributed by brainstorming areas to disrupt, overlooked areas, consumer needs or subject of interest. This first step in focusing made it clear that the exploration of Hospital-acquired infections is interesting and relevant – the general task.
The most common ways to get an infection inside a hospital are:

- Contact transmission (direct or indirect)
- Droplet transmission
- Airborne transmission
- Common vehicle transmission vector-borne transmission

Hospital-acquired infections are shown to be a problem as 1 out of 10 that has been a patient at Odense University hospital comes home with an infection they did not have when they entered the hospital according to Fyens Stiftstidende. Moving from the general to the specific task involves numerous steps, which includes several diagrams which can help to identify key areas and overlooked tasks. Also, interviews with experts and stakeholders will help to find explicit and implicit needs. This process enables the group to gain a very deep knowledge of the task – being the problem.

The fishbone diagram, which can be seen in the appendix page 9. This permits the team to determine the cause and effects of the problem. The analysis led into 5 main causes, Hygiene, Hospital Cleaning, Patient, Hospital buildings and Use of antibiotics, that represent causes and effects of the main issue Hospital-acquired infections.

Here it is clear that hygiene is an important factor, further research and discussion led the more specific task, namely self-infection, which is when the patient infects themselves by spreading bacteria from one place on the body to another where it is unwanted. Self-infection was then analyzed in a mindmap (see appendix page 10). A mindmap provides the user with an overview of the problem and leads to further identification of the specific task. Combining the mindmap with the triz model enables the possibility to cut through the complexity of the problem so the problem that needs to be solved gets clear. Here our problem is self-infection, which is investigated in the future, present and the past and in sub-system, system, and super-system (see appendix page 11).

To get a professional point of view an interview was conducted with the department nurse, Jeannette Thierry Andersen, at the Joint and Tissue Diseases department in Aarhus University Hospital. She gave an inside knowledge of the problem self-infection. She said that the biggest problems with hospital infections are when the patients have a weakened immune system because it makes it easier for an infection to survive. The cleaning procedure at the hospital is generally very high. The hospital room is cleaned daily and the nurses use alcohol-based hand sanitizer many times every day. When asked about procedures around personal electronic devices, especially patient devices, Jeanette responded the following: *"I do not think so, but it is a good point, because it is filled with bacteria... Incidentally, it is quite interesting because I also go with my own phone, and so do all the nurses and doctors... We have new habits that have come in the last few years, and we need to pay extra attention to this... As I know, we do not have any hygiene document on the cleaning of your own mobile phones."*

This was surprising to hear, and the group decided to change the focus to infections caused using personal electronic devices and more precisely, patients' mobile phones.
A recent study by R.R.Brady (2011), concluded the following: *"Eighty-six out of 102 (84.3%) patients' mobile phone swabs were positive for microbial contamination. Twelve (11.8%) phones grew bacteria known to cause nosocomial infection. Seven (6.9%) phones and 32 (31.4%) nasal swabs demonstrated Staphylococcus aureus contamination. MSSA/MRSA contamination of phones was associated with concomitant nasal colonization."* The amount of phone users has only increased since 2011, and now even elderly patients use phones on a regular basis. This increases the problem even further.
The chosen specific task can be formulated as the following: How can bacteria on phones, located in hospitals, be prevented from infecting the patients and the hospital personnel. This is the task that will be solved through the ideation process.

4 Ideation

With the defined focus/task followed the ideation, and as the team was already composed with optimal numbers and great diversity, it was decided that all 5 team members participated in the creation of ideas. The problem-solving method was used as a starting point, as all team members, as future engineers, have become accustomed to developing on the basis of a problem, thus this would facilitate the startup process. Later in the ideation process, attempts were also made to pursue a disruptive process in order to think further out of the box.

4.1 Ideation on demand

The first inputs were made with the question of how to avoid contact infection through electronic devices, and the methods that were used were based on Søren Hansen's presentation about Ideation on Demand and making innovation through creative thinking. By using the six steps of ideation with fluency, flexibility, originality, alternatives, new categories and development of an idea, the process eventually ended up with a result.

At first 100+ inputs were made through fluent thinking and 5 different techniques were used for this. The first technique used was brainstorming by Alex Osborn, USA. Here the goal was to produce as many inputs as possible so all members could empty their heads. This was done separately in silence. All ideas were accepted, and with the awareness of the importance to continue, when it at some point became almost impossible to come up with more ideas, time was extended. The next technique used was picture stimulation by Tom Peters and others, USA, categorized in the random area. This was also done separately in silence via an internet-based picture simulator as stimuli. In addition, the bi-association technique was also used, were the simulator showed four pictures at once, and this ideation was done in pairs to help each other to get as many ideas as we could. The next area is the third area, Role, and then the fourth technique, Rolestorming by Rick Griggs, USA. This were used because it is known that many people are embarrassed to volunteer creative ideas in a group, because they are afraid that they will not be taken seriously, and here Rick Griggs has discovered that people are not so much ashamed of their creative expressions when they put forward ideas in the name of someone else. Based on the daily routine in the hospitals, each of the team members was given a role as either patient, staff or relatives, and the defined personas were used to live in the roles. Here it was experienced that even more inputs were brought to the table than before, which might be because it became easier to look for solutions from a user's and a possible costumer's perspective. The fifth and final technique used was the technique called Beyond Realism by Brian Ryder, USA, that comes from the area of provocation. Here the team members were asked to come up with crazy inputs that at first glance seemed completely unrealistic. The purpose of this technique was to create inputs that became the inspiration for more inputs, and after this, more than 102 inputs were made to bring further in the process. Through the next step in the Ideation on Demand method, flexibility was created by organizing the inputs and categorizing them after what principles they use.

This was done to think beyond the usual trends of thoughts, and by a deliberate attempt to understand situations and things in new ways and from new angles, the thinking was forced into new trends of thoughts. The principles that were found were among others removing bacteria from the devices, avoiding bacteria on the electronic device and detecting bacteria, and these were written down and used as headlines to the categories. Next, steps tree to five overlapped when they were used in the Horizontal Triangle. The third step was to search for originality, so within each category possible original ideas were identified, which could then lead to the fourth step where alternatives were to be found. Alternatives were found in the same categories, also called valleys, by using the described principles, and by looking for valleys in other domains new categories were discovered. The new categories were e.g. not using electronic devices.
Last were the sixth step for further development and all of the +100 created inputs were challenged fast. The real ideas were made by this process of accepting the ideas and saying "Yes, and...". In this way, ideas were developed in the team by creative collaboration, and a deliberate attempt to engage in the idea and to add more ideas to build on it was made.

4.2 Ideation

Through this process, 46 ideas were developed and after that, the ideas were sorted in the C-Box by giving the ideas colors (green, blue and red) after their feasibility and originality. To this, the Rosetta was used, and screenshots can be seen in the appendix on page 12. Powers and problems were created to see what ideas the most pains and gains had, as it has previously been discovered that the best and most disruptive ideas are those that have many advantages but often also have many obstacles to implementation. Hereafter all team members individually picked out their favorite radical ideas, that had to be either blue or red in the C-box. At this stage, everyone tried to stay open to the ideas. Saying YES – even if the idea was not beneficial. The technique where you say AND to every ide, adding another brick of knowledge to the idea, so descriptions of the ideas were made, were also used. Stepping stones were used and played until the emergent knowledge showed itself. In this way, it was almost managed to postpone the judgment without voting or merging ideas. However, as mentioned, the best ideas had to be picked out and therefore make decisions to move on from a stuck process. Finally, three promising ideas were left: Machine cleaning with UV light, external easy cleanable shared touch screen and a sleeve with antibacterial properties. To these ideas, an external nurse helped with further development and gave an awareness of the applicability of the ideas in a busy daily life at the hospitals. The ideas should be light and handy and not create any waiting time or complicate the workflow. Therefore, the idea with an external shared touch screen was canceled.
Lastly, we defined the novelty for two of the ideas and made a novelty search to see if similar ideas had already been invented or whether we had invented a complete or partial new solution. On this search, it was found that there are already several UV light cleaners designed and patented for use in hospitals and we selected the sleeve with

antibacterial properties because it was the newest and most innovative idea.

4.3 The product

The result of the ideation is thus a sleeve for smartphones that contain antibacterial properties. The product solves an overlooked problem with contact infection in a newly emerging area due to new phone habits in recent years. The unique feature of this product is its ability to passively kill bacteria on the entire phone using tight fitting without the use of electronics, which makes the product more durable and climate-friendly. The novelty search showed that the idea of using copper's antibacterial properties in fabrics such as microfibers is not previously patented but that the same thinking was used with other metals such as silver used to keep clothes clean. However, the idea still requires further product development and research on efficiency. See appendix page 17 for pretotype pictures.

4.4 Patent

PABS - Patient Anti-Bacterial Sleeve, passively killing bacteria on electronic devices, unique pressure foam and sliding mechanism.

4.4.1 Description

The Patient Anti-Bacterial Sleeve passively kill the bacteria located on the user's phone. This is done by the user inserting the phone into the sleeve by using the patented sliding mechanism (p. 3 demands). The bacterial killing system incorporates known microfiber properties with the new patented technology (p. 1 demands) which uses copper ions winded into the cloth to passively killing the bacteria. This is well documented and can be shown to kill up to 99,9 % of bacteria located on the phone. The used pressure foam technology utilized known memory foam technology and incorporates it into the PABS housing. This will ensure proper contact between the antibacterial material and the device. Note that a picture of the PABS can be seen in appendix page 19.

4.4.2 Patent demands

See appendix page 20 for picture references.

1. Invention. Inside of the sleeve is made of a microfiber cloth with induced ASTM B36 copper threads, which prevents and kills bacteria.
2. Invention. A unique high-pressure foam which ensures the contact between the microfiber copper threads and the electronic devices, even in small cracks and craters.
3. Invention. The special sliding mechanism which prevents scratches to the device from the copper threads due to the special loop winding of the copper threads.

5 Discussion

If the idea was to be developed as a start-up business, the project will need to be developed by ourselves. This means we will have to take the project through the typical startup development phases, where we will specify exactly what customers we're aiming at and be responsible for the marketing of the product. We will also need to acquire funding in some way, which leads us to another possibility; selling (parts) of the rights to the idea – if not all of them. By selling the idea the idea will be developed by others. Depending on who has most of the shares we will still have some influence, however, if we sell the majority of the rights the further development of the project is not entirely up to us.
If the idea was to be developed in an already-existing company, the obvious choice would be to cooperate with a company that already makes sleeves and cases for phones to utilize their expertise to develop the project. The idea could also benefit from the fact that the existing company is already settled in the market with many contacts and retailers. This makes it easier to brand the product and saves the effort of marketing a brand-new project with no reputation.

6 Vertical Innovation Process - From a great idea to a brilliant concept

The idea from the pr[illegible]n their phones. This is a great idea for a [illegible]es the importance of developing a business [illegible]rgoes a process which covers the broad perspectives of a business model which includes a business part, financial part, a process part and

The concept relies heavily on the product, finances and culture. The concept is the following: the product, which is the PABS, will be produced by a business partner in a country with cheap labor and manufacturing costs – China. This would lower the startup cost of the business and prevent the issue with limited experience of manufacturing. This solution lacks innovation and will not contribute to the strong points of the concept, thereby scoring low on the Vertical Process graph.
The business step is very constrained in the sense of the customer type. If the Danish hospitals are chosen as the customer, it is the regions that manage the flow of new products. Therefore, the business process is only possible through contacting them directly. Other possibilities in this process are the change of customer type to private users instead of patients. This enables an entirely different business strategy with a much broader change of being radical, but this is not the chosen strategy.

The financial process, on the other hand, is much more potent because of an annual subscription-based system. As the PABS needs refurbishment or replacement as the copper corrode/wears, the subscription will include the refurbishment of the PABS and would be based on the amount of PABS needed. The PABS would then be color coded as of when the PABS needs to be replaced, for example red color code could be PABS produced in the first quarter of 2017 and would then need replacement in 2018. Then the PABS would be easily recognized by the personal so they know to send it to refurbishment. Also, a new business partner would help with the logistics of the transportation of the PABS from hospitals to the refurbishment facilities. This would reduce startup costs further. The hospital culture would accept the concept as the concept does not involve the nurses and thereby not increase the labor at the hospitals, furthermore the users already have sleeves for their phones (79 % in a recent study). Therefore, the culture would only contribute to the concept. Going from the concept to a concrete business model the canvas model (Alexander Osterwalder, Yves Pigneur in 2010) is used, this can be found on page 23 in the appendix.

7 Conclusion

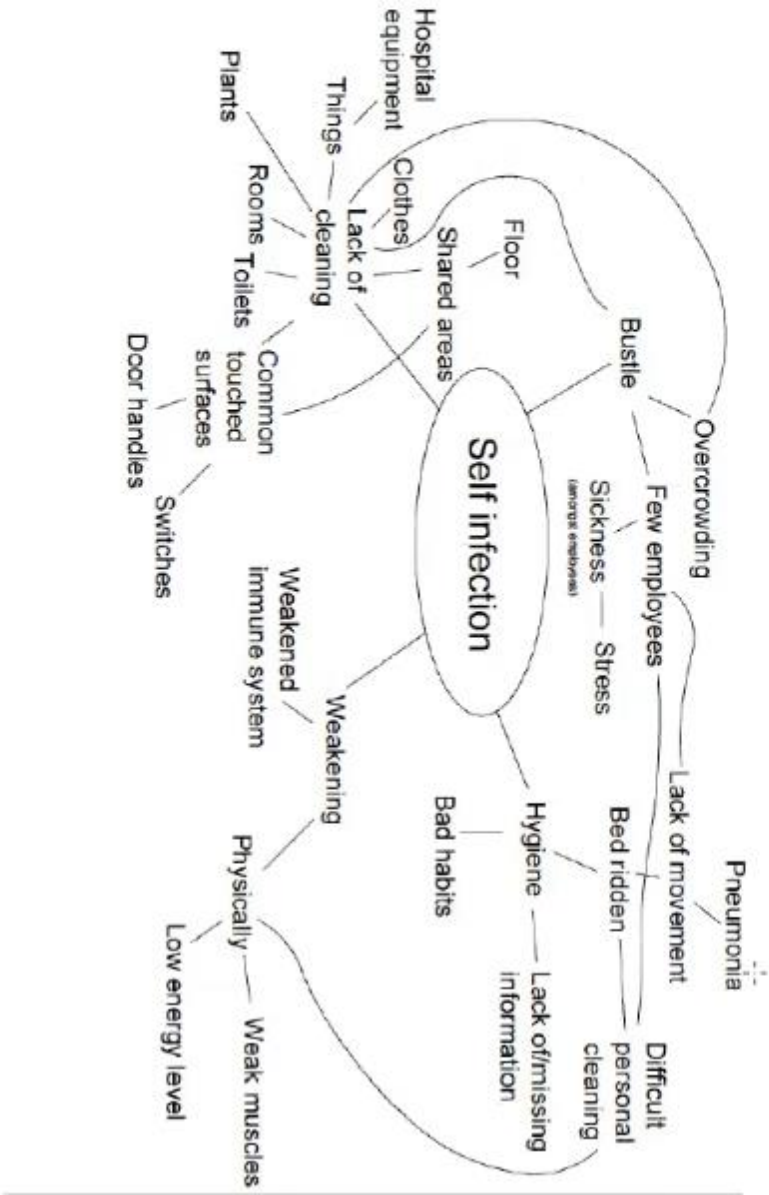
Through the innovation process, the core strength was always the great team flow and work ethics. Also, the diverse structure of the team composition served as a great catalysator, especially in the ideation process. A lot of time were spent in the focusing process, which in turn helped a lot in the ideation process as the team members had a deep knowledge of the specific task. The ideation process included a lot of different techniques that explored all the potential radical ideas and by using the provided software, Rosetta, the ideas were organized in such a way that the development of the ideas was easy. Conclusively the idea that was chosen was the PABS. This device enables the possibility to solve the specific problem, but do not serve as a radical solution, even though it includes 3 patent attempts. After the idea, a vertical innovation process was used to further develop the concept. The result of the VIP which is the innovate landscape provided the structure of which the business model is based upon. This business model serves as a final result of the whole innovative process.

References

[1] R.R.Brady, A.C.Hunt, 2011, Mobile phone technology and hospitalized patients: a cross-sectional surveillance study of bacterial colonization, and patient opinions and behaviours, Science Direct

[2] Vibeke Toft-Nielsen, Tag på sygehuset og bliv syg, Fyens Stiftstidende

8.2 Mindmap


Self infection
Hospital equipment
Things
Plants
Clothes
Rooms
Lack of cleaning
Floor
Toilets
Shared areas
Common touched surfaces
Door handles
Switches
Bustle
Overcrowding
Few employees
Sickness
(amongst employees)
Stress
Pneumonia
Lack of movement
Difficult personal cleaning
Bed ridden
Hygiene
Lack of/missing information
Bad habits
Weakening
Weakened immune system
Physically
Low energy level
Weak muscles