Final Raport 19.12.2013

Study group: Tuiti Paju/ Maria Mikkonen/ E. Hengjia

3D Printed of Textiles Scan&Print service

The brief

The world of cellulose.

The basic brief for our project was: “Creating a new future-oriented systems in the field of 3D printing of textiles and the textile industry”. Factors that were to be taken into consideration were: on-demand production, customization, personalization, material flows, lifecycle design and stakeholder mapping.

Ideation and getting started

Based on the brief we started to ideate what the world of 3D printing and textiles would hold, what would be the key things to look into and what problems currently are in the textile industry. We brainstormed the following mind map shown in figure 1:

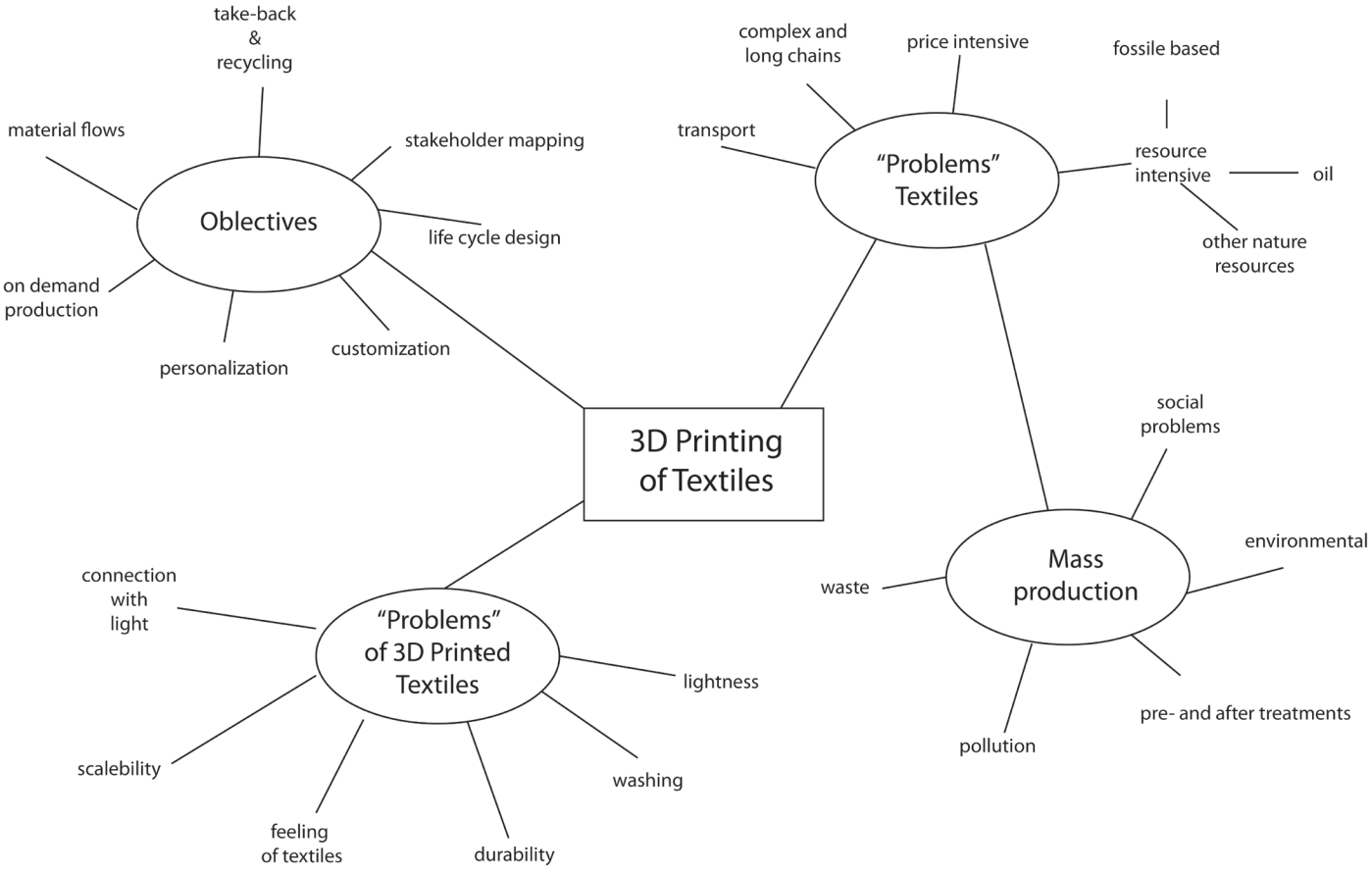
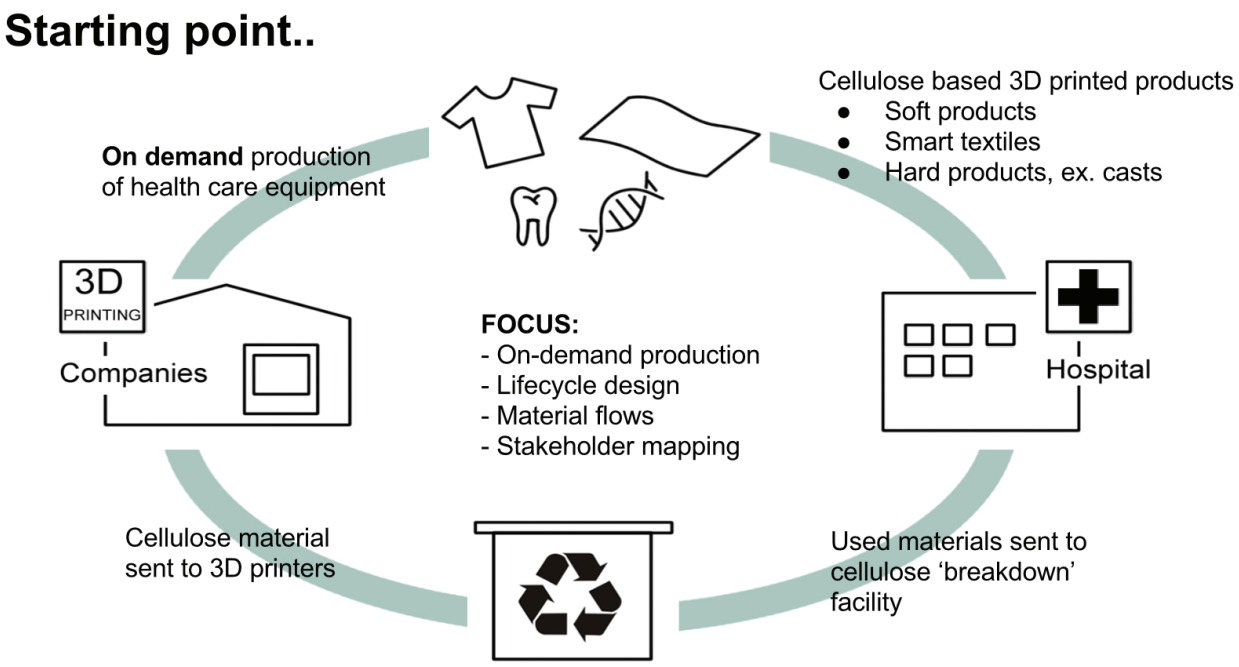


Figure 1: first ideation session with our team

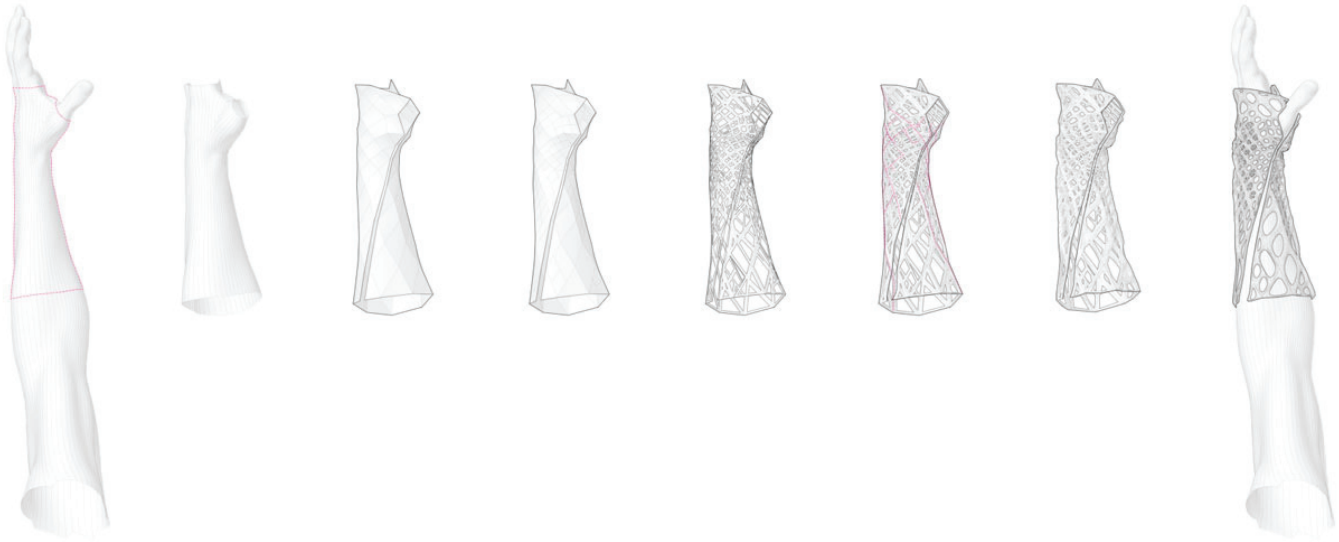
In this mind map we looked into three key areas, which were the main objectives of the project, problems with 3D printed textiles and problems with the textile industry. This was an ideation exercise before the actual research, but gave us a nice view about each other’s perspectives and knowledge to these issues.



Research

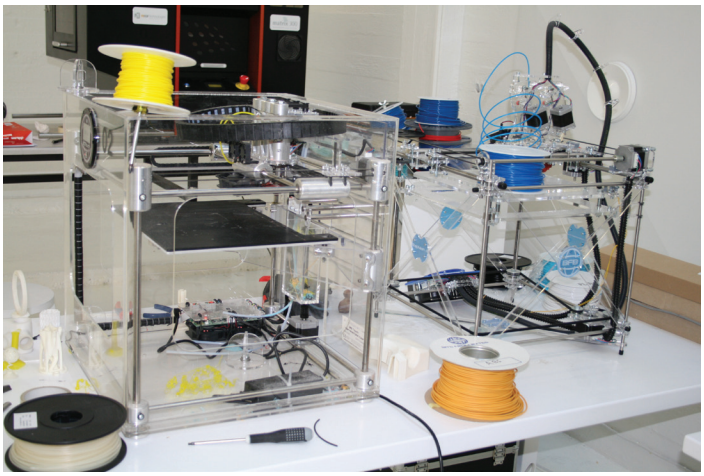
We continued the project by looking into different example cases of 3D printed textiles, 3D printing technology and its different applications. As for textiles we found out that with current technology there haven't been materials printed which have fabric-like features such as softness and flexibility, but have been used already in high fashion (Pictures 1 and 2). Also, we found interesting applications in the health industry and got very inspired by this. For example, it is already possible to print bone structures and joints, as well as different medical equipment such as casts (Picture 3).

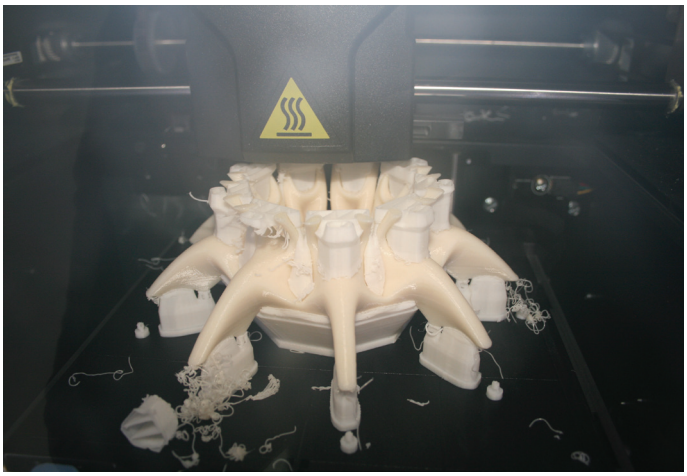
Pictures 1 and 2: Iris Von Herpen's 3D haute couture



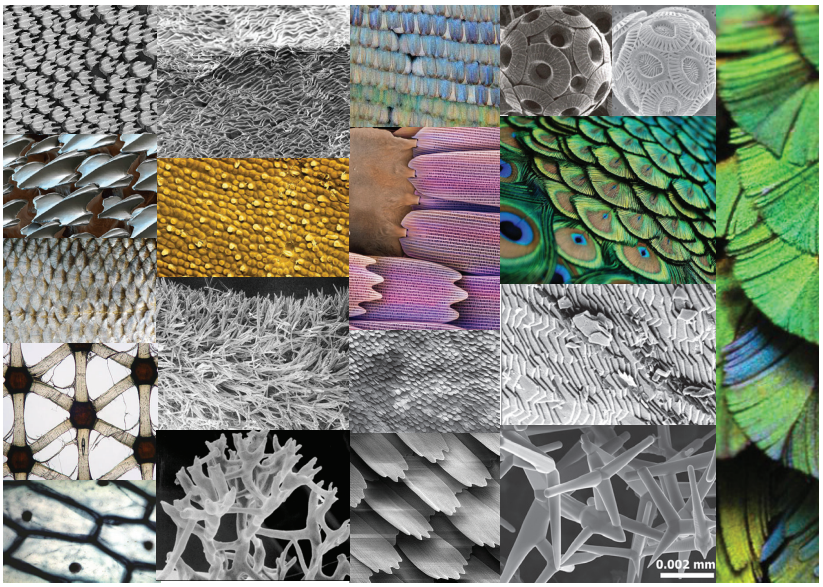
Picture 3: casts made with 3D printing technology

As part of our initial research, our team visited ADD Lab, which is a space in Otaniemi campus, where studies, workshops and research around 3D printing are conducted. During this morning's visit we saw the actual 3D printers, how they worked in action, examples what they had done at ADD lab and briefly how the CAD application turned computer code into an actual three-dimensional object. Below some photos from the visit (Pictures 4 and 5):





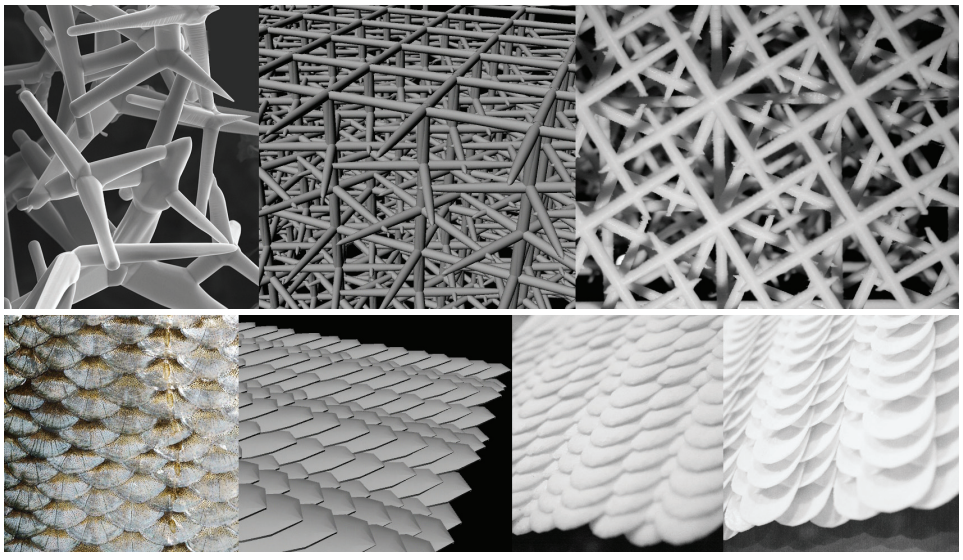
Pictures 4 and 5: 3D printers at Otaniemi campus' ADD Lab



3D Printing

The digital design in fashion workshop series explores software techniques employed in animation and gaming industry in fashion and textile design. The students were taught basics of maya software as a design apparatus. The focus was on design procedures such as repetition, shape morphing, deforming and sculpting in digital format. Students were also given a brief introduction on additive manufacturing. The workshop ended with students having a grasp on the process of digital to physical production with the help of 3d printers in the lab. This was an introductory workshop. The follow up workshop will take place at ADD in spring 2014. (Source: http://addlab.aalto.fi/#education/add-topics/digital-design-in-fashion-textile)

During this case-course Tuiti Paju took also part on an 3D printing course held at ADD Lab. She designed textile structures which took inspiration from nature, also known as biocracy. The idea was that in the future structures will be printed from nano cellulose. The printed material would function with body heat, for instance. In this example, the structure would change form when the body heat is too low or high and will collect information from the body at the same time. Another structure was based on a marine sponge and another from a fish skin. (Picture 6)



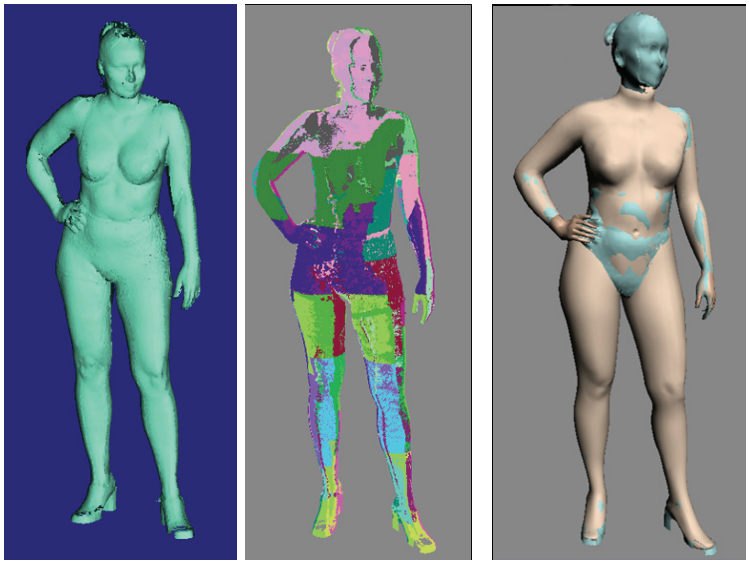
Picture 6: Tuiti Pajus structure 3D designs and 3D prints

Picture 7: Second skin face 3D model by Tuiti Paju

3D Scanning

3D scanning technology has become more popular in the clothing industry. Many applications have been developed. This allows retailers to retain their old customers with a value added professional service and to attract new customers who demand personal fit. Different 3D body scanners have distinct features and advantages. The optical devices used by the 3D body scanners can be light projectors, CCDs and light sources (halogen, infrared or laser).
(Source: Clothing Appearance and Fit: Science and Technology Jintu Fan,Winnie Yu,L. Hunter page 161-162)

In 2003, Tuiti Paju tested the Techmaths bodyscanner, during her final work The Virtualwomen. Body scanner is a cabinet where the person getting scanned goes in and stands still, while in few seconds four scanners (in the corners) scan the bodyform and create a virtual 3D model. The model takes form from separate meshes. After this, the 3D software user has to simplify the model and create second skin top of the original model. If we use 3D printers in Scan+Print service, we will print out second skin from the 3D printer. In this case the printing material would be nano-cellulose. (Picture 7 and 8)



Picture 8: Second skin body 3D model by Tuiti Paju

Questions for Uudenmaan Sairaalapesula (in finnish)

Juha Kosonen, Toimitusjohtaja - Margit Perälä, Työnjohtaja - Anne Lintukorpi, Tuotepäällikkö

1. Kuinka monta sairaalaa toiminta-alueellenne kuuluu?

   HUS piirin sairaalat Tammisaarta lukuun ottamatta, siis HYKS, Lohja, Hyvinkää, Porvoo ja Helsingin kaupungin sairaalat. Maaliskuusta 2014 alkaen myös Espoon kaupungin Puolarmetsän sairaala.

2. Hoidatteko itse tekstiilien noudon ja palauttamisen sairaaloihin. Miten logistiikka hoidetaan?

   USP toimii tekstiileitä vuokraavana pesulana, eli pesula omistaa lähestulkoon kaikki tekstiilit. Logis tiikka (ulkoiset kuljetukset) on ulkoistettu ja kilpailutetaan. Sairaaloiden sisälogistiikkaa hoitaa yhteistyökumppanit HUS-logistiikka ja Palmia.

3. Kuinka paljon tekstiilijätettä sairaaloista syntyy kuukaudessa tai/ja vuodessa?

   Sairaaloissa ei synny tekstiilijätettä, USP:la poistaa omistamansa tekstiilit. Kierrätettävää tekstiilijätettä syntyy vuositasolla reilut 20 000 kg ja kuivajätettä noin 5 000 kg.

4. Minkälaisia palveluja tarjoatte?

   Vuokraamme lähes kaikki sairaaloiden tarvitsemat tekstiilit ja huollamme osastojen omistamat tuot teet tarvittaessa.

5. Mitä tuotteita sairaalatekstiileihin kuuluu?

   Liinavaatteet, potilasvaatteet, henkilökunnan suojavaatteet, leikkaustekstiilit ja joukko erikoisteksti ilejä esim. potilaiden siirtoon tarvittavia nostoliinoja yms.

6. Ovatko kaikki tuotteet 100% puuvilla. Jos ei mitä muuta materiaalia tuotteissa on käytetty?

   Tuotteista hyvin vähän on 100% puuvilla. Yleisin materiaali on sekoite puuvillan ja polyesterin kanssa. Osa tuotteista on polyesteria ja sitten erilaiset laminoidut ratkaisut ovat yleistyneet. Kalvona käytetään polyuretaania tai PTFE kalvoa.

7. Mitä vaatimuksia tekstiileille on sairaalaympäristössä?

   Huollettavuus eli tekstiilit saavat lämpödesinfektion pesuprosesissa. Yleinen vähimmäisvaatimus on 70 astetta ja kymmenen minuuttia. Osa tuotteista saa lämpökemiallisen desinfektiokäsittelyn jolloin pesulämpötila on yli 60 astetta ja desinfektioaineena käytetään peretikkahappo pohjaisia desinfektio aineita. Tekstiilien pitää olla mikrobiologisesti puhtaita huoltoprosessin jälkeen. Leikkaustekstiilien pitää olla steriloinnin kestäviä, standardi vaatimus on 3,5 min 134 astetta, mutta siihen on hyvä lisätä muutama minuutti ja lämpötilaa aste, pari.Tekstiilit eivät saa aiheuttaa haittaa potilashoidossa ja ni iden pitää toimia henkilökunnan työn vaatimusten mukaan.

8.Minkälaisia käsittelyjä tekstiileille tehdään?

Uutena leimaus, lajittelu, pesu, kuivaus, viimeistely ja pakkaaminen.

9. Miten tekstiilit tällä hetkellä kierrätetään?

Poistettavista tekstiileistä osa myydään pyyhin/siivous käyttöön osa erilaisiin humanitaarisiin avus tuksiin ja loput edellisiin kohteisiin kelpaamaton päätyy kuivajätteeseen eli poltettavaan sekajättee seen.

10. Osaatteko mainita potilasryhmää, joka vaatii erikoistekstiilejä.

Lapset vaativat koon ja puettavuuden kannalta erikoisvaatteita. Iso ja pienikokoiset potilaat vaativat kokolajitelmaa. Leikkauspotilaiden lämpötalouden ylläpito leikkauksen aikana. Näitä on kyllä aika paljon alkaen 500g. painoisista keskosista, joille laitetaan suonikanyyleita steriilisti, heille on oma steriili leikkauspakkaus.

11. Minkälainen toimija haluaisitte olla vuonna 2020?

Edelläkävijä ja tuoteinnovaatioiden kehittäjä. Uusien markkinoille tulevien terveydenhuollon tekstiili tuotteiden testaaja. Pesulan prosessien kehittäjä ja uusien menetelmien käyttöönottaja

Interview with HUS palovammakeskus

Sari Ilmarinen, apulaisosastohoitaja

The interview was conducted as a discussion, with the few following questions for guiding the conversation:

1. How are the burns currently treated?
2. How would the 3D technology be of benefit to the burn patients?
3. What features would be required by our products in the case of burn patients?

The key findings from the interview were:

1. Burns are currently treated with multiple layers of different bandages
2. Absorptive bandages are changed at least 3 times a day
3. Features required:
    a. Non-sticky
    b. Hygienic and antibacterial
    c. Promoting regrowth of the skin

4. This technology would be especially useful in cases when
    a. A high % of the body has burned
    b. The burns are in very ‘customizable’ places such as face

Focus area

Based on our research and inspirations from our coaches and the staff at ADD Lab, we decided to focus our project on health care applications, closed loops and take-back of cellulose from the hospital environment. We looked into industries where there were an high turnover of materials containing cellulose and decided to focus on hospitals in the public sector with the following reasoning:

- High quantities of soft cellulose needed and high turnover/usability
- Constrained and already closed system to work on before expanding to other areas
- The textiles in the hospital industry are quite simple and basic

OPPORTUNITIES

- We wanted to look for places where there were high quantities of soft cellulose needed and high turnover/usability
- When looking and systems, it is easier to find a constrained and already closed system to work on before expanding to other areas
- The textiles in the hospital industry are quite simple and basic

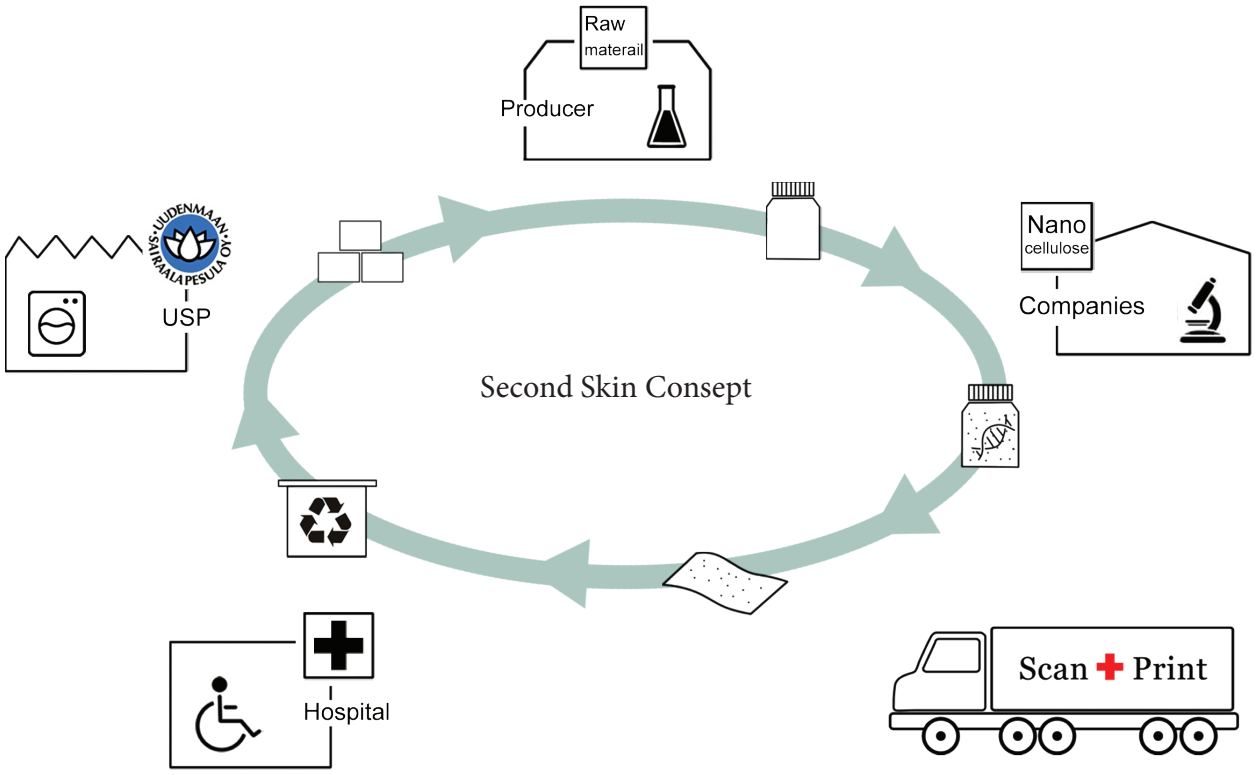
CHALLENGES

- Hospital environment and regulations present challenges to hygienity
- How much material or products can be created from recycled bulk cellulose (ex. what percentage of a bedsheet can be re-formed into new material)
- State owned/public sector presents problems within purchasing regulations and competition laws
- The products brought into the healthcare sector must be safe and highly durable

System Map

The system map for our solution consists of five stakeholders: hospital laundry service (USP), raw material (cellulose) producer and manufacturer, nanocellulose and smart material producer (addition of special chemicals and materials to the bulk cellulose), Scan + Print and the Hospital system.

In this closed loop cycle, the raw material (hospital textiles, sheets, patient wear etc.) is collected by the hospital laundry service USP. USP cleans the usable textiles and sends them back to the hospital, but the unusable sheets (waste) is transported to the raw material producer. The raw material producer breaks down the textiles into pure cellulose (for instance separating polyester and cotton). If extra features and chemicals are required, the material moves on to the nanocellulose companies, which then add the required ingredients and the final material is collected by Scan + Print. Working closely with the hospital system Scan + Print is transported in a proximity of a hospital close to the need of 3D printed health care products. On demand these patients are scanned and the 3D printed products produced according to the need on site, fast and painlessly. The products are recycled as far as possible and turned back into cellulose raw material. (Picture 10)

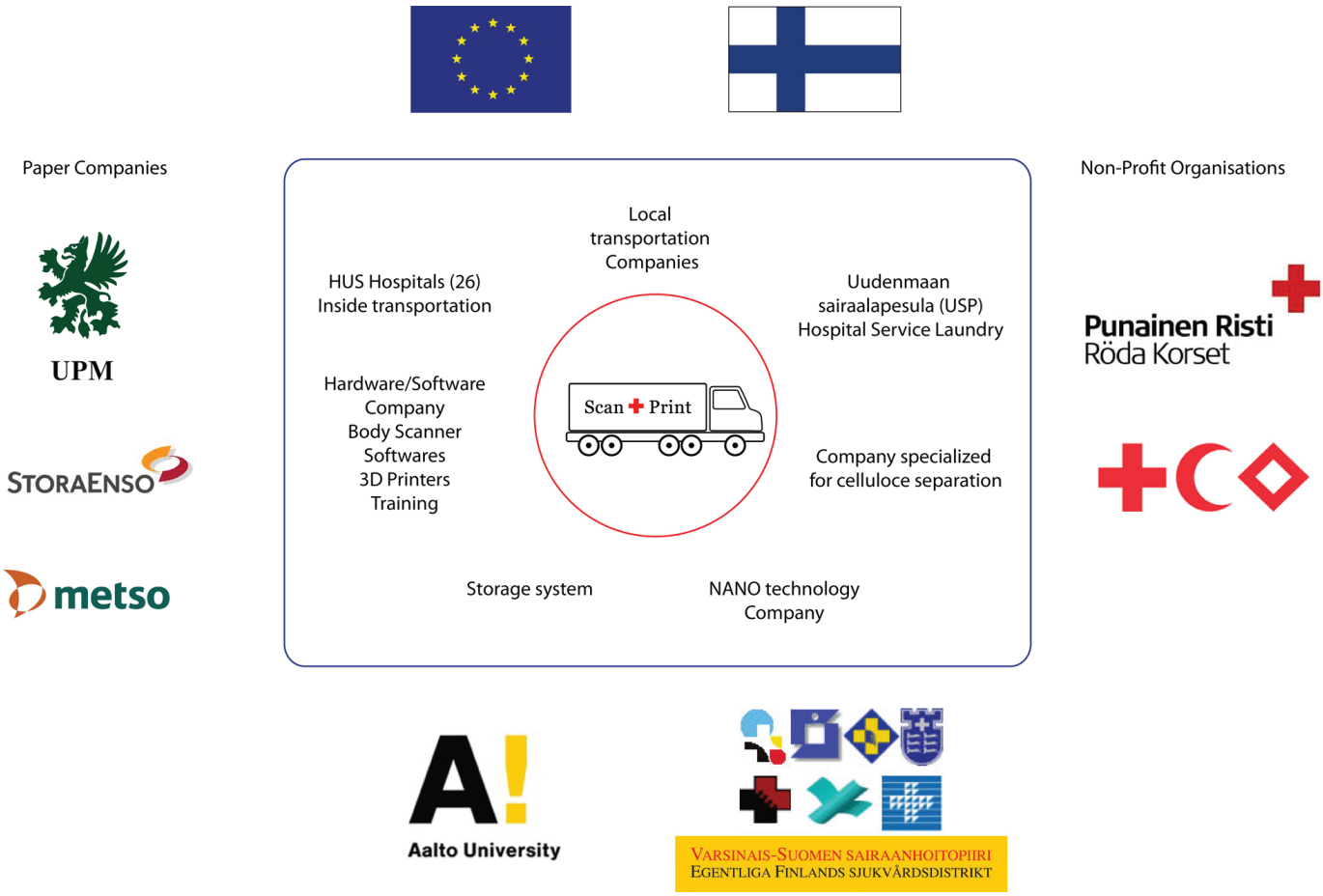


Picture 10: Second Skin concept system map

Stakeholders Map

Surrounding our concept Scan + Print, as this stakeholder map shows are the following stakeholders: HUS Hospitals and internal transportation, transportation companies, hospital laundry service USP, cellulose separation company, nanotechnology company, storage system, as well as technology and IT companies specialized in 3D scanning and printing. These stakeholders are required for our closed loop system.

As we move one step further, we are looking at stakeholders such as: paper companies (interested in finding new solutions and applications for cellulose material), EU and the Finnish government (Tekes and other government supported programs), Non-profit organizations such as Red Cross, universities with various research aims and projects, as well as hospital systems in other parts of finland and abroad. (Picture 11)



Picture 11: Scan&Print service stakeholders

SCAN + PRINT service

Transportable 3D scanning and printing service for burn and fracture patients. Highly customized dressings and casts. Fast and painless solution for nano and microbial cellulose printing.

GOOD POINTS

- Easy to move different places
- One unit can serve several hospitals
- Easy to multiply
- Quick and painless for the patients
- Customizable for different kind of injuries
- Possibility to do hard and soft products
- Add value to recycled cellulose
- Some of technical solutions has been already used and tested

BAD POINTS

- Expensive equipments and softwares
- Technical problems
- Requires a lot of specialized knowledge
- Todays 3D printers are too slow
- Truck consume a lot of fuel
- Takes time to travel place to place
- Requires space