



TEXTILHÖGSKOLAN

HÖGSKOLAN I BORÅS

Strategy for Research and Doctoral Education

Textil and Fashion

(dnr 375-23)

2023

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SUMMARY

Textile is a unique material, being ubiquitous in human life. Textiles occupy a central part of all human cultures. Likewise, textiles constructs and deconstructs social status, gender, perceived age, culture, and social class. It is one of the largest industries globally. At the University of Borås, textiles as education and research focused on three subjects design, textile technology, and textile management. Textile and fashion are among the areas in which the University of Borås, through the Swedish School of Textiles, has national responsibility for both the development of the artistic perspective and the cross-disciplinary collaboration between art and science.

The University of Borås is nationally unique (Nordic unique also) by having a research and education environment for textiles all the way from textile fibre to final product. In this production chain, aspects of design, textile technology and textile management are covered. Our full-scale laboratory, workshops and technical facilities make us stand out from most European universities and schools. Moreover the Swedish School of Textiles is considered one of the top five schools in terms of educational and research environment in textiles. The main research areas within the design are Fashion Design, Textile Design and Textile Interaction design; textile management deals with sustainable supply chains and business models, marketing and consumption, circular economy and inter-organizational relationships and textile technology focuses on materials, process technology, resource efficiency, and functional and smart textiles. For that, the Swedish School of Textile is well-known worldwide and considered as Borås ambassador.

The research groups in Textile and Fashion have significant collaboration with several Swedish and European universities and industries, including TEKO (Sveriges Textil och Modeföretag).

The research groups in Textile and Fashion have significant external research funding; the external research funds comprised with 80,7 Mkr in the last five years (19 Mkr in 2022), these values without taking into account the project which led by Science Park Borås, where a lot of research groups have highly involved in collaboration with them, and we are taking into account the limited external finance available for research on the artistic foundation from typically available funding bodies for research.

For 2023, the internal research funds comprised 17,48 Mkr (of which SEK 13,2 million went to the research school), and part of this funding is directed to the artistic. Currently, 26 doctoral students are in the area, and around 40% of students' financing are external (project funded).

The total number of publications was 30 in 2022, based on the Web of Science. In addition, we need to consider the high artistic productivity of design that complements with curated exhibitions and artefacts and that we have high involvement in projects related to the industry where publishing the project results is difficult.

Our vision is to be one of the top international universities in textile and fashion in education and research with a high focus on sustainability and digitalization. And to strain our unique completeness environment consisting of design, textile technology and textile management with truly comprehensive full-scale laboratories and workshops.

We aim to lead the textile and fashion industry in creating sustainable societal and environmental impacts and providing solutions that exploit the school's research and innovation excellence.

1. PRIORITIZED RESEARCH AREA

Textile and Fashion, Area representative is Prof. Nawar Kadi.

2. RESEARCH PROFILE

2.1. Description of the history and organizational development

The University of Borås is nationally unique (Nordic unique also) by having a research and education environment for textiles all the way From textile fibre to textile retailing through textile produce manufacturing and distribution.. In this production chain, aspects of design, textile technology and textile management are covered, with our full-scale laboratory, workshops and technical facilities make us stand out from most European universities and schools and the Swedish School of Textiles is considered one of the top five schools in terms of educational and research environment in textiles. And also, the area has a special contribution and situation by gating permission to issue doctoral degrees on an artistic basis and general.

The development of doctoral education in the field of textile and fashion at the University of Borås (HB) started in 2003. Doctoral students placed at the School of Textiles (THS), were admitted to doctoral program at Chalmers University of Technology and also in Engineering Science at Tampere University of Technology (TUT). Through a collaboration agreement, the main supervisor and examiner employed at HB, and placed at THS, THS could function as a home institution. The work continued to build up a research environment at HB / THS.

Since 2010 HB has received permission to issue doctoral education on both general and and artistic domains. The doctoral program is very successful, with 41 doctoral students having so far defended their dissertations in the area of textile and fashion.

There are 8 research groups in the textile and fashion area. The distribution of the research groups is represented in Figure 1.



Figure 1: Research groups structures in the area of textile and fashion.

2.2. Special conditions and factors

The textile and fashion area has a research and education environment for textiles all the way from textile fibre to final product. This production chain, aspects of design, textile technology and textile management are covered, which are considered unique in their comprehensive environment. Our full-scale laboratory, workshops and technical facilities make us stand out from most European universities and schools, and the Swedish School of Textiles is considered one of the top five schools in terms of educational and research environment in textiles. For that, the Swedish School of Textiles is well-known worldwide and considered as Borås ambassador.

The area has an exceptional contribution and situation by gating permission to educate doctoral students on an artistic basis and in general.

The project with the city of Borås project ended in 2022, which had a high effect on the textile area, especially that for design (artistic) field there is very limited external finance available for research on the artistic foundation from typically available funding bodies for research in relation to other established research areas like for example technology, business, medicine etc. This condition increases the need for faculty finances to ensure a critical mass of research students and postdocs.

Most research groups in management and technology were created in 2018, where there is also a need for more investment in PhD and Postdoc to allow these research groups to develop in good condition. We note that despite this short time, several research groups have done tremendous work in getting external funding, demonstrating the importance of more investment in the area.

3. RESEARCH ENVIRONMENT

The Swedish School of Textile is an attractive environment for staff members and doctoral and master students.

The area we focus on is the work condition of PhD students, especially the financial situation, where external funding (especially from the non-European industry) is highly investigated to validate their financing to avoid the exploitation of PhD students.

The research in textile and fashion has been well-developed, with 8 research groups (one in design, three in management and four in technology) :

- Textile and fashion design

The textile and fashion area is related to the methods and models that are of importance to the development and application of textiles and fashion in research, industry, and society at large. The area investigates the relationships between materials and design variables for function and expression in the development and production of textiles and fashion, as well as the connection between economic and design variables (resources) for function and expression in the production, distribution, and trading of textiles and fashion (research group leader Prof. Clemens Thornquist and Prof. Delia Dumitrescu)

- **Marketing, fashion and sustainable consumption**
 The research group studies with cultural and social science perspectives how marketing and fashion are created, performed and interpreted by various actors in a consumer culture. The focus is on how marketing, consumption and fashion as an industry are created, reproduced and interpreted by various actors, including marketers, creators and consumers, through different practices and processes. Consumption is a central part of these events, and is also one of the main driving forces and purposes of fashion (research group leader is Prof. Karin M. Ekström).
- **Management of B2B relations**
 The focus area of this research group is inter-organizational relationships and how these are established, maintained and managed by involved stakeholders. These relationships shall be understood as both interaction and interdependencies between organizations in order to enable sustainability for each individual actor as well as the society (research group leader is Daniel Ekwall).
- **Textile Value Chain Management (TVCM)**
 Research in textile value chain management (TVCM) focuses primarily on the examination, understanding and development of intra- and inter-organizational structures, models and forms, and their underlying variables and antecedents that would enable sustainable value generation in textile and fashion enterprises, industry, and for the environment and society at large. Two important research areas within its scope are: I) circularity, and II) digitalization of supply chains & embedded business models (research group leader is Prof. Rudrajeet Pal).
- **Advanced textile structures**
 The research group has an applied orientation based on advanced analysis methods combined with laboratory experiments. This research group aims at developing advanced innovative sustainable processes, materials and applications for the textile.
 The research group's scientific excellence, together with its relevance to the industrial field, puts important research efforts into more sustainable textile products.
 The research group is known for our research on transfer fibre to textile fibre, improvement of the spin ability of new sustainable fibre and the mechanical recycling of waste textiles (research group leader is Prof. Nawar Kadi).
- **Polymeric E-textiles**
 The research group Polymeric E-textiles, where "E" indicates the involvement of electrical phenomena, works extensively with textiles as a central object of study, with the overall aim of merging physical, chemical and biological mechanisms with textiles and using textile material and processes a) as a mean of enhancing effects from these, other fields; and b) adopting these often "hard" mechanisms making completely new kinds of fibres and fabrics ("enriching the textile realm") (research group leader is Docent, Senior Lecturer Nils-Krister Persson).

- Textile Material Technology

Research in the research group Textile Material Technology focuses on the development of advanced functional and smart materials as well as novel, resource-effective processes to produce such materials in an effective and efficient way. Innovation is created in a unique research environment with a close connection to the textile industry. Apart from conventional technologies like coating, dyeing and finishing, examples of important novel technologies used in Textile Materials (research group leader is Prof. Vincent Nierstrasz).

- Textile and wearable sensing for P-health

The research group focuses on the production of textile sensors and sensorized garments that enable personalized healthcare applications. For that, both textile-electronic integration techniques and methodologies for functional characterization of smart textiles, in general, and textile sensors, in particular, are often used. The focus of the research activities extends beyond textile aspects and includes the evaluation of the biomedical measurement and monitoring functionality (research group leader is Prof. Fernando Seoane).

3.1. Description of the research equipment and infrastructure:

The research in textile and fashion design has a well-developed infrastructure for experimental work, from experimental environments in weaving and tufting, knitting, sewing, printing, dyeing and finishing, mixed media (laser cutting, 3D printing, etc.) to full-scale workshops for weaving and knitting, which provides excellent conditions for experimentally oriented research and postgraduate education.

The textile lab environment and workshops, known for highly qualified technicians, is essential for research and education development.

A significant investment in developing the knitting laboratory and weaving labs, which are updated with new industrial machines had been done in the last three years.

Investment in the employment of technical labs Technician (engineering technicians) is essential in the development of the area:

- In the knitting lab: it is necessary to keep a high level of knowledge, as some of the main technicians will be retired, and training new technicians will take time to maintain the cumulated expertise built in the school. A dedicated action to secure such knowledge while increasing the academic level in the lab is advised.
- In spinning and nonwoven labs: it is essential to facilitate researchers' access in the lab, where the last employment of 50% didn't meet the lab's needs.
- In the research lab, there is a need for an engineering technician to help with all research using the lab.

Investment in the development of existing labs:

- Testing lab: the lab was created around four years ago based on buying the equipment for a commercial testing lab that had gone bankrupt; since its creation, the investment in the lab wasn't at all relevant for research and education. This investment was based on the labs' strategy to do a service for the companies. To

make the lab useful for research, it is required to update the lab to allow performing automatic characterization tests.

- Research lab: The equipment in this lab is based on external funding; the investment of the university is so limited. This lab has no clear budget, even for co-funding small testing equipment and consumable materials. For that, a clear budget is needed urgently for the necessary materials to facilitate the work of the researchers.
- Spinning lab: This equipment and consumable material for this lab are based on external funding, with no investment from the school in any equipment. The development of this lab is essential for research and education.

The investment in creating a new lab:

- **Creating a Textile Value Chain Innovation Co-Lab:** Such an Innovation Co-lab should harness THS's existing physical labs/workshops and digital server as integrated infrastructure to transform our research results into innovations that are of high technology-, business- and market-readiness for impacting the target users in the industry and society.
- **Digital and virtual reality lab:** where the movement in this direction is part of the area and University of Borås's strategy.

Creation of Fibre Centre:

The fibre centre will have the objective to complete the production chain (from raw material to fibres to end-product) in the same area, whether it is a woven, knitted or nonwoven fabric, to improve the research quality in collaboration with the industry and facilitate the development and prototyping for the innovative textile processes.

The complete chain will be the base for developing the research and the application of digitization of the textile process.

The goal is to have sufficient equipment related to fibre testing systems, small-scale fibre spinning systems, yarn spinning systems, recycling and sorting equipment, nonwoven systems and digitalization tools. And this centre will allow the university to take a step further, to strengthen its position and become one of the best environments for education and research in the textile area.

3.2. Description of academic networks and collaborations

The research groups in Textile and Fashion collaborate significantly with several Swedish and European universities and industries, including TEKO (Sveriges Textil och Modeföretag). As part of a textile ecosystem, Textile Fashion Center, the profile is a central part of the transformation of the textile industry, changing from being a textile supplier to becoming a positive force in social development. Both within textile design and technological development as well as fashion, new, creative solutions, business ideas and collaborations for sustainability are created

The collaboration with the science park strengthens the position of the area, where several research groups (not all) have been involved in several research and industrial projects with them; this collaboration improves the relationship between the research groups and the industry. The area is known for its high partnership with industry, where the majority of its external funding is based on

industrial collaboration.

The collaboration with the commutation department has been significantly improved, with several meetings and discussions.

The area collaborates with all top universities in the textile field, especially the European textile. And it is part of several European and International platforms, Likes:

- AIC(International Colour Association; <https://aic-color.org>)
- ArcInTex(coordinated by the Design Department at UB; www.arcintex.se)
- Autex (Association of Universities for Textiles), it creates a worldwide network of textile universities and was founded in 1994; <https://www.autex.org/>
- Cumulus Association(<https://cumulusassociation.org>)
- ELIA(The European League of Institutes of the Arts; <http://www.elia-artschools.org>)
- ETP (The European Technology Platform for the Future of Textiles and Clothing), <https://textile-platform.eu/>
- Fashion Big Data (FBD) Foundation (<https://www.fbfdfoundation.org/>). TVCM Group at UB is a founding member.
- EIHA (European Industrial Hemp Association) www.eiha.org
- IFFTI(Network of International Fashion and Textile Institutes, <https://site.iffiti.org>)
- IEEE Engineering in Medicine and Biology. Technical Committee on Wearable Biomedical Sensors and Systems
- NETFAS
- UNECE's Sustainability Pledge

We are involved in the European master program WE-TEAM (it is a two-year Erasmus Mundus Joint Master Degree (EMJMD) Programme to educate the next generation of textile engineers); <https://we-team.education/>

4. PRODUCTIVITY AND IMPACT

The doctoral program is very successful, with 41 doctoral students having so far defended their dissertations in the textile and fashion area.

There are currently 26 doctoral students in the Textile and Fashion area, and they are the central part of the research activities. Around 40% of PhD students' financing are external (project funded).

The research groups in Textile and Fashion have significant external research funding; the external research funds comprised with 80,7 Mkr in the last five years (19 Mkr in 2022), these values without taking into account the project which led by the science park, where a lot of research groups have highly involved in collaboration with them, and we take into account the limited external finance available for research on the artistic foundation from typically available funding bodies for research.

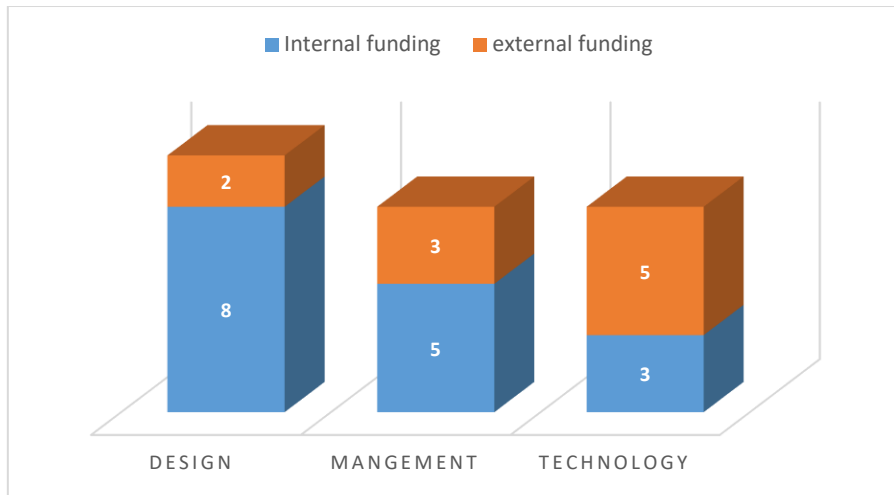


Figure 2: Distribution of PhD students in the area

Figure 3, demonstrates the majority of the projects' funders in the last five years, where the higher value is communing from Borås Stad; this funding was stopped in 2022, and the EU funding with several programs, including Erasmus+. And we note an augmentation of the projects' financings from KK in the last two years.

For 2023, the internal research funds comprised 17,48 Mkr (of which SEK 13,2 million went to the research school), and part of this funding is directed to the artistic.

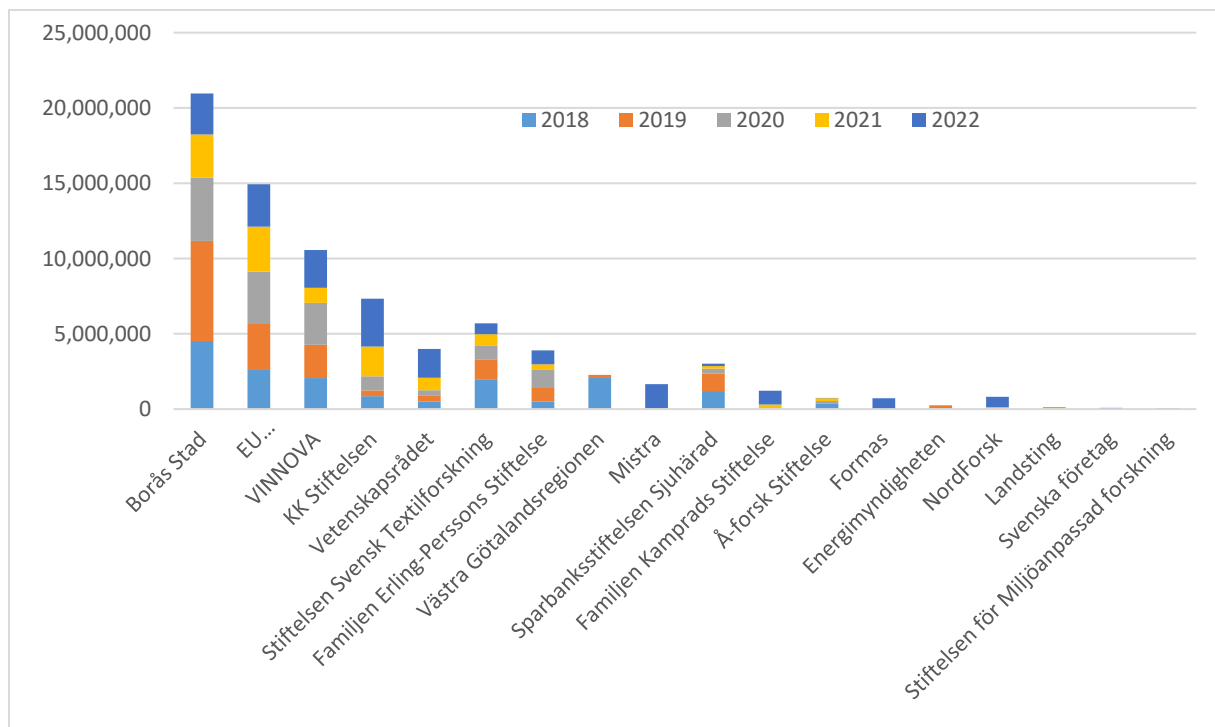


Figure 3: Research funds comprised.

The total number of publications was 30 in 2022 (figure 5), based on the Web of Science. And if we include all the conferences and other research papers will be 78 (from DIVA, figure 4). We need to consider the high artistic productivity of design that complements with curated exhibitions and

artefacts and that we have high involvement in projects related to the industry where publishing the project results is difficult.

The researchers in the area also present their research in social media, TV, radio, and popular press.....

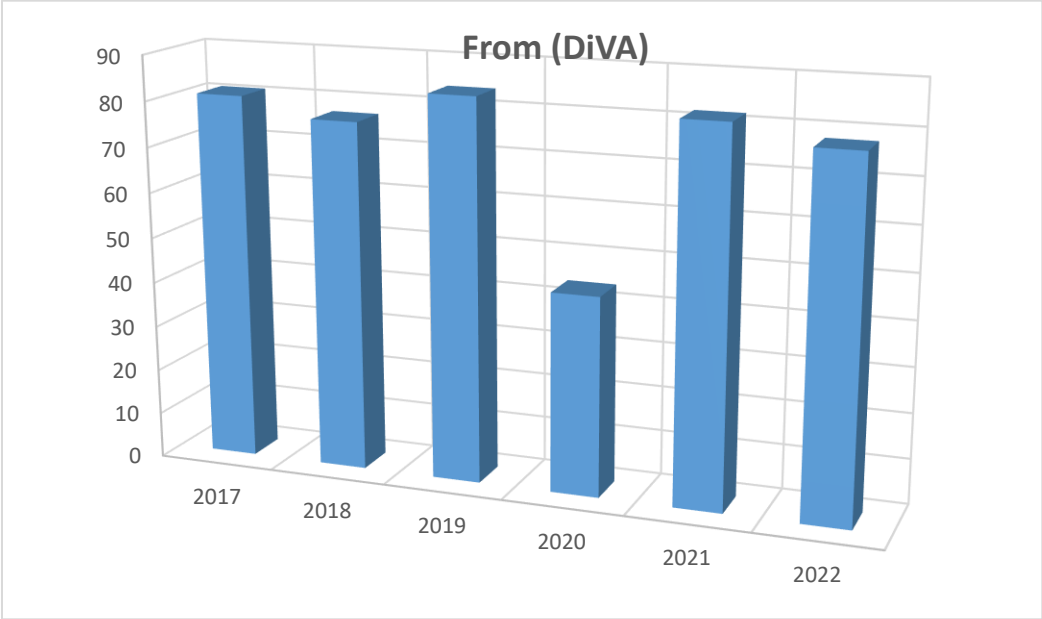


Figure 4: Number of publications in the lasts years based on DIVA.

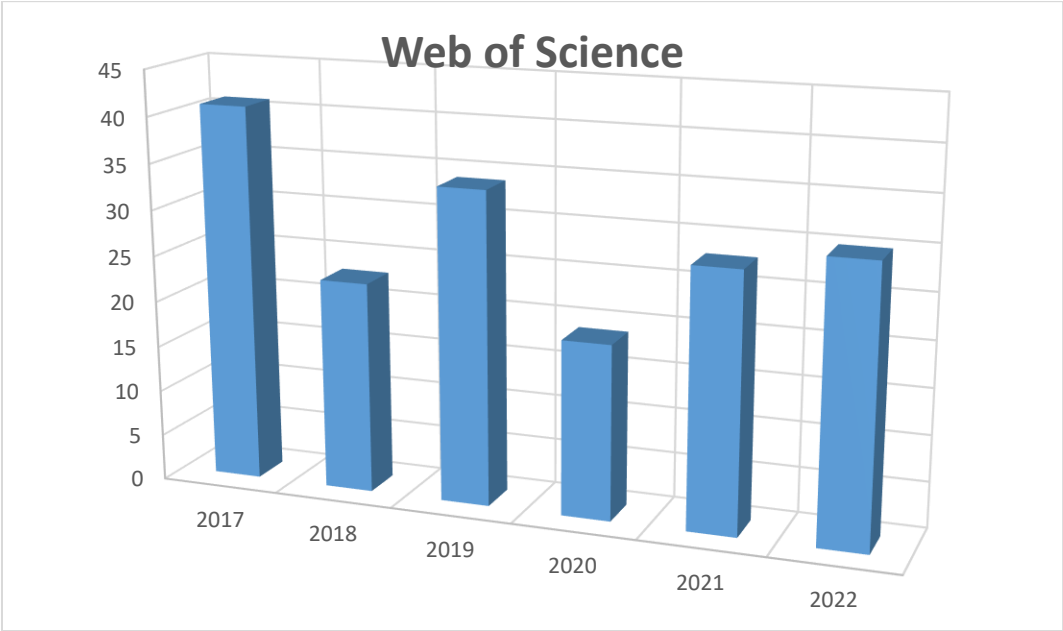


Figure 5: Number of publications in the lasts years based on the Web of Science.

The total number of the researcher in the area is 89, and the majority are not active in research where the necessity for more motivation for researchers, especially for the senior lectures to be more involved in researchers and PhD supervision, where the necessity to involve them with 50% of their

time in research.

5. DEVELOPMENT AND STRATEGY

5.1. Research environment

- Develop our research axes in the research groups to be adapted to EU Textile Strategy for sustainable and circular textiles.
- Improving and clarifying the scientific contribution needed to promote researchers.
- Promote career development for existing researchers and adopt that all senior researchers must be involved with 50% research and 50% education of their time.
- Promote collaboration and not individualization in the research work.
- Promote recruitment of postdocs and senior lecturers with a high scientific background.
- Encourage the visiting of guest researchers to contribute to the research environment.
- Improve communication with textile labs
- Improve the number of publications in high-quality scientific journals.
- Promote patenting and commercialization of research results
- Investment in research equipment and infrastructure wish had been mentioned in the chapter 3.1.

5.2. Doctoral education

- Develop collaboration with other universities for joint supervision or a double degree.
- Organize Textile and Fashion seminars/activities/poster days.
- Develop PhD-courses.
- Research groups leader need to support/give input to the Research Education Board in the ongoing quality work with the PhD programs.
- Encourage Co-supervisors between the research groups. (for exchange and broader input/knowledge).
- Ensure the minimum critical number of PhD students, especially for design (artistic).
- More acceptance of externally funded PhD students (with continuing the high investigation of the validated industrial financing for non-European companies to avoid exploiting PhD students).

5.3. Communication

- Continue the discussion and collaboration
- Encourage the researcher to use social media to communicate their research work.
- Continue the communication of our activity with the industry.
- Re-establish the Nordic-textile journal to be more international and a top textile journal cross-interdisciplinary.

5.4. Collaborations.

- improve and extend the collaboration with the Science Park Borås.
- Improve and extend collaboration with resource recovery.
- Improve our International collaboration with other universities.
- Promote patenting and commercialization of research results.

5.5. External funding

- More involvement of new researchers in the writing of projects.
- More collaboration between the research groups for funding applications.
- Open discussion with Borås Stad for the possibility of funding the area.

- Check possible external funding for research equipment and infrastructure.

5.6. Risk and Challenges

- The limitation of internal funding will affect the number of PhD students, especially for the design part, which is critical.
- The high involvement of PhD students in the project could affect the quality of the research.

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