A Room of one’s Own
Woven structures

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At Konstfack, Textile in the Expanded field
Master project
Spring 2015
ABSTRACT

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I have explored the combination of sound, textile and space. How can one create textiles to use as sound dampening material in an arts and craft practice?
To enhance the architectural aspect of textile as one of the five building materials I have chosen to weave walls. Walls don’t have to be straight or go from floor to ceiling but they should somehow create room and divide the space.
I felt the need of walls working within Konstfack because of the distraction of fellow students in the open space classroom.
Torn walls tells a story, we see the left traces. These traces I wanted to convert into woven textile.
Sounds of people and objects in public spaces bounces between hard surfaces often without dampening, this creates an environment that causes stress and distraction.
In Virginia Wolf’s essay “A room of Ones Own” (1929) she points at how important it is to create a workspace for the professional you, to take place and be part of the public realm.
A big part of this master project has been making the actual materials to build with and executing fibre. Does the material do the job of sound absorption? Wool and silk both have a fibrous cell, which is suitable for sound absorption they also have low flammability and is biodegradable; therefore I chose to work mainly with these fibres.
I share my knowledge through the experience of the space I create. How to create a Room of one’s own in an open office.
Index

<table>
<thead>
<tr>
<th>Chapter</th>
<th>page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstract</td>
<td>2</td>
</tr>
<tr>
<td>Introduction</td>
<td>4</td>
</tr>
<tr>
<td>Intention and question</td>
<td>5</td>
</tr>
<tr>
<td>Delimitation</td>
<td>5</td>
</tr>
<tr>
<td>Overview of the report</td>
<td>5</td>
</tr>
<tr>
<td>Background</td>
<td>5</td>
</tr>
<tr>
<td>Theory</td>
<td>9</td>
</tr>
<tr>
<td>History</td>
<td>14</td>
</tr>
<tr>
<td>Method</td>
<td>15</td>
</tr>
<tr>
<td>Result</td>
<td>27</td>
</tr>
<tr>
<td>Discussion</td>
<td>29</td>
</tr>
<tr>
<td>Conclusion</td>
<td>30</td>
</tr>
<tr>
<td>References</td>
<td>32</td>
</tr>
</tbody>
</table>
**Introduction**

My intention is to create woven materials for sound absorbing walls. I will make different versions of spaces. As a professional weaver I work with both the handmade and the industrially made structures because they have different character and quality, in this way I can have a broader approach to making and design, that is craft for me. Since they have different qualities and possibilities the knowledge of how to make them, how they appear and how they can be used is important. When to chose which way of making. The essay is the written part of my master project where you get a better understanding of the field of sound absorbing textiles and how I think of textile as a building material.

The project is called “A Room of One’s Own” because of the need of an undisturbed workspace, which is what Virginia Wolf writes about in her essay “A Room of One’s Own”. I needed a workspace to focus inside of. Workspaces today are often located in open landscape offices or active office spaces. The one cell office is disappearing, how does that affect us?

I have investigated required properties for materials used in the public space and realised that the most important quality’s are low flammability and porous fibre. I have chosen to work with silk and wool since they have these qualities and don’t stress the environment when produced. A big part of my investigation takes place in the loom where I develop materials and then I test them spatially and discuss with the user, the clerk and my tutor. My target group is interior architects and acoustic engineers. In the loom I also test and develop colour and structure. In the same warp I can make several expressions by changing the weft yarn, colour or binding. As a weaver I get to know the material through the making and then I see how to take it further, either in the loom or when of the loom. I make several samples when I am creating a new piece, and I save the samples for future projects; this is becoming my textile library. In my own sample collection I can see where I am, where I was and where it could lead. I am also inspired by surfaces and structures in architecture and nature and together with the woven samples I find out how to make the next move.

I test the sound absorbing quality with the “Blow-through” test in the loom, and the “Tube-test” when the material is off the loom.

Sound absorption is a wanted material property today since many offices; institutions and private spaces suffer from bad acoustic environments. Often the reverberation time is the problem. When the reverberation time is long, the eco becomes disturbing and it is difficult to hear what people say. A general high noise level can cause stress and difficulties to concentrate. This I experienced at Konstfack. Acoustics and experts working with environmental issues say, “The solution is to shorten the reverberation time and absorb the sound”. (Hoffmeyer, Rasmussen, Brunskog. Aalborg University Denmark. “Reverberation time in Classrooms” 2008)

That is why I chose to work with my own material-based craft practice towards the field of acoustics. Sound absorption is somewhat built into the textile fibres and if we use it consciously and develop them further we don’t need any boring acoustic panels/ sound boards, instead we can use textile craft and fibre art.
**Intention and question**
My aim is to work interdisciplinary with weaving and acoustics creating materials suitable for a workspace. I want to make textile walls/architecture for the public space. I will look at how workspaces are planned today with the open-plan office and how they affect us. My question is – How to work with textile architecture in the public space and make the material sound absorbing by studying how that has been done and can be done?

**Delimitation**
I have chosen to study textile as a sound absorbing building material and treat it so in my material based craft practice. This also includes my own expression. Not focusing on other technics then weaving, but look at both hand made and industrial made. I will only work with woven structures. I will not look into non-woven or knitted fabrics, they are already well represented in this field. When it comes to choice of material I am led by what is usable in a public space. I will not work with one specific space. Size will be limited by the size of the looms and time. I will not work with other colours then yellow and grey.

**Overview of the report**
In this report I want the reader to be able to follow how and why I chose to work interdisciplinary with weaving and acoustics and what I learn doing this. I have tried to catch my understanding of how to work with sound dampening textiles. First you can read about my background and the topic, and then go deeper into theory, history and the methods of my practice. The result is the result of sound tests and the response and result of the installation at the spring exhibition. In the discussion I write about how to continue this work and how to use my new knowledge.

**Background**
My context is Craft; I am a material based textile artist with an interdisciplinary orientation. Acoustics is a new field for me and felt necessary to enter to overlap the gap between how we look at textile art and the use of sound absorbing sound panels in workspaces. I will apply the Design process in my method to face the function and the new context as acoustics provides.

Looking up, metal racks and ceiling with acoustic panels.
Looking down, a hard desk, books and pieces of cloth.
Looking left, an empty shelf in metal and left traces of a former student.
Looking right, my classmates empty desk.
In front of me, a soft panel with sketches and samples.
What do I hear: noisy ventilation and someone laughing out loud.
I can’t concentrate on writing...

This is how I experienced my workstation at Konstfack, Stockholm 2013. It is situated at the textile department, in a classroom for approximately 50 students. The materials are hard and the students are loud. The space has a bad acoustic environment. The ventilation is loud and disturbing. I felt the need to develop a better workstation.
To overcome the acoustic problems of open spaces architects and interior designers often use textile. How well a fabric absorbs sound depends on the characteristics **weight, density and thickness**. There is sound tested textile material on the market but they are made to be put on a dampering soundboard. These kinds of panel structures create patterns that braks up the wall and/or ceiling. I want to make textile objects that in them self are sound dampening. It is important for me in this project that the aesthetic appearance of the textile objects and it’s sound absorbing quality cooperates.

“In architecture already exist a rich variety of architectural forms that regulate sound. But these angled, curved and structured planes regulate sound through reflection. Textile regulates sound by absorption. There exists no corresponding idiom for this type of sound regulation. Contemporary architecture is most often built of hard material that creates spaces with to long reverberation time. Mounting visually neutral acoustic panels on walls and ceilings generally solves the problem. This creates a space with an inconsistent visual and aural expression: We see a space with smooth and seemingly hard surfaces, but we hear a space without boundaries, while walls and ceiling do not reflect the sound back to us. The need of dampening the reverberation time and consistence of visual and aural perceptions are conflicting. Textile can perhaps solve this problem, without compromising the consistence of our spatial experience. Textile has good sound absorbing properties, which relies partly on the type of fabric and partly on its location in the space. Also, textile has interesting architectural qualities, which consists of its wide span of expression and function, such as transparency, structure, flexibility and lightness.”
(Cecilie Bendixen 2012, translated by Linnea Blomgren)

Bendixen points at that what you see is in conflict with what you hear, when we build away the sound rather than absorbing it through material we can see. She also mentions that textile has interesting architectural qualities and that textiles wide span of expression and function makes it suitable for different kind of spaces and architectural expression. For me the capacity of creating structures that goes with the aesthetic of the space and the textile materials flexibility is most interesting.

The name of this project “A Room of One´s Own” is inspired by Virginia Wolfs essay. To me it is her most confronting text where she with humour and honesty writes about how it was to study and work as a woman in the early 1920’s. As a writer and intellectual she had a hard time to be equally treated. She writes about respect for your own practice and knowledge. One should have a workspace and money to be able work professionally. By creating a workspace in textile I continue this task in todays open space office. Everyone should be respected when in need of working undisturbed and have the possibility to step into a room of ones own.
I can now put together acoustic, textile architecture and textile materiality with the need of privacy and focus. Function, materiality and design are all as important.

Noise has become a bigger problem in modern building since the use of concrete, steel and glass in big open spaces with flat surfaces and a strict geometric planning is today more common. Textile material can be built into the environment in different ways. For an example is a part of the roof, the wall or objects to dress the space with a comfortable sound experience. The awareness of textile, that it can be made to suite the expression of the space and that architects turns to a textile artist to get the quality needed is a part of my goal. I as a professional textile artist I want to have the acoustic knowledge about my materials. We don’t have to think that acoustic textile is only mass-produced and
looks the same everywhere. Whatever textile you bring in to a space will affect that environment. Try outs has to be made find out how much material is needed, and some material. In hard rooms the sound bounces back and forth between the hard surfaces and creates a long reverberation time that needs to be corrected for people to be able use it. This is a common problem.

**Why do we need a room of our own, today?**

We need visual and acoustic privacy to be able to focus and keep a strong personal self. The American sociologists Foote and Cotrell say; 

"*There is a critical point beyond which closer contact with another person will no longer lead to an increase in empathy. Up to a certain point, intimate interaction with others increases the capacity to empathize with them. But when others are too constantly present, the organism appears to develop a protective resistance to responding to them… This limit to the capacity to empathize should be taken in to account in planning the optimal size and concentration of urban populations, as well as in planning the schools and the housing of individual families.*"


"*In every case there must at least be room for a desk, a chair, and things from your life.*" 

("A Pattern language", New York 1977, pp. 672)

**How can I improve the sound of a space with my woven matter?**

Through working with porous material in technics that create mass and density. There should be space/air between the textile layers and/or the wall for a god result. Build away critical hard corners and parallel flat surfaces.

Before starting the actual master project I made samples in several different technics such as different cords, rag rug, plain weave etc. I used different quality of wool, silk, viscose, paper, nylon, cotton and linen. The blow through test led me towards the mix of wool and silk cloth. They are also safe for public spaces in case of fire.

My decision to weave the silk-rag was because of the properties of silk. It is environmental friendly, fire proof, keeps air and reflects light. In my shibori practice I often use silk and I had leftovers to make woven samples from. It is easy to weave with silk fabric as weft. The folds created when tying the knots of a rag rug makes the surface speak of it’s function. I tried different heights on the knot and analysed them together with acoustics. The knots/pile creates pleats in the fabric if you don’t cut it open. In this way I could get a high pile and folds in the same technic.

The weaving process of a pile is quite slow and when I realised I should do the Rag rug I planned the size of that piece in order to be able to make within the project. But first I made a bigger sample (75 x 100 cm) to see if it had the dampening effect I wanted. I examined the piece together with Niklas Billström and Björn Hellström and they both thought it would be dense enough dampen the sound. But it is hard to tell how much, and how big it has to be. We did the blow through test, and barely felt the air all the way through. The acoustics at Tyréns believed in the surface only by seeing it and touching it.
During this project some artist’s that have been important inspiration for me in how they approach their work. London based artist Ismini Samanidou trained at Central Saint Martins and the Royal College of Art is specialised in woven textiles. Her practice touches on the boundaries of craft, art and design. She uses weaving as a language to communicate and express ideas through a ‘hands on’ approach integrating digital technologies and craft skills. Ismini is interested in the way weaving exists as an autonomous language. Crossing cultural and political boundaries, weaving retains local identity with global connections, articulating narrative, space and history. Samanidou says. ‘In my own work and in my collaborative projects, I am driven by an investigation into how weaving can exist within architectural space,’ ‘I believe this creates a new value for weaving, highlighting its beauty, longevity and sustainability, while creating works that can be enjoyed by generations to come.’ Samanidou considers weaving to be one of the most sustainable techniques used today and points out that its longevity and potential to create works with high production values sets it apart from other methods. Her method in pushing her own skills towards new boarders by cooperating with other artists and knowledge is a method I am interested in since I myself try to push my knowledge and weaving through working with other professions in interdisciplinary projects. I also feel she has a fantastic way of using the digital jacquard, and exploring how it can be used. The designer Petra Blaisse, born 1955 In London is one of the most experienced interior designers within the field of textile architecture today. Her work is often moving curtains on a rail or other flexible objects that can be opened or closed. I find her interesting because of how she works in scale. Huge curtains with windows, artistic blindfolds for modern buildings with focus on function and usage. I have studied her works because she is the one I find digs most in, and try to find out new ways of approaching textile as an architectural material. The big scale is a way of telling that.

The artist Louise Bourgeois’ (1911- 2010) textile sculptures makes me question my own relation to the material. How do I treat it and why? During this Master project I have gained new eyes on how I value my material. The handmade materials are also just materials, if not ready it can be worked on and processed over and over again. The weaver Sheila Hicks has carried a small wooden frame to make “mini me’s” in the past 30 years and she makes samples for bigger weaves, like diary notes in it. I have used the small frame to sketch in during this project because it is quick and easy to bring. For me the frame works as a sketchbook, and Hicks thought me that. I find it free. These small pieces becomes so personal, the size matters. Sheila Hicks weavings each one differs from the other and they are amazing to look at. When I first saw them I felt like someone wrote in my language, but better, more vivid. With a longer life. They refer to how to material tell a story. I find that to be the language of weaving, how the threads create the story. The capacity shaping material is the work of a weaver. Building with textile."Sheila Hicks amasses individual units to make social walls of cloth, that is, environmental installations of social commentary. That she chooses the wall as her format is important. She cements the meaning into her walls by the units of cloth she chooses as her building blocks” (whole cloth).
Theory

Weaving sound dampening textile.

This is quite a new field, but at the same time old. We have used textiles more in our homes for comfort, warmth as covers and also to show our status. It was rich people that could afford and had the time and knowledge to make these expensive and treasured textiles. Today we use textiles more careless and they don’t have to be well made to keep our houses warm and show our status. The globalisation of the market has changed our perspective. We have pinpointed the function of textile as sound absorbing and comforting but it is not common knowledge how to use it or what materials to chose for what function. The need of sound dampening textiles began with the modern architecture’s open spaces and hard materials. It is used for function and wellness. I want to bring textile art back into our everyday life, in the office.

During my research on acoustic textile I read Cecilie Bendixen’s Så vidt et rum and Kaja Tooming’s paper Toward a poetics of Fibre Art and Design (2007). They both investigate the sound absorbing properties of textile material and the sound absorbing properties established through the form and position of the textile in a space. These investigations are all measured with the tube test, and if I do the same with my materials I hope to add new knowledge in how to weave sound dampening material. With the test results I can compare my materials to other materials and draw my conclusion on how my choice of material and technic worked out.

It is concluded that textile’s air permeability, stiffness and weight are important for its sound absorbing properties. Moreover that the textile’s distance to the wall, the amount of textile, its degree of draping and folding, its distribution in space and angle in relation to the sound waves, all together determine the sound absorbing effect. These are my guidelines during this project.

In Kaja Tooming’s PhD Toward a poetics of Fibre Art and Design, Aesthetic and Acoustic Qualities of Hand-tufted Materials In Interior Spatial Design from 2007 she research how to use the technique of hand-tufted textile art to make the reverb less in a specific room. She tested it spatially and came to the conclusion that the height of the pile is important for how well the material absorbs sound (which is used in a hand knotted or tufted textile). For example a 40 mm pile, lower the reverberation time more then the 18 mm pile. So you could think that the more material and air permeability, the better sound absorber. That is one of the things I want to look at when testing my materials. Is more material always better? These former PhD’s on the subject declare great research on materials such as which yarn to use in tufting, and what cloth to fold in how many layers
to get the best result. Like me, they tried not to use soundboards. What I think I can add is the view of a weaver working with colour and structure. Both Tooming and Bendixen worked with only the plain white material. White fabric and white yarn. They avoided colour and pattern in these specific projects. Perhaps a way to focus on function. I feel it is only half of the process I communicate through pattern, colour and structure.

**Natural Fibre As an Acoustic Material**

Wool has many unique properties. It is extremely durable, keeps air, and is suitable for sound absorption. Silk has a random fibrous cell, which is good for sound dampening and has a flat sound absorption without having any particular peak or dip. It works on a wide range of frequencies. The Choice of Materials suitable for public space is limited because of the requirement of low flammability. Wool is a material with low flammability. It is extremely durable and a protein fibre, which in itself is flame-retardant. Once wool or silk catches fire it doesn’t flame, but the fibres are charred and then extinguishes. This is common for protein fibres. Environmental issues, is the reason why natural fibre based interiors have increased the past years. They are biodegradable the production involves a low carbon footprint. Natural fibres used as acoustic fibres are Cotton, Silk, Hemp and Wool.

In 2012 Cecilie Bendixen finished her PhD “Så vidt et rum”. Bendixen investigated how sound absorption and textile can create space, and she also test different qualities of textile materials with the tube-test.

Cecile Bendixen wrote: “A further exploration of the spatial potential of sound absorbing is recommended, preferable with textile as absorbing material. The combination of the fields sound, textile and space is new and need to be explored.”

She examin materials like cotton, polyester and silk that exists as cloth and her work gave me a base of knowledge in what materials to work with and how. For an example what she writes about the fold, how the folded textile affects the space. In the folded textile the sound has to travel through many layers and is absorbed within the fold. It brings together the knowledge that flat surfaces facing each other, makes the sound waves bounce and that the amount of porous material in the wall/object makes a more efficient sound absorber.

I also gained knowledge of how textiles should be placed spatially to get the best effect. But this of course can differ from space to space due to materials and usage of that space. My focus is to weave walls to make “a room in a room” installation.

**Where to add the material?**

Sound absorbing textile materials are often placed in corners where the sound bounces between the facing surfaces and along edges of rooms with a parallel structure. The roof is also often used since it is a big space that isn’t used for any other purpose and the floor is important since it lowers the sound of high heels, falling objects and scraping chairs. It also helps in that way that the sound doesn’t travel further down in the building. This is knowledge that I carry with me from my background in music working in recording studios but I have researched this by reading Björn Hellströms “Open office is acoustic and architecture” 2012, and discussing with him and acoustics at Tyrëns and Cecilie Bendixens PhD “Så vidt ett rum” 2012.

In the open office a divider or object between desks and chairs is often placed to create a room in a room feeling and create a private space. I will try to make a “wall” that gives light and colour to inspire with a surface interesting to look at and feel to and of course dampens the sound from a close by colleague.
"Carpets are one of the most practical and cost-effective products available for controlling noise in the built environment." Dianne Williams, (Graeme E Harding and Associates, Consultants in Acoustics, Noise and Vibration)

I will not make a carpet but I will use the technic. My inspiration has been outdoor walls and I want to work with a vertical space-making object in the room to make walls, textile architecture.

Room acoustic
Hard walls and ceilings are great to keep sound out. Hard materials are good at stopping sound, but it also reflects the sound back into the room, which contributes to high levels of noise and echo effects. I will use soft and fibrous materials.

When a sound wave passes through a material such as a porous fibre, it drops some of it’s energy through friction; the friction reduces the sound energy. We say that the material absorbs the sound. How much sound that is absorbed depends on the material’s density, fibre structure and thickness. Any air gaps to the wall/ ceiling behind are also important.

Textile has god noise reducing qualities, but is not better then the common acoustic boards. However, textile carries a number of aesthetic and functional possibilities that the acoustic boards don not. By using textile as sound absorbing material we access both aesthetic and functional sound absorbers.

At Märta Måås-Fjetterströms Studio, we often had architects and interior designers as customers. We made rugs, tapestry’s and carpets and I realised that these textile surfaces is not only beautiful they have a god impact on the indoor environment in a broader context. They where placed in homes, offices and public spaces and it was interesting to follow the choice of style, colour and expression.

How does these skilled spatial planners look upon textile art? They use textile art to make body and mind comfortable within a space. A carpet or tapestry affects how the room sounds and how it feels to be within that space. A room with long reverberation time is not comfortable for the ears. For both of these professions the expression made by the designer was important. From this experience I learned that there was a unique selling point in textile art for the public realm that perhaps textile artists could enhance with more knowledge about it’s broader context. Sound absorbing material/art can be a part of the building budget. What if textile could be a part of the interior and an actual building material?

(This image is borrowed from Acqwool. [www.acqwool.se](http://www.acqwool.se))

[Image of sound absorption diagrams]
How do we perceive sound?
How we perceive sound differs from person to person. The experience of sound is not only depending on volume, it also depends on Frequency, Reverberation time, Exposure time and type of sound. Noise is often a mix of different frequencies with different sound levels. Low frequency noise could be ventilation or machines. These sounds are often disturbing even if they are not loud in volume. The reverberation time in a room depends on materials and angles. A standard reverberation time has been defined as the time for the sound to drop down 60 dB (decibel). So what is a desirable reverberation time? It is 1,5-2,5 seconds for an auditorium for speech and music. With a reverberation time below 0.3 seconds, the sound is defined as “dead”. It becomes difficult to hear anything in the back of the room and there is a loss of base. Exposure time is a measure of how long time we are exposed to a certain sound.

(hyperphysics.phy-astr.gsu.edu)
If we stay too long in a noisy environment it causes stress, fatigue and headache. In the report from HRF (Hearing impaired Association in Sweden) 2009 we can read that human voice is registered as important information in the brain. So talk is considered to be disturbing. I have through out the process discussed this with other people who sit in different kind of offices and I have also read surveys about the change towards the open office. One of these surveys is made by Konstfacks property owner, Vasakronan and says that more then half of the 2.3 millions of people working in offices in Sweden today don’t have a room or even a desk. 44% can rarely or never work undisturbed. Sounds from ventilation, phones and loud talking colleagues are the most disturbing issues.

Every forth is disturbed at work
Moore than half of the 2,3 millions of workers at offices in Sweden lacks a room of one’s own, or don’t even have a fixed workplace, according to Vasakronan, which has been examining office employee’s attitudes to work. And the proportion of those who work in landscape offices, or big rooms for 2-5 persons, increases. While the proportion of square feet/ employee is shrinking. A clear consequence of the shrinking space and open landscapes is that you feel disturbed at work. In the survey, nearly half, 44 %, of those who sit in the open landscape office, rarely or never can work undisturbed. Undisturbed meetings with colleagues, only 16 % of those who sit in open offices. Vasakronan survey also shows that the interference consists of noise from ventilation, cell phone signals, colleagues who talk to loud on the phone, and a generally high level of noise.”
(Vasakronan survey, Dagens Nyheter 4/9 2104,www.dagensnyheter.se)

What is a comfortable sound?
“What we experience as silence is when the air pressure is constant.”(Kähäri, Audiologist). But that is not what we experience as a comfortable sound. Comfortable sounds are sounds of nature like water, wind and birds. Sounds that don’t caught our attention and stays in the background help us to relax. (HRF). That kind of background noise is also what we call “The White noise”. It can sound like the “sh” in ash, or like an old radio in between stations. This sound can be added to an environment where you don’t want to over hear conversations or to relax when going to bed.
The workspace

Today we know through research, that open-plan offices can be bad for our health and make us less productive, 2-10 %, according to Helena Jahnke, at Gävle University. In her PhD on the subject of open-plan offices, she shows that people tend to get more tired, and less concentrated because of all the sound and visual impressions.

“*Taken together, the current thesis demonstrates that open-plan office noise can have a negative impact on fatigue, motivation and performance. How much performance is impaired varies with the cognitive processes required by the tasks performed and hearing status. Moreover, continued noise exposure during a short break can further decrease motivation and subsequent performance.*”
(Helena Jahnke, Gävle University 2014)

The first open space office was made by Norman Foster, one of the pioneer’s in the 60’s. His open space office had yellow walls, reflecting metallic roof, and plenty of social areas for talking and eating and a swimming pool for the employee’s, inside the office building. They had a terrace restaurant on the roof. This was successful. A beautiful office, planed for people. This concept where later copied, but the social areas and the common swimming pool was not a part of the later copy’s. The open-plan office was what was left. No fixed workspaces, no social spaces, no swimming pools, and no beauty. The research report "*Working environment and productivity*" newly made by the Nordic Council of Ministers, presents new findings about the relationship between work environment and productivity. (Magnus Fröderberg/Norden.org)

It says that bad physical work environment is bad for the companies’ productivity. Sounds from other people talking, noisy ventilations and so on, together with movements next to your desk, and no fixed work spaces, are the most common thing to be disturbed by in an office.

I will work with light and torn surfaces that tell a story to make the space inviting and intriguing to look at, and be in. In the last ten years several PhD’s has been written in the Nordic countries, about how to design and use textile as sound absorbers. (Bendixen 2012, Bodin 2008, Tooming 2007, Zetterblom 2011, Persson & Svensson 2004)

Bendixen’s “*Så vidt ett rum*” investigates how textiles can, or must be spatially formed and positioned to simultaneously absorb sound and create space. Bendixen uses ordinary woven cloth of different fibres and density. Her paper is the one I find most interesting, for an example, what she writes about the fold. The one thing I find strange with her thesis is her choice of material. She examines several types of cotton, only one wool polyester and nylon. But no silk. I find this strange because cotton is really flammable and not suitable for the public space.

In large open space buildings, adjustment of the acoustics with only textile is a different task, then adjusting the sound with acoustic panels. Because I don’t want to hide it, I want to highlight it.
History
Gottfried Semper (1803-1879) 1851 Introduced textile as the ideal material to make space with. Semper says that textile can make space, since spatiality is far more then what a common wall creates; it is also the idea of a space. To divide a space. Semper writes that “textile as material is what we essentially recon as room making, since it was the material we, since the dawn of time, established our first rooms with and it still is the material that manifests our capacity of understanding space. While the hard walls of architecture are protecting us from the outdoor climate, textile can be part of the architecture that make’s space.” (Semper 2004)

The nomadic people in the world have used textile as walls, ceiling, floor, and on the table for thousands of years. An example of the first Textile architecture is the Ger aka Yurt Used as housing in Siberia. It is a round portable house with mats of felted wool tied on a wood frame with ropes.

This Mongolian Yurt I photographed at the Textile museum in Tilburg, during the exhibition “Building with Textiles” 2015.
My notes about history and making of Rag rugs.

**Method**

My goal is to develop several different sound dampening materials to build a space with. I have come back to the making of samples and sketches several times during the process because I wanted to test more than one or two materials. My work is practice based. Craft is for me a material-based artistic field where the knowledge of making is connected to both body and brain at the same time. The bodily experience of material and the experience of making create new knowledge for future artistic expressions. In this master project I work with my own expression through material and I am also looking at function very strict. The sound-absorbing piece I want to develop could end up as a product for an actual workspace, office if I present it so. I was encouraged to
meet my process through the Design process method. So I will present my work in the Textile Design Process, although you will notice that it is a crafter speaking. I have developed my textiles to meet the need of sound absorbing materials in modern buildings made of wood, glass and concrete.

I decided to learn more about the field and see what I could add to it by using my knowledge in weaving and design for industry as well as handmade. I want to combine my weaving skills with acoustic knowledge to make sound absorbing textiles and really use my knowledge and background in making carpets and jacquard patterns. What kind of surfaces will work? What materials to choose? Is it only wool that works? The questions have been many, and answers as well...

**Research, examine the need**

Since I wanted to work with sound absorption and “A room of ones own” I started to look into literature and research about acoustics and textile architecture. I was recommended Cecile Bendixen’s PhD “Så vidt ett rum” and I also found “Textile Architecture” by Sylvie Kruger and I went to the exhibition “Building with Textiles” at The Textile Museum in Tilburg, Netherlands. This led me to the architect Petra Blaisse, whom is the big star of textile architecture today.

Textile is in no way a new material for creating space; it was one of our first and most travel-friendly building materials used by nomads all over the world. But the field has of course changed and it is developing with new needs, technical innovations and artistic expression. The most obvious needs are sound absorption, room dividing and the capacity to transform a space for different usage. We need textile materials in our everyday life to be able to work and live in the big open spaces of modern architecture. So, I had to learn more about acoustics to understand how I should think when choosing materials to merge in the loom. What is acoustics? How does textile material react on sound waves? Which materials have the porosity and density to absorb the sound waves? How could one place the material and how much is needed? So many questions… I was lucky to have contact with Björn Hellström here at Konstfack and he arranged a meeting with the acoustic engineers at Týrens in Stockholm. At our first meeting I brought samples of different textile technic and thickness and we talked about what functions the material should answer to, how that could be implied and tested and how they work with textile today. I also learned that they can’t propose a material that isn’t tested. We met a few times during the process and it really helped to meet these professionals that could answer many of my questions of why and how…
This is a picture of the Seminar room in Alvar Aalto’s library in Viipuri in Russia. It was constructed between 1927 and 1935 in what was then the Finnish city of Viipuri. I find it interesting and important because of how it shows how the sound travels within that space and it made me interested in architectural structures in different materials. This is Alto’s way of building away the reverberation, the sound won't bounce back and forth between the surfaces. The wave makes the sound travel. The roof is shaped like a wave; it is not a flat surface. This wave, also reminds me of textile roofs, the fold and material capacity and flexibility. I will use folds and the knots in my surfaces because the technic create layers and keeps air better then one-layer or flat structures. In a sense they tell how they work as sound absorbers

Understand the need
From what I had learned at this stage I came to the conclusion that the knotted surface seemed to be a god way of creating a three dimension material that was dense, heavy and thick and air could both be caught up in the pile and some could pass through. I also realised that one could work in layers with air in between. So not only three-dimensional textiles where necessary. The airflow and the function to shorten the reverberation time for different type of sounds was now my goal. I understood that to be able to say that the material I was to make was sound absorbing I had to test it. Or else the acoustics and or architects would not be shore if this was a god material and no less use, or suggest my materials to a customer. But I also have needs. I want to make my materials with my expression. For this project I have picked out colours from images I took of torn walls and outdoor light. I worked with the torn walls last year and made samples of warp prints but now I want to be more free bringing the in the torn surface in a more scattered form or add patina so the natural fibres don’t
look nice and pretty. I chose a bright yellow that gives light and energy, and I will mix it with together with a grey that gives the impression of heavy and calm. I want to work both with pattern and colour. The rag rug should be quite calm pattern-wise so the folded structure of the surface will not get lost. The size will matter. I have not decided a certain workspace to work with. I tried but came to the conclusion that I want to focus on the material and my way of making.

**Idea development, experiment, sketch and test**

When I weave I start with an idea. Pretty soon the choice of material is taken, since the warp is the backbone of the woven structure and it cannot be changed when once in the loom. Into the warp goes the weft, and that can always be changed. There I can play. Also the binding and density can be played with. The knots can even be changed once the weave is off the loom. By experimenting with colour, structure and yarn my design evolve in the very process of weaving and dyeing. I go between the dye workshop and the weaving workshop, trying out combinations of colour and material. That is where a big part of my work takes place. This I where I can listen to my thoughts. So, the first decisions where which material to use in the warp? I wanted to do several different one’s. The linen warp for carpets is thick enough for tying pieces of cloth in and at the same time get a plain base in, I want to work with that clear cold yellow I can get in the Remazol dyestuff, to have the same yellow in the silk. A wool yarn that has about the same thickness as the linen warp was the Norwegian “kunst vävgarn”. I also used a thinner twisted wool yarn to try out some cord structures and plain weaves in. These cords I tried out because they held a lot of material and therefore I think they also keep air. They are quite bulky, and that is often god for the sound absorbing effect. I also made a test in plain weave and I took the course “industrial weaving” to be able to work big with wool in jacquard technic.

**Idea development**

My ideas developed through sketches, writing, and mood boards, collecting references making material samples, dyeing, trying out colours and weaving in a mix. It goes back and forth a couple times. I wanted the structure to be interesting, to be something to discuss, to touch and breath through. I weave both in the loom and in a small frame to be able to test several ideas at the same time. So when I had some ideas collected, simple drawings, full scale sketch and for one idea a model, I went back to the loom again to make more versions and finally one bigger test of the rag rug in silk. Out came a Rag rug, two plain weaves, three cords and one handmade jacquard piece.

**Trial and error – every day!** I showed my best samples to the acoustics the rag rug was the surface that the acoustics and architects thought would work best. I made bigger sketches and weaves to see if the material had the effect I was after, to become a less disturbed work space. I hang the rag rug test piece, which was 75x100 cm by my desk in the textile department, and I sat in it working for two weeks. I invited others to try it. I felt less disturbed in there. But I wanted it to be bigger. I wasn´t satisfied with the hanging, which was a horseshoe-shaped metal rod covered in grey felt. But I liked the way the material came close to me and I felt stillness inside. It shut out some noise and I think it made people realise I didn´t want to be disturbed when I was in it. It felt god that no one could watch me working. It made me focus better. I felt that it needed to be bigger to work better at least 40 cm longer and 20 cm wider. The size of a screen wall placed on a desk should be at least 0.6m above the desk surface and 1,4m from the floor, when standing. (soundab.se) I realised that if I was to weave this in
The biggest loom at school was 1.4 m wide. I went for 1.4 x 1.4 m so I could turn it any way I wanted to. I made the warp extra long since on my test piece I had had extra warp dyed in grey in one side and yellow in one side and I used the yellow to make a big braid in one side. That braid made the piece look human. For me it was the presence of Virginia Wolf. I figured I could develop the finish if I had long warp threads to work with.

It is approximately 15,000 knots in the rag rug.

Process

mood board

Sketching
Through sketching I try out new ideas visually. With sketching I mean all the stick figures in my notebook to full-scale sketches, models, and try outs in the frame. Sample weaving.

**Distil, final processing and presentation of idea**

I presented my ideas and materials to a group of ten acoustics at Týrens and to an interior designer I met at the Stockholm furniture fair who works especially with acoustic textiles. Marja-Liisa Okko. They all believed in the Rag rug, the paper version of the rag rug and also the cord seemed interesting to the acoustics. The acoustics mainly looked at the materials function and one of them asked if I wanted to add a soundboard behind my material, like they usually do when working with textiles. So I explained that I wanted to make materials that function as sound absorbers by them selves without the mineral wool behind. After reflecting on the sample of the Rag rug I made a bigger Rag rug (140 x140cm) as a first “wall” in my project. The blow through test told me I was heading in the right direction. The silk rags that are looped to act as pleats, woven with wool in between catch more frequency’s. And after painting and testing and talking about this first big test I decided that the yellow had to play a bigger role and the folds should differ in height more. Some should be longer loose ends and the whole piece should be messier. I changed the tightness of the warp to a read with 30/10, instead of 40/10, and made the size according to human scale and the looms with. 1,40 was also the recommended height on a standing screen wall. I decided to add more pieces of old clothes, like silk shirts in various colours that I dyed. This became new additional mixed colours since they where not white. These rags from old clothes really helped me to get away from the to nice and shiny surface. I also worked on the patina of the surface. I tried out different colours and glues mixed with pigment and choose to use a theatre paint that is sprayed on to the cloth and don’t need fixation. The hanging of this piece is a 100 mm high, 10 mm thick plexi with holes for each set of three threads that comes from the oriental braided endings that was the finish on the rag rug. This choice I made to get a meeting between materials. A material that also spoke of light and didn’t become heavy in expression. I wanted the rag rug to hang from the ceiling. I wanted it to be a rounded shape to hug one person working. The plexi is possible to bend but it was scary, and I didn’t know how to do it. After the examination I did some try outs with heat and finally I dared to bend the 10 mm plastic in a rounded shape for one person for the spring exhibition.
The industrially made wall
With the Jacquard fabric I wanted to form a bigger wall. I had 12 meters of fabric and I
could make it 3 m high and 4,30 m with. I worked in layers to make it dampen the sound.
The pattern is made in Photoshop from a photo I took of a hand woven jacquard sample
I made during a course last year. That sample was a woven image of a torn wall. A photo
I have had as inspiration through out this project.
I reworked the pattern to become repeatable and asked Bogesund weaving industry not to do the finish (all the treatments they do after weaving), because I wanted to dye the fabric afterwards and keep the original structure. I dip dyed the 12 square meter wall in grey. I also made the backing grey first and after the examination I changed it to yellow to make it work with the rag rug wall. At first I hang it straight in deep folds but after the examination I realised that I had to work through the shape more to make it become a room. The rounded shape was missing. Not one of my weaves had the hugging feeling that I had worked out on the test pieces. I have had some trouble bending the plexi since I had a 40mm thick plexi stick that not even the teachers dared to bend. So I went back to sketching and made a model on how I would shape and hang my walls in the spring.
exhibition and then I realised I could hide the shape for the bigger space in the fabric, it so high up so no one will look at it anyway and I made it in metal instead. The jacquard weave became two spaces in a S-shaped metal hanging and the rag rug hangs in two bent plexi strips. One up and one down.

I want to make textiles that people can interact with and would like to be surrounded by of material that is durable and nice to touch and feel. Acoustic textile is a big and technical subject, so I have asked Björn Hellström, acoustic designer at Konstfack to discuss my work during the process. He also introduced me to two of his colleagues at Tyrens. It has been of great help. I could ask all the questions that popped up, and they invited me to present my work for all the acoustics at Tyrens this spring where they all where discussed with me how to do this in the best way. It was after that meeting I was promised to do the tube test in their lab. After the tube-test I learned that the diagonal cord was the best sound absorber and that the rag rug was god enough but could be supported with a mineral wool backing for an even better result. The Jacquard weave needs three layers to become a good enough sound absorber and the rag rug in paper is perfect with a 40 mm soundboard backing against a wall. All of this information and results is stuff I can come back to and work with for several years on. There is not one answer of how to shape or weave these spaces. But I will continue.
After developing the idea about how one can place textile in a space, and how to dress a space, I continued weaving a carpet to wear. This weave is a long dark plain weave with rag rug in the end. That part is for head and ears. A wearable room of one’s own. To be able to answer my question I have been working parallel with theory of acoustics and sound and researched about three-dimensional structures through the artistic design process. It has moved forth and back several times. I needed to collect knowledge from both angels to be able to come up with a material and one or more products that is both functional and aesthetically fulfilling the purpose to create a better sound environment in an open landscape office.

**Production and marketing**
The production in this project has been me weaving some materials and Bogesunds Weaving Industry weaving one material. It went quite smooth but the hand weaving process took a lot of time and perhaps it was a bit too big to make in a master. If I were to make several of these walls I would still choose to do it in the same way. I have chosen technique and way of making after what I think is the best way of making them. I am glad to keep the production close to where I work. When it comes to marketing the spring exhibition has been a great chance to meet the audience and talk about the work. I have not priced these pieces. But I will set a square meter prize for each method to be able to sell it.
**Reflect and develop**

In the beginning of this process I made research about what kind of sound absorbers there are on the market today, and what other textile designers are making in the field. I’ve read thesis on the subject textile architecture, listened to textile designer Barbro Lomakka and discussed my project with acoustic designer Björn Hellsström and acoustic engineer Josefin Lindebrink at Tyréns. I have also met interior architects and office workers who may use these materials and objects in the future. The comments and discussions have differed from person to person but I realised that my strength is in the material making and textural expression; they understand that these materials are dampening and the handmade is a quality to enhance. The function is visible.

I met with Interior architect Eva Falk at Marge Architects in Stockholm since she is working with planning offices and adding textile. Her knowledge about sound coefficient and materials was very vague. She didn’t look at numbers, she asked the acoustics for help when needed but she worked with what she called common sense. I asked her to look at my materials and sketches and how she would hang and place textile in a space. She advised me to make a telephone booth, because that is what she experienced as needed and to add a table for standing up if one should be able to work inside. She asked for a completely round space for one person instead of the S-shape for two persons. And, she saw my textiles shapes at the big entries and foyer’s at a big University’s, specifically at KTH in Stockholm. She had worked with a particular space there and in there she would have chosen one of my fancy textiles, as she put it. She thinks they are too nice for the narrow office building, she told me to go for the historical, public environments. The district court, university or hospital. She also asked me about flammability and dust.

Other sound dampening textile products on the market:

* **Acqwool** made by textile designer Margareta Zetterblom, knitted in three layers of 100% wool. It really looks like felted wool and I don’t find it interesting. The surface is dead.

* **Kvadrat’s sound absorbent Clouds** by the Bourrolec Brothers is a module that can be connected. It has a low dampening effect but looks nice. I was surprised when I learned that it’s sound absorbing coefficient was low, although it is a very popular sound absorber. But it looks good and all the small parts make it alive and possible to change over time.

* **OKKO**’s sound absorbent Tratti is made in wool and creates a roof that looks like a mushroom upside down. I see it as a clever space-making object. Here she actually works with the roof but marks a space as well.

* **Anne Kyyrö Quinn** Art of felt and fabric. Three-dimensional sculptural interior textiles. Cut, sewn and finished by hand. She was early in on the thick felt that was cut in patterns.

* **Barbro Lomakka** woven dampening modules and carpets in thick felted wool. She often works with the natural colour of the sheep. Her production is handmade on Gotland. She has worked with the same surfaces for the past 15 years. Maybe some small changes but overall the same today as in the early 2000.

**Textile material choice**

I decided to use wool and silk as material in my textiles since they are natural fibres that can be produced environmental friendly and is considered fireproof in a public space. I refer to research about materiality and it’s sound absorbing functions as well as
statements from acoustics working with interior and focus my project on making a god combination of materials and finish my products as rooms in a room. I tested how to increase the absorption through pleating, tying and compress the material. I will also let two materials work together, with air in-between. I have also worked with colour, gradient and a marble look on the cloth I died to weave with.

A couple of times during this process I made incorrect decisions and had to go back to where I came from. Like when I decided to work with a staircase because it is a space that often has a really bad sound environment and I thought it would be easier for me to work with a specific space. But then I realised that the regulations for staircases are really strict since they are fire exists and it made that space feel impossible. What was god about that journey was that I left the thought of a room for a while and I could think of it different afterwards. I could see what was god with what I did before. Writing and sketching helped me back on track again.

Tests:
The Blow through test
Hold the material close to your lips and blow through the textile.
The resistance of the fabric you notice with the blowing should be between the absolute airtight and the entirely open. (Jan Boatman, acoustic engineer 2008).
The flow resistance of the textile is an important quality.

The tube-test
A tube test of my handmade materials is be possible with the help of Josefin Lindebrink, Acoustic Tyréns AB.
The Tube-test is not too easy to do it equipment is expensive, and it requires educated staff. Tyréns offered me to do it with their equipment. I will pay for the staff, and get a full day for testing. The actual tube-test gives me a number, a value that tells the user and me what sound absorbing quality it has. This test gives me hard fact. After my research about textile fibres qualities and different weave structures and density I have got a better view on what will probably work and not. But I can only guess. With a value from the sound (tube) test I can compare it to other materials on the market.

Colours used as Patina: wall paint, acrylic, spray paint. Theatre paint. This was new knowledge for me. That there is paint one can add without having to process it to make it stay. That the plastic paint we use in both acrylic paint and regular wall paint is made of elastic plastic that creates a non air-permeability surface on the textile.

Spray-painted test weave.
Result

Test results

To compare my materials to other materials the curves on made from the tests help me draw conclusions on how my choice of material and technic worked out. Ex:

### Rag rug + 80mm air

The numbers to the left 0.00-1.00 is the absorptions-coefficient and the horizontal numbers are Hz. This example shows that the rag rug would be classified as a C absorbent hanging 80 mm from a wall.

The classification from A (0,9-1,0) to E (0,15-0,25)

### Cord 70mm air

The cord is inbetween a A and B classified sound absorber.
The cord with 40mm sound board behind, doesn’t make it better. That was really an interesting and surprising effect I couldn’t dream of.

The jacquard in three layers is super in a certain frequency, between 900-1500 Hz.

The exhibition
During the exhibition I have had interesting discussions about colour and material and the importance of the hand visible in the technic. Iaspis and SLL consultans showed interest in my work.
Discussion
How does the hand woven and industrially woven co-operate?
More will be added when the spring exhibition is done.

Innovation contra tradition. Are they contradictory? How do we use these terms today at the textile faculty at Konstfack? I have been told throughout this project that the handmade rag rug is too traditional but the industrially made Jacquard is not. For me this seems like prejudices about textile that many of us carry. The rag rug I have made is not traditional when it comes to pattern or material choice. The technique of making a knot to create a three-dimensional surface is. And the Jacquard technic is at least 200 years old. I see both of these as old and well-known technics that both are suitable for craft made today, 2015. The innovation for me in this project is testing and using these old technics in the same way as we use a textile-covered soundboard today. For me this project contains both old and knew knowledge. Couldn’t innovation and tradition go hand in hand.
**Conclusion**

New knowledge for me in this project is how to sound test handmade materials and thereby make it possible to suggest and plan in projects for acoustics and architects. To integrate them in the market for acoustic textiles. But also to show that there are other kinds of textiles to work with in the public realm that has an expression far from the mass-produced nonwoven tested acoustic textiles used on soundboards. Now I know how these materials can be used as sound absorbers and I can continue to work on my expression without questioning it’s function. I can tell what my materials do to the environment they are in. I managed to create a material that is as good as a 40mm soundboard. It is the diagonal cord that turned out to be the best sound-dampening material of all the 10 I made.

I also managed to bridge knowledge between the field of acoustics and textile craft and I now can speak a language that both of these fields understand. When meeting the audience in the exhibition it seems to me that they automatically refer to the public space and the need of an undisturbed space when they see my piece. They do dare to step inside to feel and listen. Many women have read A room of one’s own, and this is an important question of today. The most common questions and response are about colour. The grey seems to be comforting and calm and the yellow energetic. The yellow seemed to attract people. The handmade piece’s structure and dye-method is what the most conversation’s was about. I was asked by the art council to be a part of a project because of how I approached colour in my piece. I have realised that it is hard for me to put words on why and how I chose a certain colour or nuance and that it is closely connected to my gut feeling about what feels right in the process of making. To trust that gut feeling and continue working within the frames I have put up for a certain project gives me a space to improvise within. The next step seems to be more research on how I apply colour in my work. I would also like to look at other choices of material, to work towards a specific space, develop weaving outside of the loom... I feel I am not done yet. I only just now started to understand what is possible to do and how to further develop the field. It has taken me two years to learn about acoustics in relation to my craft, weaving, creating material suited for sound absorption.
Now I want to take this further and develop research about how one can create space with textile walls in other materials besides the once I have worked with now.

I want to combine new fibres and old knowledge of weaving. To continue develop the process of weaving in an interdisciplinary context. Finding new ways of examine material choice, technic and target group. To test environments that has textile art and crafted items with and without these. What happens with the sound, with the aesthetic, with the experience of that space?
References

Literature:

“Forskare och praktiker om Färg ljus rum” Redaktör: Karin Fridell Anter

“Whole cloth” Constantine, Reuter 1997

“A Pattern Language Towns Buildings Construction”
Christopher Alexander, Sara Ishikawa, Murray Silverstein with Max Jacobson Ingrid Fiksdahl-King, Shlomo Angel.
New York Oxford University Press 1977
www.library.uniteddiversity.coop

A Room of one’s Own  Virginia Wolf 1929
_A Room of One's Own_ is an essay by Virginia Woolf. Published 1929, the essay was based on a series of lectures she delivered at Newham College and Girton College, two women's colleges at Cambridge University in October 1928. The essay is generally seen as a feminist text, and is noted in its argument for both a literal and figural space for women writers within a literary tradition dominated by patriarchy.

“Bloomsbury Rooms modernism, subculture and domesticity” Christopher Reed 2004

“Ryamattan” Uve Snidare 2007

“Sheila Hicks Weaving as a metaphor” Arthur C Danto 2006

“Om kontorslandskapets akustik och arkitektur – vad örat hör men ögat inte ser”
Björn Hellström 2012

“Så vidt et rum” PhD by Cecilie Bendixen 2012


Webpages:

TT, Dagens Nyheter 4/9 2104, www.dagensnyheter.se

hyperphysics.phy-astr.gsu.edu

www.library.uniteddiversity.coop