

New Opportunities for Norwegian Wool: An Investigation of Product and Market Possibilities

Birgitte Linde Røsvik Casper Boks
Department of Product Design, Norwegian University of Science and Technology
birgitte.rosvik@gmail.com casper.boks@ntnu.no

Abstract

This paper aims to provide knowledge on how Norwegian wool can contribute to a more environmental sustainable textile consumption and increase value creation in Norwegian wool production, textile industry, retailing and design. In the context of this project, the present paper reviews existing research on Norwegian wool and the physical properties of the material in order to investigate if there are other possibilities to utilize Norwegian wool. Existing research seems to focus on wool in the setting of clothes, even though the Norwegian wool is not suited for next-to-skin clothing. As the market for traditional knitted products is limited, it is necessary to differentiate Norwegian wool from the softer qualities like merino, and find areas of use that truly benefit from the properties of the Norwegian wool. The paper also addresses how some of the barriers and misperceptions facing the wool industry can be changed through marketing and product design, which is exemplified by the development of a woolen space divider, emphasizing wools acoustical properties and ability to regulate indoor air humidity.

Keywords: Norwegian wool, Product Design, Wool Space Divider, Marketing

Introduction

This paper is related to a research project conducted by SIFO (National Institute for Consumer Research) called “*Valuing Norwegian Wool*”. The project is a cooperation between SIFO, Norwegian sheep farmers and the Nordic fashion industry represented by NICE (Nordic Initiative Clean and Ethical). The main goal of the project is to provide knowledge on how Norwegian wool can contribute to more environmental sustainable textile consumption and increase value creation in Norwegian wool production, textile industry, retailing and design. The project has involved many stakeholders from the industry, such as sheep farmers and fashion designers.

Today’s situation in the Norwegian wool industry is that as much as 90% of the wool is exported as a cheap raw material to be used in the production of wall-to-wall carpets in the UK. The reason is that the fiber is too coarse to be used in clothing, and it is not economically profitable to process the wool for this purpose [1]. The wool industry is highly subsidized by the Norwegian government, and the fear is that farmers will start keeping sheep only for the meat, and simply discard of the wool. This would seem like a waste of resources. Is it possible to change this situation and make Norwegian wool profitable again? From a designers point of view this is an interesting problem. With a practical approach to problem solving and a strong focus on the users and their needs, a designer might be able to give a new perspective on how Norwegian wool can

be utilized. The goal of this paper is to analyze if there are other possibilities to utilize the Norwegian wool, and uncover new opportunities in the market. The paper also seeks to shine some light on how a product designer can contribute to such a project.

Research approach

The paper will review existing research on Norwegian wool, and analyze the physical properties of the material. Then basic theories in marketing and design will be introduced in order to facilitate the discussion around the approach of the two different professions. The design approach will also be explored through a case where a space divider of wool is being developed.

Existing Research on Norwegian Wool

First and foremost, SIFO represents a source of research on Norwegian wool. Klepp et al. (2011) sketch the current negative development in the Norwegian wool industry, where wool has become a byproduct to sheep farming and the production is seriously challenged, but also present a belief that Norwegian wool has technical, environmental and symbolic values that are not fully exploited [1].

Research shows that one of the challenges to be overcome is related to the coarseness of Norwegian wool. The fibers of Norwegian wool have an average diameter of 31,4 micron, which exceeds the comfort limits for next to skin garments which is about 28 micron [1]. The Norwegian wool is therefore considered coarse, and mainly used in heavier garments like the knitted sweater, mittens and socks. These garments have long traditions in Norway, and are considered an important part of Norwegian handicraft tradition. They are often sold as souvenirs to tourists, but still popular among Norwegians, and by many worn on a daily basis. Other well-known wool products are the national costume and the wool-underwear from producers like Devold or Kari Traa. Although these are household products in Norway, and most Norwegians seem to believe that these products are made from Norwegian wool, they are actually made from imported Merino wool. In fact most of the wool used by Norwegian textile industry is imported [1]. Norwegian wool may be unsuitable for next to skin clothing, but is strong and very durable. These material properties should make it ideal for rougher products such as interior textiles and furniture. Unfortunately the Norwegian furniture industry mainly uses imported wool in today's production. According to Tobiasson [2] it was when Norwegian furniture weaving factories stopped using indigenous wool and instead started importing wool that the most dramatic fall in use of indigenous wool happened. But there seems to be no apparent reason why Norwegian wool should be insufficient for this use, at least not when considering the material properties. Other reasons for why Norwegian wool is mostly exported as a cheap raw material are more vegetable matter in the wool and less whiteness. Also the lack of economic incentives for professional handling, lack of interest in breeding and lack of product development are mentioned as problems by the industry [2].

In a global context, wool has been losing market share to cotton and synthetic fibers, causing prices of wool to have been falling, but several factors have changed this picture recently. One is the rise of the BRIC (Brazil, Russia, India and China) countries; another is that draught and other problems with cotton crops leading to price increases for all fibers, as well as increasing demand for wool again, which may open up new possibilities for Norwegian wool. The Norwegian sheep farming industry causes little strain on soil and water use compared to the production in other countries. Norwegian sheep are farmed both for their wool and their meat, and they graze in the outlands. They are mostly in good health, and because of the high amount of outland grazing the

sheep are less exposed to parasites, which are a bigger problem in inland grazing. The greatest threat to animal welfare is the fact that approximately 10% of the sheep are taken by wolves every year [3].

Faulty Life Cycle Analysis research is mentioned as an additional barrier for Norwegian wool [1]. In 2010 the Dutch organization Made By ranked the wool fiber very low, and alongside conventional cotton. The analysis only covers parts of the life cycle, from fiber growth to the point of spinning, which has been pointed out as a flaw as issues concerning water and land use were simplified, and did not take into consideration that sheep mostly graze on land that is not suitable for other types of agriculture. Klepp et al. (2011) also argue that the use stage (including aspects of washing, drying and durability) has not been considered [1] although it is an important aspect that should be considered in a full life cycle assessment. Wool has the unique ability that is virtually self-cleaning, smell disappears with airing and soiled clothing is easily cleaned either by using a damp cloth or by rinsing out, reducing needs for use-related environmental impacts in comparison to alternative materials.

Perception that wool itches	Lack of infra-structure	Incorrect/incomplete life cycle assessments	Lack of knowledge
Lack of downstream systems	Lack of market adaption in classification, breeding, handling etc.	Lack of product development	Lack of marketing/storytelling in local market

Table 1: Barriers to wool consumption and innovation (after [2])

Table 1 summarizes barriers to innovative industrial use of Norwegian wool. The list of challenges is long, and challenges involve the entire value chain. Is it possible to change all this? From the perspective of a designer the issues of product development and perception of wool are interesting problems to address. The perception of the product depends on many factors like culture and marketing strategy. Can product design and marketing help shape the identity and attributes of Norwegian wool? From a designer's point of view one can see that the Norwegian wool industry seems to be locked within its own perceptions of Norwegian wool which center on functional properties and how they are not ideal for clothing production. The use is connected to traditional aesthetics and handicraft and most existing research seems to only address how to adapt Norwegian wool to fit use in clothing, without looking for opportunities to open up for innovative thinking.

Therefore this paper aims to systematically identify such opportunities. To do so, the next chapter first investigates both the cultural and the physical qualities of wool.

Properties of Wool

One can read extensively about wool, but little is published scientifically. The industry seems to investigate properties in connection with specific products, but studies covering the general properties of the material are rare. This section aims to summarize the most important available studies.

Physical qualities

The quality of wool is mainly characterized by the diameter and length of the fiber, and how many folds a fiber has, its crimp (Figure 1). The diameter can vary from about 15 micron (mm^{-3}) to as much as 80 micron. Merino wool is of the finest quality, with a fiber diameter of about 15 micron, and is suitable for cloths and other delicate products [4]. Wool with an average fiber

diameter of more than 28 micron is too coarse to be comfortable in next to skin garments [1]. Coarse wool is therefore mostly used in other products, and the lowest qualities go into technical products like house insulation. Wool fibers are covered in scales (Figure 2) which are the reason why wool will felt when exposed to heat, water and mechanical movement.



Figure 1: A clear picture of crimp of wool fibers (source: Flickr)

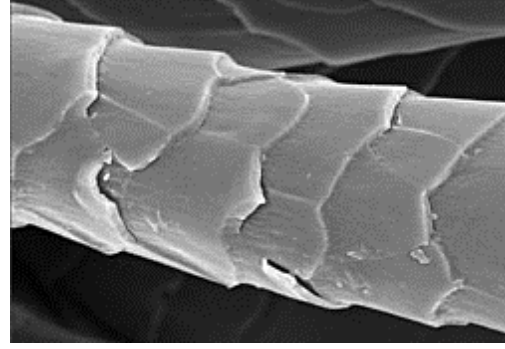


Figure 2: An untreated wool fiber magnified about 2500 times (source: www.carpetinstitute.com.au)

Insulation

Still air is a very good thermal insulator, whilst moving air facilitates convection. The high level of crimp and the loose structure of wool yarns allow trapping millions of small air pockets within the wool, giving the material very good properties for thermal insulation. This is perhaps the best, known quality of wool, and wool garments are therefore uniquely suited for garments used in cold, damp climates [4].

Absorption of moisture and flame retardance

Wool is known for its ability to absorb large amounts of water. When wool absorbs moisture it gives off heat, so that wool apparel helps stave off the cold, clammy feeling that accompanies damp weather [4]. Upon drying wool absorbs heat from the body as the absorbed moisture slowly evaporates. Wool can in fact absorb as much water as 30% of its own weight before feeling wet [1]. The fiber also has a very slow drying rate so the fiber maintains its isolating properties even in a wet condition. Wool can absorb moisture from the air, and will strive to maintain equilibrium with its surroundings [5]. This also contributes to flame retardance: wool is hard to ignite in the first place, and when it burns it is a weak burn that limits the rate at which the fire spreads. In addition, wool does not melt like plastic based textiles. Wool simply smolders and leaves a protective layer of char [6].

Wool and respirable dust particles

In connection to the production of wool flooring, research has been conducted in order to establish the effect of carpets on indoor air quality (IAQ). Carpet flooring has a bad reputation among consumers in Norway. The general perception seems to be that carpets are dusty, difficult to clean and should be avoided for health reasons. A lot of research has been conducted on the matter, and there seems to be contradicting results. Dust from carpets has a much higher concentration of allergens than dust from hard floors, and that wall-to-wall carpets may have a negative impact on air quality [7]. While this may be true for carpets from synthetic fibers with small fiber diameters, woolen carpets however will attract and trap dust within its longer fibers, keeping respirable dust out of the breathing zone. In rooms with smooth floors on the other hand dust will continuously be swirling back into the breathing zone when disturbed, for example by

someone walking through the room [8].

Sound absorption

Wool can be used to improve the acoustical climate in a room in several ways. It can be used as insulation in the cavities of walls, substantially reducing the sound transmitted to neighboring rooms [9]. It can also be used in wall panels to absorb sound in the room and shorten the reverberation time. Such products are already on the market. Wool will also lower the impact sounds against a surface. An example would be a woolen carpet absorbing the sound of an object falling or someone walking across it. When wool is compared to conventional sound absorbing materials it definitely has some advantages. Glass fibers are very thin and will cause irritation and rashes to the skin and respiratory system of people working with it. One must therefore use protective glasses, masks and suits. Wool on the other hand possesses no such treats, and can be handled without protective gear. The use of woolen bonded bats for sound insulation is also comparable in cost with glass fiber [9].

Overview

Wool is well known for its good insulation properties, but the fact that wool also absorbs sound and can be used to regulate the humidity levels in the air is probably not general knowledge. The fact that it is naturally flame retardant and can be used to keep allergens out of the breathing zone simply adds to the benefits of the material. Is it possible to develop a product that exploits some of these properties, and that at the same time convinces the public? In order to help answering this, the next chapter seeks to analyze the cultural properties of wool in order to get a better understanding of the consumer's point of view.

Cultural Qualities

Wool possesses cultural qualities just like it has physical qualities. Cultural qualities refer to people's perception of wool and in which settings it is used. Cultural qualities also include what people associate with wool and what values they connect to it. Today wool is mainly used in clothes and in interior textiles. It is often used in high-class furniture, and is by many associated with high quality and traditional Norwegian knitting garments. During the last 10 years designers and producers have reinvented these traditional garments. Modern versions of the old patterns have emerged, and even reached the catwalk for Dolce & Gabbana and Ralph Lauren [1]. The Norwegian clothing manufacturer Devold has produced warm "super-underwear" for Norwegians for more than a hundred years. They have been known for their blue sweaters and longs, but have managed to change their collections over time, and by introducing new patterns and colors, given their products a fresh and modern expression. Several Norwegian winter sport athletes have launched their own collections of sportswear. Often this is woolen sportswear. One of the most successful athletes doing so is Kari Traa, known for her freestyle skiing. With strong colors and untraditional patterns her collection of underwear is almost "high fashion", and presented as such on "high profile" fashion shows. The Norwegian company "Røros Tweed" has recently been awarded the Norwegian design council's award for design excellence for their wool blankets, which have become popular amongst Norwegian consumers.

Marketing wool

Insight in such cultural qualities is important in order to understand the consumers and their relationship with the product. The designer must understand the symbolic values of the product in order to reach out to the consumers. It is therefore very important to know who your desired

customer is and what is important to them. Markets are heterogenic, with customers that have different buying behavior and motives. In order to shape a marketing strategy that appeals to the right crowd, one can divide the market in homogeneous groups and construct a strategy that attracts a specific group, called market segmentation. One can choose to focus on one segment, or one could develop products for several segments. Based on a literature study of marketing theories, Thjømmø [10] identifies three qualities of a product that may be used to reach a certain market segment: (1) *The product is perceived as having qualities it does not have*, (2) *to grasp a concept and promote it more heavily than the competitors*, and (3) *to add something that is not related to anything with the product at all.* Hestad, an industrial designer, questions the first category and argues that designers relate to the product before it is developed, and can consciously build qualities into the product, and defines three new categories, based on a desire to build the brand through the design process. The first category is to market the benefits of the product. The second category is to take one of these benefits and communicate it stronger than the others, and the third category is to market a story connected to the context of the product [11]. These categories can be exemplified in the case of Norwegian wool. The first category would be to market the wool by its physical benefits like how it's a good insulator, absorbs sound, and can regulate air humidity. The second category would market one of these qualities stronger than the others; perhaps emphasize the acoustic properties of wool. The third category would consist of marketing the story of the material like; "the sheep graze freely in the clean and beautiful Norwegian nature". From a designers perspective branding a product with qualities it does not actually have is not a sustainable marketing strategy. Hestad comments on the fact that: *"An industrial designer starts the process of adding values into the product before it is designed. In several marketing theories the focus is on adding values after the product is designed"*. In the case of Norwegian wool branding would be a good tool to add value to the material. One should also consider segmenting the market and applying different marketing strategies for different types of wool, as will be further discussed below.

How Designers Work

Designers usually take a practical approach to problem solving and have a strong focus on users and their needs. Therefore design competence may give a new perspective on how Norwegian wool can be utilized. Coming back to the questions put in the introduction, on identifying innovation potential for utilizing the Norwegian wool by uncovering new opportunities in the market, and on how product designers can contribute to such an undertaking, the next section introduces a design project in order to discuss these issues.

Case study: Development of Woolen Space Divider

The project described here has been the result of a student project at the Department of Product Design at the Norwegian University of Science and Technology in cooperation with SIFO and is connected to SIFOs research project "valuing Norwegian wool". In the project the material has been the starting point of the product development, looking for broader than just conventional applications. The design project itself was prefaced by an extensive search of background information on physical and cultural properties of wool which has been reported on, in a concise way, in the previous section, based on scientific and other sources. The background research was done to learn about the material's possibilities and limitations. Summing up in short, it was found that wool is almost exclusively associated with the clothing industry because of many of its

properties, but that, given its coarseness, Norwegian wool is less suitable for next-to-skin products. This however does not mean that it is of lesser quality, only that its potential is in other product areas. It was also found that the Norwegian wool industry is bound by its traditions, and may need to open its mind and think in new ways in order to be able to innovate. The market for traditional knitted products is limited and dependent on trends and fashion. In order to substantially increase the use of Norwegian wool in commercially attractive ways it is necessary to look for new products exploiting the unique qualities of the material.

With this knowledge in mind, an interdisciplinary workshop was arranged with five participants: two industrial designers, an artist, a participant with a PhD in biochemistry, and a participant with an MBA and a background in sales, all of them bringing different perspectives to the group. At the end of the workshop the group had discussed a range of possibilities from chemically changing the fibers to the use of wool in cars for thermal and auditory insulation. Finally it was concluded that the most promising area of innovative use was to improve indoor air quality, exploiting and combining the ability of wool to regulate air humidity, absorb sound and thermally insulate. The next stage was to generate ideas of different products that could showcase the use of wool to improve indoor air quality. An important aspect was to find a product that would introduce large surfaces of wool. All the relative properties would increase its effect proportionally with the amount of wool in the room. The most conventional way to do this would be to lay woolen carpets, but this market is already well established and does not hold any unique opportunities. In the end it was decided to develop a space divider for office buildings or public buildings. This is a new product area where the properties of wool can be utilized, and where the material contributes with direct benefits to the product. The space divider was then taken further through a design process to define its functionality and appearance.

The project was presented to Norwegian industry representatives and although the response was positive none of the involved parties showed interest in actually contributing to the realization of the product. Barriers like the lack of willing producers, high raw material cost and what was experienced by the designer as a lack of initiative in the Norwegian industry appeared to be the main challenges. Nevertheless, the product was further developed in a master thesis project (Figure 3), and in relation to this a business plan was written. The result of this is very promising, and the business plan recently won first place in a Norwegian business plan competition called Venture Cup Mid-Norway, being awarded 70.000 NOK. The plan was written by NTNU industrial design students Birgitte Linde Røsvik and Mats Herding Solberg, who are at the time of writing this paper looking into establishing their own company around this woolen space divider.



Figure 3: Prototype for a woolen space divider

Conclusions

The project described above is only one of many possible innovations, and provides an example of how one can utilize the acoustical properties of wool in a space divider that could be used in office buildings or libraries. Such a product could be a gateway to new and larger markets if the industry is willing to change and adapt. From a design point of view, the strong focus on

handicraft and tradition in association with Norwegian wool, limits the way designers see the material. Tobiasson also mentions lack of product design as a barrier in the industry [2]^{Error!}

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Through the workshop and later brainstorming the field of indoor air quality has been identified as an area with potential for product using wool. The ability to regulate air humidity and filter particles, are positive arguments for increasing the use of wool in interior design, and if you add the ability to absorb sound, you have a product with a potentially large market; space dividers for office buildings. Communication is also important through the aesthetics of the product. In order to avoid associations to handicraft it is recommended to avoid knitting and knitting patterns. When shaping the space divider an even felt was used, giving a smooth and modern expression. By distancing products of Norwegian wool from clothes, also by using different production methods and different textures, one can create a new understanding of what wool is, and fight the misperception that all wool clothes will itch.

In the case of Norwegian wool it seems that the industry has a limited view of what products wool can be used in. This paper recommends the industry to think differently and look for products that can open doors to new markets. This is not necessarily rocket science; the case study shows that a practical design approach including background research mapping out the physical properties of wool, understanding of user needs, and basic marketing theories, already result in a promising new way of utilizing the material's unique properties in an innovative way.

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