

Theme 4: Materials and equipment

Sustainable sport and outdoor equipment – Smarter materials and material flows

Theme leader: Prof. Mikael Bäckström, Mid Sweden University.

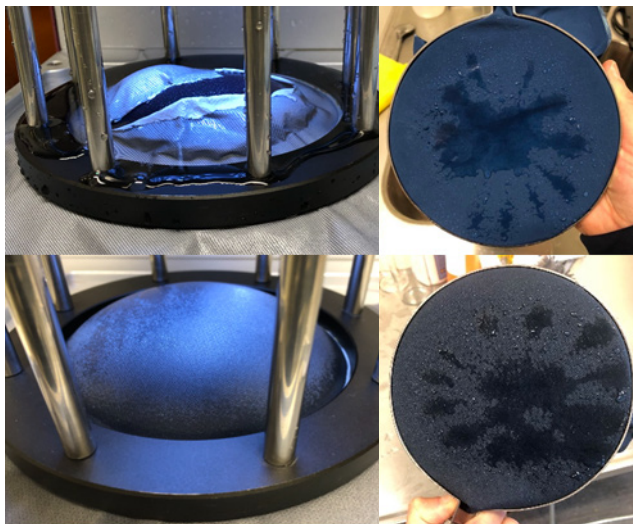
Learning groups: Material and equipment (3 practitioners, 6 researchers). Facilities and surfaces (4 practitioners, 4 researchers).

The challenge of theme 4 was to investigate the different ways that materials and equipment impact our environment, and to identify ways to reduce our impact. The clothes we wear, the new golf clubs we buy to improve our game, and the places where we practice our activities, all have an impact on the environment. The research was governed by the overarching questions: *How can we measure the environmental impact of our consumption and use of sporting equipment? How can we increase our understanding of the environmental performance of circular economy measures relating to sporting equipment? How can the environmental impact of sporting facilities be reduced?*

Functionality of sport and outdoor products and circular economy measures

Researchers and partners in the co-creation group defined functionality as a key criterion in assessing the sustainability of sporting equipment. Functionality in the context of sporting goods relates to both its performance and practicality. That is, how well a product serves its intended purpose in a way that enhances the user's experience. In the context of sustainability, the concept of durability is also key – that a product can retain its functionality over time.

We decided to focus on hard shell jackets as a typical example of a functional outdoor product, which can be used for a multitude of sports and outdoor activities, but which is often found available on the second-hand market, for a variety of reasons. Previous research



Functionality testing of used jackets in laboratory.

How can we measure the environmental impact of our consumption and use of sporting equipment?

How can we increase our understanding of the environmental performance of circular economy measures relating to sporting equipment?

How can the environmental impact of sporting facilities be reduced?

about sustainable clothing conducted by Mistra Future Fashion showed that doubling the lifespan of a garment reduces its carbon footprint by almost 50 percent. Based on this, we focussed on two approaches – defining the functionality of shell jackets, to be able to assess the performance of used jackets, and an LCA approach looking closely at the impact of circular economy measures, which combined can offer the potential to reduce the total impact of equipment.

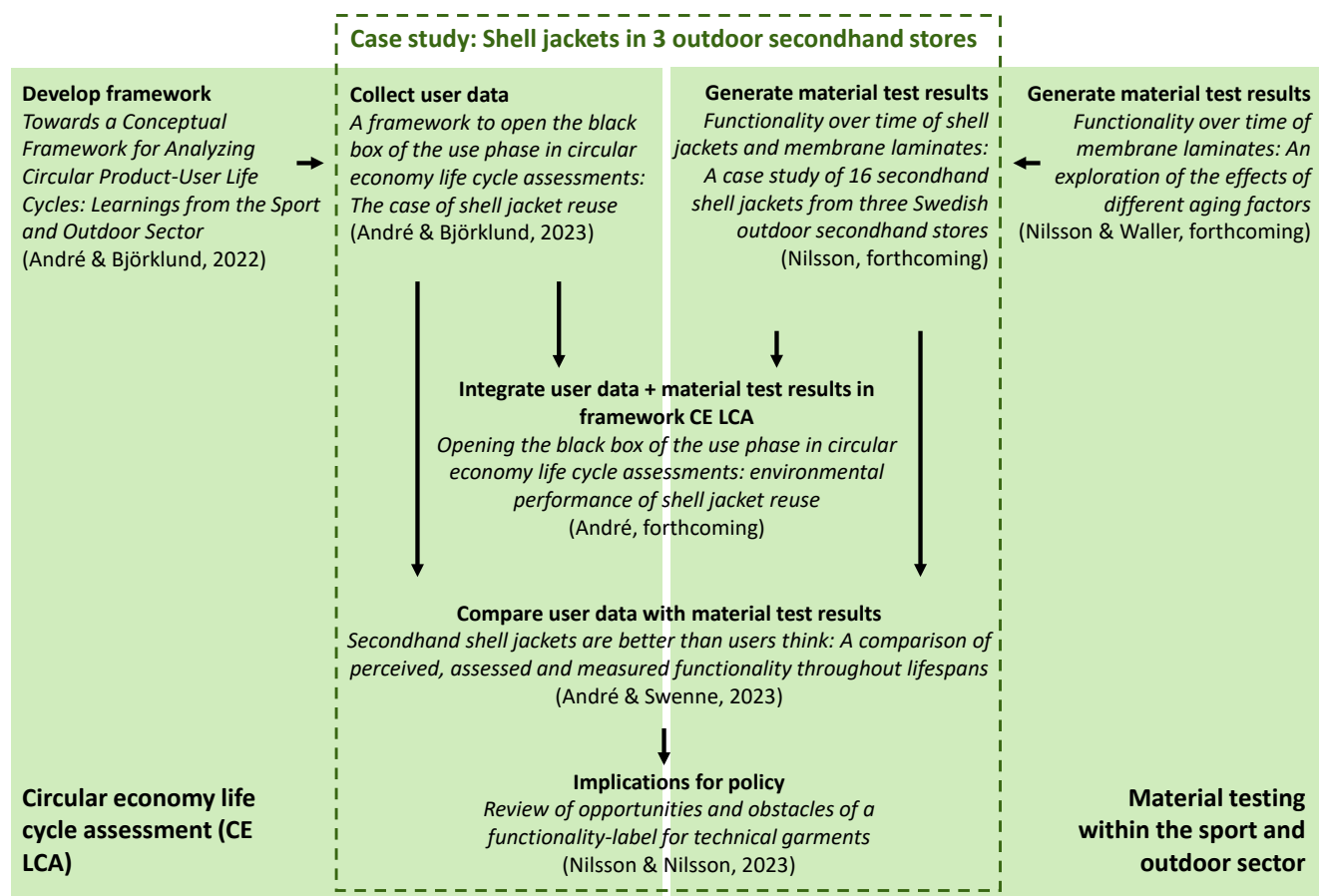
There is no standardized method for measuring the quality of a second-hand garment, so we identified, in conjunction with the learning group, a need to develop tests, which can provide us with information on a jacket's performance that can encourage re-sale and second-hand purchases and enable this increase in service life that can reduce the products' environmental impact. We developed a testing protocol for shell jackets, comprising visual inspection and traditional textile testing methods. We assessed second-hand shell jackets purchased from Swedish second-hand retailers and determined their performance in four key functional areas: air permeability, water repellence, water penetration resistance, and breathability. This measured function was compared with the original stated performance of the jackets and used to determine how the different components of functionality deteriorate over time and correlated with the reduction in sale price from the "as new", to second hand market price. We found that while a jacket's air permeability remains relatively constant,

its water repellence, water penetration resistance and breathability does decrease over time, but at different rates. Even after 10 years, the jackets we tested still had over 50 percent of their original function remaining. The resale value of the jackets was often set by the second-hand store at a lower price than the residual functionality would suggest, indicating that physical functionality is only part of the value of a functional garment, and other aspects, including appearance, also play a role in determining economic value.

In LCA, it is recommended to account for products' functionality deterioration over time, but in practice this is seldom done. Integrating measurements of functionality to CE LCA, we can gain better insights about the potential benefits or drawbacks of CE measures. Questions relating both to the life length and deterioration of sports equipment due to various environmental factors, and how life cycle environmental impact may vary in different circular solutions while considering both functionality over time and user behaviour were investigated. One important output of this research was the development of a framework for data collection and analysis, with the objective of contributing to deeper and more accurate understanding of the environme-

ntal performance of circular economy measures such as reusing, repairing, and sharing. The framework aimed to facilitate accounting for influential, but often overlooked factors, such as functionality deterioration over the lifecycle, rebound effects and real data on user behaviour. The framework was utilized to collect data concerning a case study on second-hand shell jackets, which revealed novel insights on several aspects of the use phase of new and second-hand shell jackets. One surprising finding was that shell jackets, which had a reuse phase enabled by the second-hand stores were used less overall, than those that were used by one user throughout the entire lifetime. In addition, a rebound effect of reuse was identified – the possibility to re-sell shell jackets second hand seems to intensify new consumption for some users.

The data and insights gained from using the framework on the case study were also utilized to conduct a CE LCA, demonstrating for instance the importance of real data on user behaviour, rebound effects and methodological choices for the outcomes of reuse/second hand as a strategy for reducing environmental impact. An implication of the finding that shell jackets with a reuse phase in their lifecycle are used less than jackets



Overview of the research concerning circular economy measures and functionality of sport and outdoor products.

without a reuse phase, was that “circular” lifecycles are a “second best”, environmentally, compared to relatively long “linear” lifecycles. Overall, the results called for a more cautious stance with regard to the environmental promise of circular economy measures such as reuse.

To build on these results, we have identified a need for a standardised method for assessing the residual functionality of jackets, whether for primary, or second-hand use. Confirming a jacket’s performance level may encourage first-hand users to keep using a product for longer and encourage second-hand consumption by providing reassurance as to a product’s performance. Many standard textile-testing methods are destructive in nature, which make them impractical for such an application, so a new testing protocol needs to be developed, as does a means of communicating residual functionality to the consumer. We have conducted a pre-study into the possibilities of developing this concept further within the context of the second-hand market.

Sports surfaces and facilities

The rapid demand for additional sports facilities and sportification processes in society are entangled with environments in complex ways, which underlines the need for more research on how sustainability comes into play in where we choose to play our sports. In the learning group focusing on surfaces and facilities we studied these environmental effects with a special focus on football surfaces and artificial snow.

Football is a growing sport globally and it is the most popular sport in Sweden with more than 4000 facilities.

Artificial turf was first introduced during the 60s as an alternative playing surface to natural grass, and quickly gained popularity: today, artificial turf comprises about 25 percent of all football surfaces in Sweden and is expected to increase in the future. However, the use of artificial turf brings with it a specific set of environmental challenges, not limited to the fact that each full-sized field contains around 135 tonnes of plastic material, and most of these incorporate granulate material made of rubber, which is a primary contributor to microplastic waste. The granulate material will be banned for sale within the EU in the coming years, which is an additional challenge to all involved in the procurement, operation and use of artificial turf facilities. Due to this, we performed a study to identify the environmental conflicts that exist at all stages of the artificial turf lifecycle. The aim was to map out the perspectives, challenges, and interests of the different stakeholders, at all levels, from the sport’s governing bodies and associations to manufacturers and end-users. The analysis identified and discussed 14 different environmental-related themes, which were divided into four main clusters: market aspects, technological aspects, design aspects, and human aspects. The results provide insights on the complex relationship between the artificial turf sector and its effect on the environment.

To contribute more knowledge regarding geographical challenges, a LCA study investigating the environmental impacts of the maintenance of football surfaces comparing various types of football fields in different locations, from the south to the north of Sweden, is currently ongoing. In this study data is being collected

Artificial turf.



about energy flows, material flows, and the utilization of the fields. The results could be used to optimize the usage of the existing artificial turf surfaces.

In collaboration with theme 6, the investigation into the environmental challenges related to artificial turf was broadened to investigate a policy and behavioural perspective through interviews with different actors and questionnaires sent out to players. The results from the data collected was interpreted using the value-action-gap framework, to investigate barriers that prevent actors within artificial turf, who were noted as being generally positive towards sustainable practices, from acting in accordance with their intentions.

Identifying sustainable practices is also of interest within the winter sports community. In contrast to football, where the playing season is increasing in length, the inverse is true for the natural snow season in Sweden. As our winters are getting warmer as a consequence of climate change, many ski areas are having to rely on the use of snowmaking and the use of alternative solutions, such as storing snow over the summer to use as a base in the early season, or even the use of “plastic snow” to ensure that they are able to open for skiers as soon as temperatures start to drop, and to eke

out the season in the spring to give the maximum number of ski days, and to increase revenue. We are currently conducting interviews with those responsible for the maintenance and running of different ski resorts and facilities, as well as collecting data from users of these facilities to try and map the different practices employed, determine their sustainability from an environmental perspective, and to assess people’s attitudes towards them. The first results from the study should be available in spring 2024.

