1. Introduction

Over the recent decades, a gradual shift towards less physically active and more sedentary work tasks and environments has taken place in many professions (Church et al., 2011). The change is partly related to technology- and work organizational developments focusing on efficiency and safety (Cavill et al., 2006; Craig et al., 2012). The shift is positive from many perspectives. On the downside is that low levels of physical activity are now one of the major societal challenges due to its negative impact on health (Lee et al., 2012; Hallal et al., 2012). Many hours in sedentary screen based work postures leaves us without adequate physical stimulation or variation for our muscles and cardiovascular system (Thorp et al., 2011). The amount of energy needed for screen based office work is comparable with lying in bed (Ainsworth et al., 2000).
Studies (Tobiasson, Hedman & Sundblad, 2012; Tobiasson, Hedman & Gulliksen, 2014) highlights that many initiatives to change the situation add physical activity as separated from work tasks with the sole purpose of being physically active. This approach is not always appreciated. It has been reported as a cumbersome addition to the work tasks and as an unwanted pressure having to include exercise during spare time to compensate for increasingly sedentary work tasks (Tobiasson, Hedman & Sundblad, 2014).

In this paper we report on a case study with 15 participants from three different workplaces conducted over the course of 18 months. The purpose has been to generate knowledge on how to support a change of work practice from low levels of physical activity to an increased level by combining and integrating and not separating work tasks from physical activity. This approach resulted in Meeting afoot – a system supporting walk meetings developed in close collaboration with the participants and a cross-disciplinary team. The study shares generated knowledge from two design iterations and user experience that can be valuable for the design research community aiming at similar approaches.

2. Background and Related Work

Examining office work from a perspective of physical activity many professions can be defined as “office-work” as low levels of physical activity and sedentariness are present. A common activity in office environments is work meeting.

Work meetings are described as a way to, exchange information, establish a common ground, generate new ideas, sustain and manage relationships, build or break team feeling and work climate (Meinecke and Lehmann-Willenbrock, 2015). Often there is some technology for presentations and a structure dividing tasks among the attendees such as cheering the meeting, taking minutes. Commonly employees bring their mobile devices into the meeting and interact with them in different ways. This can be convenient but may also disturb the meeting both for the individual interacting with the device and for the peers (Middleton and Cukier, 2006, Camacho, Hassanein, and Head, 2013).

Meetings are also regarded as problematic and a waste of time. In a study including employees from 41 countries less than half of the respondents described meetings as an effective use of time. The analysis suggests that invitation to meetings are sent out to employees that find the meeting of low relevance for their work and that meeting design practices are not followed (Geimer et al., 2015).

Research and development aiming at increasing physical movement at the office focus mainly on the setting. What about walking meetings – how has that been considered?

In university settings Damen et al., (2018) has explored walking meetings and they suggest looking at services to take notes as a mean to further develop walking meetings. Ahtinen et al., (2017) developed and tested a technical application supporting walking meetings. They report it as an obstacle having to carry and look at a smartphone in order to interact with the system. Using a smartphone while walking poses extra load on the low back extensor muscle.
(a muscle involved in supporting stand upright and lift objects, and helps keep the spine upright) compared to walking without holding smartphone (Choi et al., 2019).

A technical system aiming at simplifying documentation of activities while doing the activities are described by Milara, Georgiev, Ylioja, Özüduru and Riekki (2019). They are not discussing walking meetings. Although different in focus area this case share the same aim of designing a technical support to simplify documentation of activities.

Finally, Opezzo and Schwartz (2014) describe, how they through four experiments together with university peers studied walking at work, in relation to creative ideation and walking was found to support cognitive processes of creative thinking and at the same time opportunity for the whole body to be physical active.

There are many cases from industry, business and management developing methods for walking meetings. Some of these cases are communicated in business reports, on-line magazines and in blog-posts. Kara Goldin, 2018 in Forbes (https://tinyurl.com/y8o6os2y) discuss how presentation technologies make us reluctant to change meeting habits. Bob Graham, 2020 in Triveglobal (https://tinyurl.com/y7y4qqwt) shares his experience of walking meetings and suggests as short standing meeting at the end of the walk to summarize. Others recommend avoid making the destination a source of unneeded calories, do not surprise colleagues or clients with walking meetings, stick to small groups and have fun (Clayton, Thomas and Smothers, 2015).

2.1 Physical Activity

Physical activity (PA) is defined as any bodily movement produced by skeletal muscles that result in energy expenditure (Caspersson, Powell and Christenson, 1985).

It is well established and communicated worldwide that PA has positive effects on several of our bodily functions including mental health. It lowers risk factors for ischemic heart disease, stroke, diabetes, and breast and colon cancer. It is also part of treatment and prevention (Lee et al., 2012; WHO Global status report on non-communicable diseases, 2014). PA is associated with activities that primarily aims at increasing muscle strength and improve cardio-vascular endurance. Tissues and genetic material in the human body look almost the same as 10,000 years ago and many systems (skeletal, muscle, metabolic, and cardiovascular) rely on physical activity in order to function (Booth et al., 2008).

Matheson et al., (2013) discusses that the area of prevention has been caught between healthcare and policy-makers discussing among themselves who should take action and responsibility for prevention. They propose collaboration with the design community and the human-centred design approach. This is a strong motivational factor for this case study.

2.2 Walking

The activity of walking is an everyday physical enactments, a somewhat un-reflected practice (Edensor, 2000) because we rarely spend time thinking of how, why and how much
we walk. Walking has for the past two centuries changed from being used as a common mode of transport, towards being described and used more as a leisure activity and a social practice to address sedentariness (Newman, 2003). The activity of walking has been used in large-scale public settings as a method to explore the setting and generate data (Kanstrup, Bertelsen, & Madsen, 2014).

Walking is also a social and cultural learning and meaning-making process performed by the entire body in motion including arms and hands that swing and lungs that support the activity (Ingold, 2004, 2011; Ingold and Vergunst Eds., 2008 and Sennet, 1994). From the perspective of tourism and outdoor activities walking can be related to different performativity norms that form the basis for a sense of identity (Adler, 1989). Walking in the countryside on routes that provides guiding for walkers creates patterns described by Seamon (2015) as a practical knowledge situated, seen from both geography and history as an embodied practice.

2.3 Sedentary office work and current remedies

Parry & Straker (2013) studied patterns of sedentary behaviour during both work and non-work activities in office-employee. They state that;

Although office work has traditionally been considered a “low risk” occupation in terms of chronic health outcomes, it may in fact increase the risk of mortality and cardio-metabolic disorders due to overall accumulated sedentary time and especially sustained sedentary time at work. (Parry & Straker, 2013, p.9)

Another approach within organizations aiming at increased levels of physical activity is to introduce competitions. Step competitions are one example. However, Calderwood et al., (2015) discusses this approach towards promoting physical activity and points out that there may be a downside to this approach since comparisons among the employees may not be positive to all employees.

When examining the literature of interventions at workplaces that try to reduce sedentariness through increasing standing or walking Parry et al., (2017) found three categories of interventions: 1) targeting the physical environment (e.g. treadmills and adjustable desks), 2) targeting the individual with advices to use the stairs instead of elevator, break-reminding software, walking programs and 3) targeting the organization workplace policy changes such as standing meetings and active/walking emails. The multitude of interactive devices and systems that people handle on an everyday basis construct movements that are choreographed through the designs of the devices and systems (Loke and Kocaballi, 2016). They propose vocabulary to reason about qualities of movement related to decision-making in design of technology to support designers.

2.4 Physical literacy

The concepts of physical literacy (PL) originates from Whiteheads (2010) were PL is described from six dimensions; Motivation, Competence, Environment, Sense of the self, Expressions
and Interactions with others, and Knowledge and understanding.

Being active from a physical movement perspective enhances physical literacy. Being physically literate gives us confidence in our own physical ability and allows us to feel secure in trusting our movement abilities. Physical literacy is our ability to capitalise on our embodied dimension (Whitehead, 2010).

Schraefel (2015) discusses how knowledge from sports could be translated and transferred to benefit knowledge workers. And treating body and brain as two entities is an error born from culture.

“...this separation between sports as fundamentally physical, on the one hand, and knowledge work as exclusively cerebral, on the other, reveals a grave mischaracterization of how we excel at cognitive activity.” Schraefel (2015 p. 34).

This case study is inspired by PL as a frame of reference and as a bridge to overcome the dichotomous view on knowledge work and physical activity.

3. Method

This case study has generated knowledge on ways to transform work meetings into a more physical literate, health sustainable and physical active work practise.

In the project researcher and practitioner with competence in interaction design, preventive health, ergonomics, user experience and computer science collaborated with participants experienced in office work. The choice to explore ways to enhance and support walking meetings was made after reviewing literature and a brainstorming session with participants where the idea of walking meetings as an alternative came up and was discussed and problematized. One problem was documenting, taking minutes.

3.1 Participation and user experience

We approached the design space through user experience design influenced by the Scandinavian tradition of cooperative design (Bannon & Ehn, 2012, Björgvinsson, Ehn and Hillgren, 2012, Björgvinsson, 2007, Nygaard, 1990, Sanders and Stappers, 2014). Physical movement seems weak to speak for itself in relation to screen-based knowledge work until the results of a prolonged sedentary style of work are communicated through discomfort, pain or diseases. Seen from a participatory perspective - the body affected by a design should have a say in that design process.

Using different methods and materials generates experience that are discussed and reflected upon in order to understand the setting and guide design (Bannon & Ehn, 2012). In close collaboration with the participants and based on their comments and ideas the concept and the design of the prototype evolved following an iterative process. The design decisions where constrained and framed by time, competences and resources. Within these frames the project members and the participants collaborated to make the most out of the exploration. In this case study multiple perspectives, mutual learning and sharing of
3.2 Inviting and selecting Participants
A mix of companies, municipalities, and universities received information about the project through phone-call, emails, or during meetings and were asked if they would like to participate. The selection of participants was guided by acceptance to our invitation.

Several of the companies replied that they could not set aside time to participate. Three different office workplaces accepted the invitation. The administration office at the school of Sports Science at Umeå University, The sports federation at the county of Västerbotten and the department for Public Health at Umeå Municipality. Umeå is a small town situated in the northern part of Sweden. As the selection was done through acceptance of our invitation the participating organisations already had some interests and experience of trying to augment levels of physical activity in their organisations. This may have influenced their responses and experiences in this case study.

There were 15 participants (5 male and 10 females, ages between 30-60). The participants worked in an office environment, although in different domains the work tasks were mainly screen-based and individually performed or in work meetings.

During 18 months the case study has iteratively and collaboratively developed and evaluated prototypes aiming at supporting walking meetings.

3.3 Designing prototypes and generating data
Idea-generating workshops, iterative design- and evaluation sessions in which the ideas were tested in field settings provided data for the study.

In order to validate the usefulness of the first and second version of the prototype, the participants used the system for real walking meetings in both indoor and outdoor settings.

The mix of methods facilitated our understanding and provided means to gain knowledge how to proceed with the design in this unknown area of exploration (Bødker & Iversen, 2002; Silva, Hak, & Winckler, 2016). As described by Suchman (1993) work practice is a non-static activity and experience of the work tasks, generating of skills and knowledge is situated and complex.

3.4 The Meeting afoot prototype in two versions
This first version of the prototype was tested and the feedback and comments guided the development of the second version of the prototype.

The first prototype was an Android application developed in Eclipse. The smartphones were relatively simple models from LG. An underlying MS SQL database stores data from the meetings as well as audio and video files. All data are uploaded to the database via the mobile data network. The user creates a login to the system and connects to one of
a number of predefined workplaces. During the meeting, geographical position, sound recording, photography and text input are logged. The data are uploaded to the server to be presented after the meeting. Once the meeting is created the user defines how long the meeting will last and the application uses a session timer to remind users that the meeting is in progress. Signals given by vibration and sound to alert the meeting halftime and when only a short time is left, providing opportunity to summarize and compile the meeting. For this, a website was created (ASP.net) where users can log in and see the session data.

Following participant reflections from testing the first version two of the major revisions implemented in the second version were a flic (a soft programmable button https://flic.io/) and speech to text system, the Google Speech API (https://cloud.google.com/speech-to-text/docs/apis) in order to meet user desires.

Something the participants described as cumbersome during the test-sessions with the first version of the prototype was to handle and type on a smartphone as illustrated in Figure 1. To minimize the use we introduced a Flic button as illustrated in Figure 2 to provide user input to the mobile application running on React Native (https://facebook.github.io/react-native/) and to record voice, take pictures, and videos. Pressing the flic button the participants could start and stop the recording that communicated via Bluetooth. This made it possible to keep the smart-phone in the pocket during the walk and thereby free the hands and arms for gestures supporting the discussion and the walking through participating in the pendulum and the hip rotation.

The recorded media files are then sent to Google Cloud via an API interface in order to produce transcripts of the meeting. A microphone with qualities sorting out some
disturbing sounds collected speech that through pressing the flic button was decided to be of importance to record. The Firebase database acted as a data-bridge between server and client components, thus maintaining data-integrity. Back at the office the speech to text is visualized at a web-based GUI in the format of text-boxes that makes it possible to detect who said what at what time of the meeting. Figure 3 illustrates the architecture (Back-end service workflow) of the system in the second prototype, apart from the flic.

Figure 3  Back-end service workflow

Not all reflections and desires from the participants were implemented due to time-constrains and technical issues.

3.5 Analyzing generated data
A content analysis was conducted on the material generated from the users tests such as field notes, images and video recordings (Krippendorff, 2004). The narratives of the user tests were sorted through coupling data that described similar issues then clustering connected data under themes that evolved during the analysis. The digital images were printed out in order to facilitate the collaborative analysis among researchers and designers. Allowing time in order for the material to speak back as reflections-on-actions (Schön, 1987) supported the meaning making of the material that at the starting point was overwhelmingly diverse.

4. Results
When analysing the participants reflections and comments from testing the first and the
second versions of the meeting afoot prototype themes were identified. The results are here presented separately, then discussed in relation to each other and in relation to literature. Themes that evolved from testing the first version of the prototype:

4.1 Interacting With The System
The walks often came to halt during cumbersome handling with the system through the smartphones. This was expressed to come in the way of the rhythm of walking and disturb the flow of the meeting: “You do not want to keep on handling the smartphone – you want to talk and discuss with each other” (P4) Typing on the smartphone was not received well. The need to hold the smartphone was described as frustrating and distracting for the flow of their walk meeting. Here expressed by one of the participants: “Clumsy awkward cumbersome – you do not want to walk and hold the smart-phone in your hand” (P11) Holding a phone while walking is a common scenario, here it was seen as disturbing for the flow of the meeting afoot.

4.2 Acceptance and Integration
Some participants shared reflections whether or not meeting afoot would actually be effective work meetings or mainly turn into a social activity and loose track of the agenda and action points. Here expressed by one of our participants: “I thought that it would turn into a social chat and that we would not discuss the actual agenda for the meeting” (P15) Although participating in the case study was accepted on management level at the involved work settings. The actual activity of walking was perceived as somewhat problematic. It was communicated differently in the organizations. In the Municipality, one of the managers, not directly involved in the project, formally approved the activities which seemed to relieve some of the anxieties towards leaving the work-setting and go out for a walking meeting: “It feels great now that it is anchored, established and that our manager has given approval that we can do this” (P7) In two of the other organizations, managers were directly involved in the walking and more obviously approved the project.

4.3 Identifying Types of Meeting
Questions emerged concerning what types of meetings are suitable for walking meetings. Two types of meeting that was explicitly expressed as suitable were when starting up new projects and when discussing particular issues.

The participants expressed positive experiences from walking meetings but raised concerns for types of meetings: “It went really well to talk but it is not suitable for all tasks” (P3) Some of the comments shared a concern that meetings involving large amounts of documents would be practically unmanageable as walking meetings. To bring along or display the material on a smartphone seemed not doable: “This will not work since at our meetings there are a lot of materials that needs to be displayed” (P1)
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open up meetings for walking as a part of the meeting: “...well part of the meeting for sure can be done while walking” (P1)

One participant shared a reflection on using the meeting afoot system for a single participant, and if that would be regarded as a meeting: “I wonder if it would be okay just to walk by yourself – sometimes I need time to think to come to a conclusion how to approach a work-task” (P13)

This was a new perspective and vividly discussed. At the end, meeting oneself during a walking afoot was decided as method to support reflection.

4.4 Afoot

Participants discussed how the meeting afoot would be arranged and work in practice from different perspectives including selecting a route, weather conditions to take notes to measure steps and compete. Concerning meeting during winter season: “Not the best place to have a walking meeting” (P6)

Reflections where shared on how to select a suitable route for a particular meeting and the agenda for the meeting. “To decide or judge on the distance you need to walk in order to get through the issues or the tasks you need to deal with and solve through discussing seems difficult” (P2)

A related concern was that it might be easy to lose the sense of time when having a meeting afoot and that it might be important that the system gives a reminder when it is time to head back to the workplace: “Good to get the reminder about time to end the meeting in order to head back to the workplace within the set time of the meeting” (P3)

Regarding the distance walked, several of the participants expressed a desire to know how far they had walked and that it could promote meeting afoot also from a physical activity perspective.

“Maybe fun to know the distance you walked” (P14) In line with this was a discussion if the activity could be used as a competition: “We like to compete with the Office in Skellefteå – that would probably motivate us to walk more” (P12) Measuring and comparing were discussed as motivating and related to generate something that could be communicated and shared with peers.

Themes that evolved from testing the second version of the prototype:

4.5 Control, Selection and Access

A recurring theme of discussion was whether there should be a single or multiple sources for recording the minutes: “Should a microphone be provided to all? If everybody has a flic and a smartphone maybe that will leave room for misunderstandings?” (P1)

“Having the record option only in the hand of one individual is in a way providing a power imbalance” (P8) Another issue was discussions on what should go into the minutes and how
it should be organised: “How to find the most appropriate option for collecting the important parts of the meeting?” (P10) Being the one taking the minutes during meeting afoot was described as being in control of the game.

4.6 Trusting technology
How is trust towards the technology established? How can you rely on it to function as intended? These questions and related issues were discussed and here illustrated by the comments below: “Trusting the technology may depend on the background experience – tech or not tech” (P8) There were comments related to trust and ease of use when introducing the flic: “Yes, this is exactly what I had imagined” (P1) Then reflections on technology in meetings: “We all know that technology at standard meetings is still crappy and unstable – we joke about the projector, adapters that are missing.” (P9)

Trusting the technology were said to depend on the participants familiarity with technology and how at ease or secure they feel in having their speeches recorded.

4.7 Multitasking
There were some different views expressed on the way recording minutes was performed while walking. For some it worked well to walk and talk for others expressing something of greater importance stopped or interfered with the phase of the walking. Here exemplified as: “Do not want to stop and talk – it gave me an impression that it is hampering the conversation.” (P9) “Maybe one should stop when recording something of importance” (P1). This may partly be related to getting to know how to handle the system.

4.8 Hold, Wear or Gesture Interaction
There were some perspectives on how the Flic button could be designed as a wearable or even left out in favour for gestural interactions: “The button is small enough to get lost. It might be designed as a ring like Lord of Rings” (P9) “It might not need to be a button it might work with gesture-based interaction” (P9) “The flic is soft and nice to hold on to - it has a distinct on and off” (P1)

The flic apart from being at risk of getting lost was appreciated and it did not seem to hamper gestures underlying speech during walking.

4.9 Preparation and Post-Work
Under this theme issues concerning preparation, planning and sorting of the minutes are discussed: “What do I need to do before the meeting? Create a profile, invite attendees to the meeting, name the meeting. A plan and a discussion where to go/walk are needed” (P5) “Structure of the meeting – will it need to be organised in a different way?” (P5)

There were also reflections on what would be appropriate actions in order to access the minutes after the meeting afoot: “The text that is generated might benefit from being
coloured as to mark-up sections of higher importance” (P9) “How do I get access to the audio-files?” (P1) There were vivid discussions on practical questions.

4.10 Transforming Practise
This theme reflects comments on what meeting afoot could bring to the workplace: “Break out of the office setting – was great” (P8) "Walking is more active than sitting in meetings for ends on where you may become so passive” (P10) “See potential user domain such as rehabilitation, business, personal development coaching” (P5)

“You change in a way the behavioural of meetings” (P8) Many reflections were shared on the positive feeling of being in motion.

5. Discussion and Conclusion
Manner of working has in many professions become increasingly screen-based and sedentary. Work meetings are no exceptions. Research results communicate that levels of physical activity are low to the extent that it poses risks from a health perspective. Actions aiming at mitigating the situation mainly add physical activity as an add-on and suggest that the employees perform physical activities separated from work tasks.

In this case study we have explored ways to integrate movement capacities in office work tasks through designing support for walking meetings. Themes that evolved when analysing user experience from the two versions of the prototype are here discussed in relation to each other, theories and related work.

The theme Interacting with the system from the first version of the meeting afoot prototype. As pointed out by Damen et al., (2018) a service that simplifies taking notes may enhance the motivation to perform walking meetings. This is in line with what participants in this case study reported as important and they expressed similar experience as reported in Ahtinen et al., (2017) that interacting with a smartphone hamper the walking meeting. The changes made in the second version seemed to have overcome some of these issues as the participants expressed positive attitudes towards the changes.

Under the theme Hold, wear or gesture interaction changing mode of interaction from smartphone to the use of a flic triggered the participants to imagine other ways of interacting with the system. As described in Loke and Kocaballi (2016) the design of digital devices and interactive systems creates the movements in a way as choreographed by the design choices. This insight may not always be present throughout the process of design.

Another theme Identifying types of meetings from testing the first version consists of comments concerning what type of meetings would be possible to perform in a walking manner and if a meeting could be held with only one person attending. Would that then be tagged as physical activity or could it be viewed as an accepted work task? The activity of walking has been seen as a mean of transportation to and from a workplace and as such embedded in everyday activities.
How can walking be more valued as a physical literate and sustainable work practise?

The theme Control, selection and access and the theme Trusting technology relates to what would happen if all or only one of the participants had access to the recording part of the meeting afoot system? In sedentary meetings only one is often selected for taking the minutes. Here that position was more directly discussed from a power perspective. This can be connected to how Middleton and Cukier, (2006), and Camacho, Hassanein, and Head, (2013) discusses structure and power during standard meetings. Although in the second version all you did was pressing a button when recording material to go into the minutes, issues of trusting technology where discussed and how these might be related to levels of competence and experience of technology. The theme is also connected to the theme Organisational Acceptance and Integration from the first version in that levels of success may be influenced by how the organisations act and structure walking meetings, if it is seen as a work practise or mainly a social physical activity. In other words: From focusing on the individual when aiming at increasing levels of physical activity to design and integrate a physical literate approach to movement as a resource for a sustainable change of work practise - a transformation of work practice on organisational level. This is one answer on how walking can be more valued as a work practise.

On the move is the last theme from testing the first version. How phase of walking, time and distance were correlated was discussed. This can be related to the notion of competence from the physical literacy approach as knowledge of these three components and how they are connected will start to build up as the numbers of walks increase. The movement, the traces of distance, the change of scenario as the walk takes place – generates experience of the relation between time and phase of movement – if walking in a certain phase eventually that brings you back at work in time set. The theme On the move is linked to the theme Multitasking. While walking some of the participants shared that they stopped walking when they wanted to record something for the minutes. This might be related to individual preferences as not all participants stopped walking to record. As the literature describe walking as social and cultural learning and meaning-making process (Ingold, 2004, 2011; Ingold and Vergunst Eds., 2008 and Sennet, 1994) where the knowledge is situated in a relation between the walker and the context (Seamon, 2015) and that the walking may contribute in establishing as sense of identity (Adler, 1989) in may also create individual differences.

Issues related to Preparation and Post-Work would probably be of value to discuss to improve standard sedentary meetings as well. As described by Geimer et al., (2015) meetings are not always seen as a productive manner of working. Here the reflections came as a result of changing the structure of the physical movements.

Finally the theme Transforming Practise reflects comments on what meeting afoot could bring to the workplace.

If technology has been part of choreographing sedentariness could the design community with motivation from approaches such as physical literacy transform practises to break out
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of habits, change behaviour? We have gained experience, insights and knowledge from the meeting afoot case study and we think it stands as one example of the power of mixing competences and to not forget competences on physical movement and physical literacy when designing in settings were moving bodies are present. One obstacle described as a hinder for walking meetings to be a more integrated part of the work-practice at the office is the difficulties to take minutes of the meeting. The Meeting afoot system offers opportunity to take turns in note-taking during the walking meeting through speech-to-text. It has been perceived as a good experience among participants and several companies and organisations in different parts of the country has showed interest in the system something that motivates us to try to continue develop the prototype into a ready available system.

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About the Authors:

Helena Tobiasson is Associate senior lecturer in Interaction Design at Mälardalens University, Sweden. Her research focuses on user-experience, movement Acumen design and physical activity for sustainable development and planning.

Fredrik Nilbrink is Senior Software Developer at RISE Interactive, Sweden. He has a special interest in sports technology enhancing physical literacy among children and adolescent.

Jan Gulliksen is a Professor in Human Computer Interaction and Vice President for Digitalization at KTH Royal Institute of Technology, Sweden. His research concerns practice-oriented action research on usability, accessibility and user-centered systems design, focusing on improving digital work environments.

Pernilla Eriksson is the Assistant director for Umeå School of Sport Sciencies, Sweden. Her work focuses on developing sustainable environments for people to combine elite sports and academic studies. She is driving force for collaboration in Västerbotten county.