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# The Hubs: Design Insights for Walking Meeting Technology

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**Abstract.** As an active form of meeting, walking meetings can be beneficial for office workers who often have a sedentary work routine. Despite their substantial benefits in terms of health, social interactions, and creativity, walking meetings are not yet widely adopted. Some key barriers limiting their social acceptance and wider adoption, for instance, the difficulty to present files or take notes, might be addressed by technology. Using the Hubs - a network of stand-up meeting stations - as a design exemplar, we conducted a scenario-based survey (N=186) to provide insights into how technological solutions can support the practice of walking meetings. Focusing on the size of the group and type of meetings, we identify scenarios of use and discuss design implications for the development of future technologies and service design components to support walking meetings.

**Keywords:** Walking meetings, Office environment, Sedentary behavior, Survey, Physical Activity, Work.

## 1 Introduction

We are currently on the brink of a fourth industrial revolution, where artificial intelligence as an emerging force is reshaping and disrupting our world. This will transform the way we work by fusing technologies and blurring our physical and digital world. Our offices are becoming more and more “flexible”, with remote work and telecommunications on the rise. Be it at the office or from home, knowledge work is characterized by sedentary behavior, with 71% of working hours of office workers spent sitting [12]. This has been further emphasized during the COVID-19 pandemic [39]. Sedentary behavior is however a major public health risk [8]. Physical inactivity is now considered the fourth leading cause of death worldwide, with over 5 million -theoretically preventable- deaths per year [23, 48, 49] as it is associated with a variety of diseases such as type II diabetes, cardiovascular diseases, colon- and breast cancer [6, 19, 33, 47, 48].

Office work is characterized by physically inactive behavior, with office workers spending most of their working hours sitting [12]. To reduce this considerable sedentary time, a myriad of digital tools and interventions have been developed over recent years [14, 21], with a focus on mobile applications, smartwatches and prompting software.

Most of these products however consider physical activity as a break from work [14], encouraging workers to take more breaks during the day [14]. Very few tools and interventions are based on the underlying principle that physical activity and office work are not mutually exclusive.

Within the field of Human-Computer Interaction (HCI), a few tools or interventions that facilitate physically active ways of working are described. The most common example is a dynamic workstation, as described by Tobiasson [45], Choi [11] and Probst [35]. These designs aim to support the integration of physical activity with work behind a standing desk.

Beyond the individual desk, a promising opportunity for physically active ways of working can be found in the context of meetings. Previous work did research position changes through modular meeting furniture [15] or strongly emphasized the potential of walking meetings [1, 2, 3, 13, 16]. Ahtinen et al [1, 2, 3] developed and researched the use of mobile technology to mediate walking meetings, whereas Damen et al. [13, 17] implemented a service design for walking meetings called the WorkWalk [13, 17]. Both research teams gained users insights on the barriers and drivers of walking meetings and provided some design recommendations [1, 17]. What remains however underexplored is how technology can support the practice of walking meetings in order to overcome barriers and strengthen opportunities for users. This is a timely topic that the HCI community can address to contribute to future and healthier ways of working.

In this paper, we build on the work of Damen et al. [16] in order to explore workers' needs during walking meetings with an emphasis on the match between specific tasks or use scenarios and potential technological support. To the best of our knowledge, no previous study did sample a large number of participants in order to understand users' perceptions and needs with regards to walking meetings. Through a scenario-based online survey (N=186), we explore the most relevant use cases for the design of "walking meetings Hubs", stand-up meeting stations that accommodate different tasks during walking meetings. We purposively used the Hubs as exemplar of a tangible technology situated in a physical work environment, in order to investigate this under-research area (previous work in HCI focusing mostly on mobile-mediated concepts). We discuss the usefulness and relevance of the Hubs concept to overcome the obstacles associated with walking meetings and expand the discussion on how existing and emerging technologies can support efficient walking meeting experiences. We finally emphasize implications for design, relevant for the development of future technologies and service design elements to support walking meetings.

## **2 RELATED WORK**

### **2.1 Physically Active Ways of Working**

A large and growing body of literature has investigated the role of sedentary behavior in office workers, ranging from the negative health effects [18, 19, 20, 23, 29, 33,42, 44] to how we should design interventions to reduce sitting at work [14, 21, 24, 25, 29,

31, 41]. There is, however, a relatively small body of work that is concerned with physically active ways of working. Especially within the field of human computer interaction, we see very little research on this topic. In 2012, the concept of working “in motion” was introduced to facilitate seamless changes between different work task and work position such as sitting and standing [35]. Probst et al. [35] promote a paradigm shift towards an integrated supportive work environment through active office design, for instance an interactive chair as an ubiquitous input device to control the workplace computer by tilting, rotating, or bouncing [34].

Other examples of designs that facilitate physically active ways of work are active desks or desk applications, like the design “Tap-Kick-Click” of Saunders and Vogel [37]. They present a foot interaction technique to control conventional desktop applications at a standing desk. Similar to this concept is the “Foot-Mouse” concept of Tobiasson [45], that is presented as a physical movement probe for the office in their paper “Still at the Office”, together with the concepts “active desk” and “irritating chair”. All probes were designed in an attempt to transform the sedentary nature of office work into more physically sustainable work [45]. A final notable example is the work of Nieuweboer et al. [30], a provocative design called “The Office Jungle”. With their work on “designing for wildness”, they propose to transform the way we work by turning the office environment into an office jungle.

## 2.2 Walking and Walking Meetings

According to the ancient Greek philosopher Hippocrates “walking is a man’s best medicine”. This old wisdom still holds true according to modern science. Walking is beneficial for several physical and mental health issues [9]. Walking can for instance decrease bodyweight, BMI and bodyfat percentage [7, 27]. It can furthermore increase maximum aerobic capacity, lower blood pressure and decrease resting diastolic blood pressure in previously sedentary adults [27]. Moreover, walking can reduce the risk of cardiovascular diseases [28].

In addition to these physical health parameters, walking can have a positive influence on various mental and emotional outcomes. Thayer et al [43] found that the amount of daily walking predicted a wide variety of positive psychological conditions. They report a positive correlation between step count and self-rated health, energy, overall mood, happiness and self-esteem. In addition, walking can reduce stress and anxiety [10] and decrease or even prevent depressive symptoms [4].

Walking at work may even enhance work performance of employees. Walking increases blood flow to the brain, which may result in cognitive benefits like increased creativity [32]. It can also counteract the health risks that are associated with prolonged sitting such as an increased risk of anxiety [42] and intermediate levels of psychological distress [22]. Walking could also facilitate psychological processing and promote a collaborative way of working, as is used in therapy settings [26, 36].

Despite all the positive effects that walking can have on a person’s health and well-being, walking meetings are not a common work practice. Several barriers remain for office workers to engage in this practice. Damen et al. [9] have identified nine, amongst

which the most common barriers are unpredictable weather, cultural acceptance, difficulties of integrating walking meetings into daily routines and the lack of possibilities to take notes or give a presentation [17]. In 2016, Ahtinen [3] presented ten design implications for persuasive, mobile walking meetings. One of these implications is that enabling walking meetings to “become an accepted way of work” by designing an “official” tool could support the uptake of this practice.

### 2.3 Walking Meeting and Technology

By designing tools and interventions that enable and facilitate walking meetings at work, walking might become a more natural part of an office day. In contrast to the current intervention strategy to encourage people to take more breaks and interrupt their work, walking meetings can integrate physical activity with work. This may make it feasible to adhere to the expert statement on the growing case for change towards better health and productivity in office work that states that “*Workers should aim to initially progress toward accumulating 2 hours per day of standing and light activity, such as light walking during working hours, eventually progressing to a total accumulation of 4 hours per day*” [8].

To date, there is a dearth of research on how technology can mediate the practice of walking meetings. We found merely three designs can be found in the field of HCI. Ahtinen developed and studied the use of mobile technology to mediate walking meetings by means of an app [1,2,3]. The “Brainwolk” and the preceding “walking metro” mobile application provides an introduction to walking meetings at work to increase the social acceptance. The Brainwolk app features a university campus map, suggestions for walking routes, checkpoints with short visual break exercises and motivational thoughts about walking and a reward system [2]. One of the drawbacks of this applications was that “the use of the application caused too much disruption and the users were not able to concentrate on the meeting itself” [1]. According to the authors, researchers and practitioners can encourage physically active ways of work by combination of digital and non-digital discreet persuasion techniques to help motivate sedentary workers to become more active, creative and sociable [1].

Damen et al [13, 17] developed and studied a service design for walking meetings called the WorkWalk. The WorkWalk consists of a physical route of 1.8 km long, has meeting point signs at all faculty buildings and is integrated in the university’s room booking system [13]. Damen et al. [17] used this concept as a design research artefact to study walking meetings and reflect on them during walking interviews with the participants. Their findings suggest five design recommendations for the development of future technologies and service design elements to support walking meetings, such as “*Embedding active ways of working in existing infrastructure and work routines by making it physically visible increases social acceptance*” [17].

In 2020, Damen et al. [16] presented a case study detailing the design and pilot study of The Hubs. Based on previous research addressing the barriers of walking meetings, the Hubs were designed to accommodate different work-related tasks during walking meetings. Damen et al. [16] report on two pilot user tests investigating users’ experiences and ideas for improvement. They did not, however, gather insights in how the

Hubs could be used in different scenarios and what potential features a Hub should have to accommodate specific meeting types.

## 2.4 The Hubs Concept

This research focusses on how technology can support walking meetings, and more specifically how users envision themselves using the Hubs concept. The Hubs in the present study are used as a research artefact in order to gain broader insights into the support technology could bring to facilitate the adoption of walking meetings. The Hubs network is a series of stand-up meeting stations (Figure 1) that accommodate different work-related tasks during indoor or outdoor walking meetings [16]. Several Hubs form a route that guide the meeting for a pre-set duration. The Hubs are equipped with touchscreen-controlled laptops, which can be used independently or in a duplicate mode. By scanning an employee card using the RFID scanner on top of the Hub, the user can access a custom-made web environment with their personal files. The Hub is currently controlled by an Arduino and Processing sketch.



Fig 1. Hub, as part of a network of stand-up meeting stations

## 3 Methodology

In order to explore the most relevant use scenarios for walking meetings with technologies such as the Hubs, we designed an online survey combining Likert scales with vignette-like scenarios [5]. The scenarios feature two distinct variables: the number of coworkers involved in a walking meeting, with three conditions (a group of 2-4, a larger group, or by oneself) and the type of meeting, with eight defined meeting types.

### 3.1 Participants

A total of 186 respondents (99 females, 81 males, 6 prefer not to say) filled out the survey, with a mean age of 33.4 (SD = 12.3). Of the 145 respondents (78%) who specified their occupation or background, fifty-four respondents (29%) were students, 18 (9.7%) designers, 20 (10.8%) researchers and 53 (28.5%) categorized as “other”. The level of experience with walking meetings was on average  $M=1.79$  (SD = 1.07, Min=1, Max=4) on a scale from 1 ‘Novice’ to 5 ‘Expert’. The majority (56.5%) of respondents self-described as novices to walking meeting (rating of 1), 21% little experience (rating of 2), 9.7% some experience (rating of 3) and 12.9% leaned to the expert side (rating of 4).

### 3.2 Procedure and Material

The survey was disseminated online during a 6-weeks period early 2020 and advertised on social and professional networks, targeting people involved in sedentary professional activities such as office and knowledge workers (this second category also included students in higher academic institutions). It thus involves a non-probabilistic sample. Ethical approval for the study was obtained from the university’s review board. The questionnaire is composed of 4 sections.

#### **Socio-demographics and meeting routines.**

This section included questions about age, gender, job title, as well as the experience with walking meetings (assessed on a 5-points Likert scale from “No experience” to “Expert”) and the type of meetings conducted in their professional activity. For this last question, respondents assessed the frequency of 8 categories of meetings (described in Figure 3) using 5-points Likert from “Never” to “Very often”.

#### **Introductory scenario and desired features.**

In this section, we used a storyboard to introduce the Hubs as a network of interactive device designed to support walking meetings. We then asked respondents to assess the importance of nine potential features of the Hub to support their walking meetings using 5-points Likert scales from 1 “Not important” to 5 “Very important”. These features were note-taking, presenting, web browsing, sketching, video calling, access to personal files, brainstorming tools, access to email and calendar, printing. In addition, respondents could come up with additional features in an open-ended text field.

#### **Scenarios based on the number of team members involved in the walking meeting.**

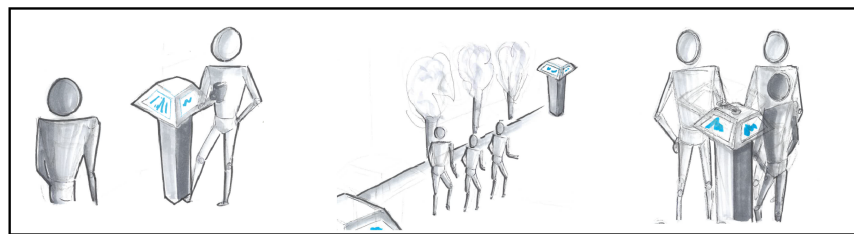
We created three storyboards representing office workers going for a walking meeting using the Hubs (Figure 2). Following the method used by Walsh et al. [46] the scenarios presented are incomplete: it is up to the respondents to imagine how they will use the Hubs. The scenarios varied in the number of co-workers involved in the meeting, with three alternatives presented, respectively walking (a) with a group of 2-4 (b) with a larger group or (c) by oneself. Using a multiple-choice question, respondents are asked



“Which types of meetings would you most likely have in this scenario? (potential answer options based on the 8 meetings types described in Figure 3).

Two subsequent open-ended questions asked, “In your opinion, what influence can the Hub have on your meeting when (meeting context based on the meeting size)?”, one being focused on the positive influence, the second on the negative influence in order to counterbalance biases. Both questions suggest an influence and are not neutral in essence, because our aim is not to prove a positive or negative tendency but to act as a trigger for respondents to envision ways such a technology can affect their meetings. Finally, respondents declared how likely they were to personally go walking meeting in each scenario using 5-points Likert scales from 1 “Very unlikely” to 5 “Very likely”.

### Walking Meeting with a group of 2-4



**Step 2:** You meet-up with your colleagues at the starting point, equipped with a Hub.

**Step 3:** You go for a walking meeting by following the network of Hubs.

**Step 4:** You stop at a next Hub.

**Fig 2.** Example of an incomplete scenario used as a prompt in the walking meeting survey

### Walking meeting journey.

The last part of the survey asked respondents to define and describe their own walking meeting journey. First, they picked their preferred group composition and preferred meeting type. Instructions were as follows: “In order to design optimal interactions with the Hub, we need people to imagine themselves in a precise context of use. We will thus ask you to pick a type of meeting and a number of participants (the most suitable meeting situation for you) and then to walk us through the story of this meeting, supported by the use of the Hubs. You can rely on a previous meeting you already had and transpose it to the situation of a walking meeting with a Hub or rely on a future meeting you expect to have at work.”

Respondents freely described their actions through the meeting journey, at 3 defined stages: 1/ “You are starting your walking meeting at the starting point, equipped with a Hub, could you describe the actions you would do at the first Hub?” 2/ “After a couple of minutes of walking, you arrive at an intermediate Hub. Could you describe the actions you would do at this intermediate Hub?” 3/ Finally, it is almost time to wrap up this meeting and you go to the last Hub on your path. Could you describe the actions you would do at this last Hub?”.

### 3.3 Data Analysis

Qualitative answers were coded and analyzed with MaxQDA 2018 by thematic analysis using an inductive approach. The first and last author independently coded a data sample and made a coding scheme, after which consensus was sought among them to derive a final coding scheme. The survey questions are provided as supplementary material.

## 4 Results

### 4.1 Types of meetings

To gain insights into the types of (traditional) meetings the respondents generally have in their job, they were asked to rate the occurrence of eight types of meetings from 1 (never) to 5 (very often). Figure 3 shows the distribution of these frequencies and the average ratings. Regular meetings occurred the most ( $M=3.75$ ,  $SD=1.01$ ), followed by information sharing meetings ( $M=3.68$ ,  $SD=0.96$ ) and one-on-one meetings ( $M=3.39$ ,  $SD=1.09$ ). These were closely followed by decision making ( $M=3.37$ ,  $SD=1.04$ ), problem solving ( $M=3.34$ ,  $SD=0.95$ ) and brainstorming ( $M=3.24$ ,  $SD=1.08$ ). Presentation ( $M=2.99$ ,  $SD=1.05$ ) and training sessions ( $M=2.47$ ,  $SD=0.99$ ) were the least frequent types.

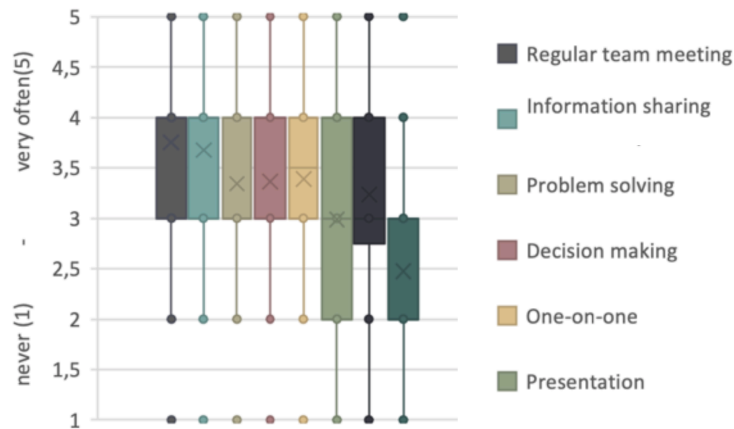
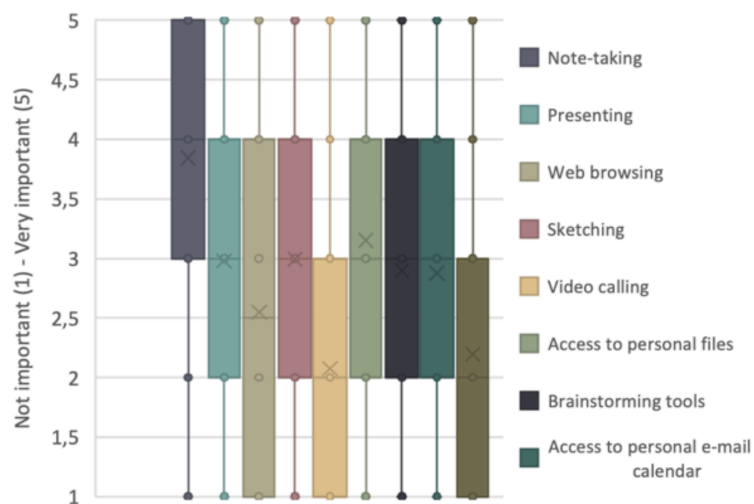


Fig 3. Descriptive statistics of the meeting type frequency, assessed on 5-points Likert scales

### 4.2 Features of the Hubs

Participants were asked to evaluate the importance of potential features of the Hubs, ranging from not important (1) to very important (5). Nine features were evaluated (Figure 4), of which note taking ( $M = 3.84$ ,  $SD = 1.14$ ) was considered the most important, and printing notes or documents ( $M = 2.19$ ,  $SD = 1.28$ ) the least important. It

was hypothesized that walking meeting experience could affect the rating of features, yet we found no significant difference based on walking meeting experience.



**Fig 4.** Descriptive statistics of the Hubs features importance assessed on 5-points Likert scales

In addition to the Likert scale questions featuring nine predefined potential features of the Hubs, respondents could add additional features they would personally need. The most frequent replies were related to time management and route planning. Seventeen respondents mentioned that the Hubs should help to keep track of time by displaying the time left for the meeting. In addition, eleven people expressed the need for directions or walking route options.

Another common feature suggested by respondents was voice or video recording, mainly to replace written meeting minutes. Some people would like to see an automatic transcription of their audio recordings at the end of the meeting. These transcriptions should be sent to their email account or uploaded in a personal cloud. An automated generation of written minutes or to-do lists was another recurring feature, yet most respondents mentioned the need to take notes manually. Like the audio recordings, these writings should be easily shared with all participants or send to third parties.

Lastly, a couple of Hubs set-up features were suggested, for instance the adjustable height of the Hubs. The Hubs could also be used “as static meeting points by adding something to lean against while using them. This might be useful when you need some more time with a visual or for people with less mobility that still want to have outdoor meetings”. Finally, one person mentioned the use of “inspirational ideation prompts”, to make sure people do not linger at one Hub and walk to the next Hub for instance by giving a question to think about while walking to the next Hub.

### 4.3 Expected Positive and Negative Effects

In order to assess how people felt the Hubs would affect their meetings, they were asked to think about the potential positive and negative effects of the Hub network (Table 1). Participants mentioned several positive effects, the meeting structure being the most common. Thirty participants expressed that the Hubs could support meeting structure by giving direction, providing demarcation time or by using the Hubs as distinctive “landmarks” which could “give a marker in space and time”. These landmarks could be related to the agenda points, act as a trigger for decision making or transitioning to a new topic. A respondent also expressed that the presence of Hubs could “ensure targeted meetings”, since “Hubs are intermediate cells where you can take notes” and can wrap up your meeting by discussing and setting future agenda points.

A considerable number of benefits mentioned did not specifically address the Hubs but were related to the practice of walking meetings. People stated that it could promote health, creativity, camaraderie, social interaction, keep people engaged and stimulate out-of-the-box thinking. The fact that the Hubs could facilitate note taking, presenting and looking up information, made walking meetings more accessible according to the majority of the respondents.

However, several people questioned why they would not use their phone or tablet to do these tasks. This held particularly true for individual walking meetings. In addition, some people felt that the Hubs conflicted with the essence of walking meetings, often being ‘low tech’ and triggering mind wandering and divergent thinking. Several other drawbacks were mentioned. While lack of recording and note-taking opportunities is a commonly documented barriers to walking meetings [17], which was confirmed through our survey, some people felt that the Hubs provided “too much infrastructure for too little value”. In addition, one participant expressed that the Hubs would probably never be there at the exact moment when you need them: “It could disrupt the flow of the meeting”. This is aligned with a few participants expressing concerns that one could forget the elements to write down in-between the Hubs. Another potential barrier was that people would stay at the Hub for a long period thus stopping their walk. As one respondent stated, “it then becomes a standing desk outside”. According to several respondents, such a practice would nullify the positive effects that walking meetings could have such as out-of-the-box thinking and being physically active.

Another common negative effect was distraction. The Hubs itself could provide distraction according to some, however, most felt that the environment and other people could drive them to distraction during the practice of walking meetings (no matter if technology is involved or not). This was especially true for larger groups, as “it is difficult to let everyone hear the one who is speaking due to surround noise and spatial organization.” Several respondents explained that it could lead to people splitting up into groups, staying behind or not participating in the meeting. In addition, not everyone is able to use or view the Hub to take notes or see what is presented. Less common concerns were matters of privacy, such as how to deal with people that could overhear a private conversation. Some people also said it would look weird or feel lonely to stand at a Hub by yourself.

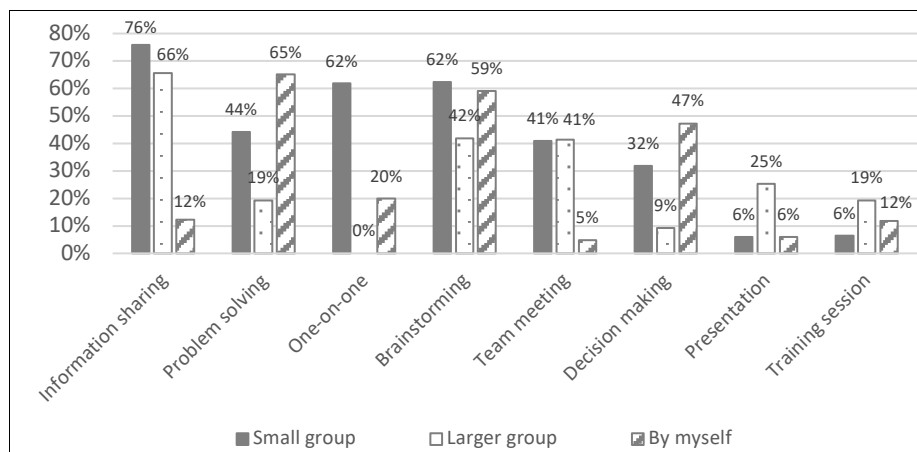
**Table 1.** Summary of the most cited positive and negative effect of Hubs technology

Potential positive effect	Potential negative effect
Structuring the meetings	Conflicting with the perceived “low-tech” and unique nature of walking meetings
Being landmarks or markers in space and time	Not being supportive when needed
Practical purpose of note taking and presenting	Infrastructure costs might be too high for the added value (as compared to mobile tech)
Making walking meetings more accessible	

#### 4.4 Envisioned Use

The likelihood to go for a walking meeting using a Hubs network varied among respondents and depended on the meeting size (aka. number of team members involved) and the level of experience with walking meetings. A walking meeting in a small group (2-4 persons) was most likely to occur ( $M = 3.84, SD = .91$ ). The individual walking meeting scored between “neutral” and “likely” ( $M = 3.27, SD = 1.38$ ), whereas the likelihood of people going for a walking meeting in a larger group (over 5 people) was overall considered unlikely ( $M = 1.85, SD = 0.92$ ).

Consecutively, we asked respondents which types of meetings they would most likely have while walking, dependent on the group size. As shown in Figure 5, information sharing and brainstorming sessions were considered the most likely types of meetings to do while walking, in both small and larger groups. The likelihood of individual walking meetings was highest for problem solving and brainstorming meetings. Presentations and training sessions were overall least likely to be done while walking.

**Fig 5.** Likelihood of doing a walking meeting, based on meeting type and group size (N=186)

To explore the use scenarios, we presented the respondents with an incomplete storyboard to complete. First, they picked their preferred group composition, and preferred meeting type. Twenty participants selected a walking meeting by themselves, five choose the large group meeting, and a vast majority (n=161) picked the small group composition. A brainstorming meeting was the most popular choice (n=55), followed by information sharing (n=42), regular team meetings (n=31), problem solving (n= 30), decision making (n=14), and one-on-one meeting (n=12). ‘Training sessions’ and ‘Presentation meetings’ were not chosen by respondents.

A thematic analysis resulted in 29 distinct activities that respondents would undertake at the Hubs. These activities were clustered into nine overarching categories, based on the subdivision of possible features of the Hubs (Table 2). The clusters link to the technological modalities that might be needed to carry out the tasks. For instance, “writing down action points” will probably need similar note taking modalities as “setting meeting objectives”, whereas “sharing meeting results” would require different features like emailing or uploading to a shared folder.

**Table 2.** Activities clustered around possible Hubs features

Cluster	Activities
<b>Note taking</b>	Take notes, check notes, document ideas, start audio recording, setting meeting objectives/agenda, write down action points, recap, evaluate/summarize outcomes, make decisions, scope problem
<b>Presenting</b>	Discuss case/ideas, present meeting objectives or agenda, present work, logistics (time management, route setting), explain Hub, give update
<b>Web browsing</b>	Check info
<b>Sketching</b>	Sketch
<b>Video calling</b>	(not mentioned within the scenarios)
<b>Access to personal files</b>	Log in, check meeting agenda, emails, log out
<b>Brainstorming tools &amp; printing</b>	Show artefacts, brainstorming techniques, automated inspirations
<b>Access to e-mail and calendar</b>	Send or share results, rephrase ideas

Based on the different scenarios imagined by the respondents, we created a walking meeting user journey (Figure 6). This journey presents the most commonly cited meeting activities for each meeting type. Documenting users’ goals and needs aim at supporting the development of future walking meeting technologies, which might not necessarily build upon the concept of Hubs stations along a walking meeting path.

In this typical walking meeting journey, note-taking and presenting were the most frequent activities in all meeting type scenarios. Video calling, on the other hand, was

not mentioned at all in the stories of the participants (which confirms the results found in section 4.2).

Notable differences between the envisioned activities can be found between the different types of meetings, but also between the first, intermediate and final Hub. For instance, presenting was mostly done at the first and second Hub, whereas access to personal email and calendar was solely mentioned at the final Hub in order to schedule a follow-up meeting or to send notes. Web browsing and access to personal files were mentioned in all meeting types and at all stages of the meeting. Access to personal files was most prominent in the information sharing and presenting meeting type category, and particularly relevant at the beginning of a meeting.

Not surprisingly, sketching was mostly mentioned as an activity during brainstorming meetings, as well as brainstorming tools and printing. Brainstorming tools were not mentioned for regular team meetings, one-on-one meetings and information sharing and presenting meetings.




Legend: *Italic* = less common, Regular = common, **Bold** = most common

**Fig 6.** Walking meeting journeys representing six types of meetings, ranked from the most commonly chosen to the least commonly chosen in the survey

Table 3 displays illustrations of the top three scenarios, inspired by representative participants' quotes about the actions they would typically perform at each stage of their walking meeting.

**Table 3.** Illustrative scenario sketch of three meeting types, featuring the most common actions at each stage of the meeting journey



Brainstorming		
<i>"As a starting point, I would use the Hub to sketch a mind-map or use other brainstorming tools to define the scope of the problem."</i>	<i>"After ideating between the two Hubs, I would stop at the second point as a milestone to discuss the ideas and draw them out"</i>	<i>"At the last one, I would use tools to visualize all ideas we gathered along the way and select the most promising ones"</i>
Information sharing		
<i>"I would use the first Hub to share some prepared points to be discussed during the meeting. So the agenda points, as well as the documents we need to consult before starting"</i>	<i>"Intermediate Hubs can be useful to input relevant information that came up during the walk so that we don't forget it."</i>	<i>"I would do the same at the last Hub. In addition I would check if all the agenda points were discussed and schedule a follow-up meeting if necessary"</i>
General team meeting		
<i>"The team should open our shared files/calendar to check the agenda points, and decide on which ones will be discussed while walking"</i>	<i>"After a few minutes of walking, the next Hub can be the place to structure the initial discussions, like a formal moment within the less formal walking time"</i>	<i>"We would open our shared folders again, talk about what has to be done and who will be responsible for those action points"</i>

These typical scenarios feature mostly common work task and corresponding features and are useful to define minimal viable walking meeting products and services. In addition, we also looked at unique or inspiring responses. Original or unique insights (mentioned by only a few participants) can be used as design inspiration for future research and development of innovative tools and technologies [38, 40]. They may open up new perspectives for novel, but also current technologies, that could be used to facilitate physically active ways of working.

Participants for instance mentioned creativity tools to be used while walking to the next Hub, for instance an inspiring ideation prompt (e.g., from the Oblique Strategies technique by Brian Eno) that would be printed out on a receipt using a thermoprinter. This would provide a pleasant surprising effect and trigger curiosity. A second idea was



that the Hubs could present different activities to help structure a meeting, such as selecting a brainstorm technique at the first Hub, sorting out ideas at the second Hub and elaborating on it to sketch it at the third Hub. A related idea was that the Hubs would generate automated meeting minutes and action points, based on audio recordings.

Suggestions were also provided regarding logistics. The Hubs could give direction on the route and could adjust the route based on the intended meeting duration or the style/tone of the meeting. Imagine an ‘inspiring route’ that could be designed around artistic installations or charming points of interest, whereas a decision-making route’ would make use of natural landmarks (e.g., a tree alley or crossroads) in order to structure the meeting and push for decision moments. Technology could also be used to advise you to take either an indoor or outdoor walking meeting, depending on the weather, perhaps even displaying the weather forecast as a prompt (e.g., “It won’t be raining within the next two hours, it is an ideal weather for a walking meeting”). Finally, more futuristic visions included the possibility to interact with a remote teammate via holographic projection.

## 5 Discussion

The present study set out to provide insights into how technological solutions can support the practice of walking meetings. We conducted an online survey to identify scenarios of use of the Hubs, a network of stand-up meetings stations. The Hubs concept was not the main object of interest per se, but was used as a virtual research artefact intended to trigger reflection in office workers about their needs to conduct walking meeting in an efficient and pleasant way. The use of the Hubs as a design exemplar supporting respondents in envisioning use scenarios was intended at investigating perceived benefits and limitations of stationary artefacts located in the physical work environment. The insights we collected can be confronted to previous work, which is scarce and mostly focused on mobile-mediated technologies (e.g., smartphone apps). Our contribution thus brings a novel perspective on walking meeting technologies.

Our results show that the envisioned scenarios of use and necessary features of the hubs vary depending on the type of meeting, the number of participants as well as the temporal stage within the meeting itself. The most common meeting type chosen for the user scenario was a brainstorm with two to four attendees, which is aligned with previous research on walking meeting practices [17]. This scenario deviated the most from the other meeting type scenarios in terms of envisioned use. Not surprisingly, brainstorming tools and sketching features were more prominent in brainstorming meetings. Presenting features, on the other hand, were emphasized in all user scenarios and mainly considered useful at the start of a meeting. This does not present any major technological challenge, except for the need for robust outdoor screens which are already well spread in the public space for information or advertisement purposes. An original idea would consist of repurposing public screens currently used for interactive advertisement (e.g., on bus stations) or smart city information displays in order to make them punctually available to office workers.

In terms of desired features, we see a link between the rating of features' importance and the envisioned activities at the Hubs. Note taking, for instance, was considered the most important feature, and was also the most mentioned activity in the scenarios. Printing notes or documents and video calling were perceived as least important features and were not often mentioned in the user scenarios. At the end of the meeting, access to personal files, agenda and e-mails were considered key features. These insights could be used to rethink our office environment and how we adapt different areas at and around our workplace to different temporal stages of a meeting. One could for instance envision starting a meeting indoors in a meeting room to show and discuss the agenda, before going outside for the second part of the meeting. This part could be more creative or social, which relates well to the beneficial effects of walking.

While walking meetings are often perceived as less structured and more open than regular meetings [17], a common opinion shared by the respondents was that Hubs could have a beneficial effect on the meeting structure. Several ideas mentioned in the scenario revolved around the fact of using the Hubs as structuring devices, supporting a sequence of activities and tasks. Of the few existing studies on walking meetings, Ahtinen et al. [1, 2, 3] report findings from mobile-mediated concepts, which might be considered as the ideal medium - mobile, multifunctional and private - to support walking. While mobile technologies in general might be used to address challenges related to walking meetings, shared interactive products or urban furniture placed in the physical environment present alternative opportunities which are relevant to investigate. They might for instance contribute to overcome known barriers of walking meetings, by providing visible support and giving walking meetings a more official status. As an ecosystem of devices clearly visible in the work environment, technologies similar to the Hubs can constitute an 'official' sign that walking meetings is an accepted way of work in a company. More than the Workwalk by Damen et al. [13,17] presented as a dotted path, physical artefacts can support the communication of a modern organizational cultural and the social acceptance of the practice. This official character is emphasized by the physical presence of the devices inside the company's building or outdoor in the vicinity, sponsored by the company or the municipalities. This is in line with one of the design implications of Ahtinen [3] to design an "official tool" to increase acceptance of walking meeting practice.

## 5.1 Implications for design

As a synthesis of our findings, our walking meeting journey (Figure 6) presents typical scenarios. These tend to be aligned with current meeting practices, featuring a selection of common work tasks and corresponding features (e.g., presenting, note-taking and scheduling). While not surprising, these synthetic findings can be useful to define minimal viable products and services supporting walking meetings, relying on the most relevant features only. Similarly, quantitative findings about the preferred meeting type and number of coworkers involved provide designers with a precise scope to focus on.

While the overall perceived need for features in our survey was close to the tools used during regular meetings, the question is whether designers can encourage new practices rather than solely supporting existing ones? In our experience, it is a challenging endeavor to disrupt ways of working entirely and technologies such as the Hubs (which support rather typical meeting scenarios) might constitute a first step towards new practices, which designers can encourage.

Walking meeting technology should not be a copy-paste of regular meeting tools. Walking meetings have distinct characteristics, which should be considered to strive for positive, and perhaps innovative, meeting experiences. As reported by Damen et al. [17], walking meetings offer different social dynamics and set-up of meetings. This invites the design field to rethink what is needed to facilitate walking meetings, both in adapting current technologies (e.g., speech-to-text), as well as in inventing new interactive products or services specifically designed for this practice. Some of the original user insights uncovered through our survey can provide inspiration for more disruptive technology use. One can also approach the challenge from a ‘technological push’ perspective, by considering how current and new technologies developed in other application areas could be applied to walking meeting practices. The Gartner Hype Cycle for the digital workplace ([www.gartner.com/smarterwithgartner/6-trends-on-the-gartner-hype-cycle-for-the-digital-workplace-2020](http://www.gartner.com/smarterwithgartner/6-trends-on-the-gartner-hype-cycle-for-the-digital-workplace-2020)) might for instance be a starting point.

Interestingly, the impact of the Covid19 pandemics on workers triggered reflections and questioned the status quo and ways of working in general. In terms of walking meetings, not only can designers think of synchronous face-to-face (or rather side-by-side) meeting types, but also on how to support walking meetings with geographically distributed participants. Gamified processes could be implemented in order to trigger new dynamics, for instance by “forcing” participants to walk a certain distance in order to submit ideas in an online remote brainstorm (one idea every 500 meter). GPS technology could be used there in a similar fashion as the app DeepTimeWalk, a narrative experience which requires the users to walk to listen to the story. As mentioned earlier, it might also be interesting for policy makers to look at ways of repurposing the public space to support innovative and healthier working practices. Could urban parks become places where office workers meet, supported by walking meeting technologies?

Yet despite benefits on the practical and social side, one can argue that the downside of technologies for walking meetings such as the Hubs is to remove part of the freedom that characterizes walking meetings. The “freedom from computer” is highlighted by Ahtinen et al. [2] who argue that “without the usual office tools, one gets more space for thinking and concentration to the actual topic”. Although technology has the paradoxical effect of being both confining and liberating at the same time, we believe this work can spark new research and development to the under researched field of HCI for active ways of working. Beyond developing more interactive products and services around this practice, a challenge to be addressed by the HCI community will be to find the right balance between the level of support provided by technology and the nature of walking meetings.

## 5.2 Limitations

Our work entails several limitations. First, the example chosen and the method in general might have influenced some of the results of the study, for instance by suggesting a 3-steps meeting structure or using a set of specific scenarios. Our sample is mostly composed of respondents who have little (or no) experience with walking meetings. Their perceptions are thus rather based on envisioned practices, and might differ from the ones of more experienced participants. Although many generic findings align with previous work [1, 17], some user needs are only uncovered in-situ, and further research is thus needed in the field.

One can also question the soundness of an online survey, as compared to field tests using actual devices. However, pilot tests of the hubs, briefly described in the late-breaking work paper by Damen et al. [17] hinted at many variables hard to research experimentally and had a different purpose. The survey allowed respondents to imagine how a technology such as the hubs would suit their needs and made it possible to collect insights on a large and diverse sample of office workers. The insights derived from the hubs as a design exemplar in our survey point towards a broader application and contribute to inform the design of technologies to support walking meetings.

## 5.3 Future work

Future work includes semi-experiments with office workers to study the experience of walking meeting technologies in-situ. We are particularly interested in investigating the benefits of combining mobile and stationary technologies, and even the ones of including low-tech approaches (e.g., walking meeting routes using traditional signage). In line with previous work done by industrial designers, we first aim at conducting design-through-research studies on artefacts making use of the physical space to support walking meetings, and to nudge office workers to adopt this practice. Our focus will be on the role of these modular artefacts, their influence on the meeting flow, and the optimization of the location/number of artefacts in a workplace environment. From a UI perspective, many elements are still to be researched. We are also conducting design explorations on interactive walking routes, to indicate the position and availability of walking meeting devices or to suggest personalized paths depending on the meeting type. Finally, a special attention could be paid to the facilitation of walking meetings.

## 6 Conclusion

In this paper, we provide insights into walking meeting scenarios that can serve as input for new technologies to facilitate physically active ways of work. We sampled a large number of participants in order to understand users' perceptions and needs with regards to walking meetings. Through a scenario-based online survey (N=186), we explored the most relevant use cases for the design of walking meetings Hubs, stand-up meeting stations that accommodate different tasks during walking meetings. We purposively used the Hubs as a design exemplar of a tangible technology situated in a physical work environment, in order to investigate this under-research area (previous

work in HCI focusing mostly on mobile-mediated concepts). The insights collected and subsequent discussion points can be used by design researchers and practitioners to rethink the office environment and related working practices, in order to combine productivity and wellbeing at work. We encourage the HCI community to unite around this timely and societally relevant topic.

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