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## Ethics in Design and Implementation of Sensor Technology Applications for Workplace Health Promotion

A Case Study<sup>3</sup>

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<sup>3</sup> An adapted version of this chapter has been submitted to an international peer-reviewed journal by C.C. Roossien, A.M. Bonvanie, M. de Jong, & E.L.M. Maeckelberghe

## **Abstract**

Responsible research and innovation studies have established a firm framework for addressing ethical issues in designing and using new technologies. However, despite this comprehensive ethics framework there is still a lack of knowledge on how to overcome the divide in ethical approaches to designing and implementing innovative technologies, on how context-specific ways can be used to address critical ethical issues such as privacy and autonomy in responsible research and innovation, and how ethical responsibilities of the different stakeholders can be made manifest and used.

These three problems are a major challenge for the development and implementation of new technologies. The case study of SPRINT@Work describes how these problems were addressed in a multidisciplinary research project, thereby developing a context-sensitive ethics approach. Using this context-specific approach, we could specify and operationalize the critical principles of privacy and autonomy in the SPRINT@Work project, we bridged the gap between design and implementation of the technologies regarding values and their impact on intended and actual use, and make the responsibilities regarding use of the technologies more tangible.

### **Introduction**

Responsible Research and Innovation (RRI) is a field of science that aims to highlight the socio-ethical issues in research and innovation practices (Asveld et al., 2017; B. J. Koops, Oosterlaken, Romijn, Swierstra, & van den Hoven, 2015; van de Poel & Verbeek, 2006; Van den Hoven, Lokhorst, & Van de Poel, 2012). In the past decade, new knowledge and guidelines have been developed that empower researchers to incorporate the researcher's ethical responsibility throughout the innovation process (Stahl, 2013; Stilgoe et al., 2013), focussing on anticipation of (un)foreseen ethical qualms, reflexivity on one's own role, inclusion of a diversity of perspectives, and responsiveness to societal needs.

Research into the design and implementation of work-related sensor technologies intended to promote self-regulation of healthy work behaviour, seems to be surrounded by ethical issues that require Responsible Research. Examples of sensor technologies that are applied in the workplace are accelerometers measuring bending and standing activity (Villumsen, Madeleine, Jørgensen, Holtermann, & Samani, 2017) and wearable sensors for measuring fatigue (Aryal, Ghahramani, & Becerik-Gerber, 2017). Additional intervention technologies, such as activity monitors are increasingly implemented to support workers to alter their behaviour in order to prevent or solve health problems (Huang et al., 2019; Jacobs et al., 2019). Two ethical issues that are critical in the design and implementation of such sensor technologies are privacy (Spook, Koolhaas, Bültmann, & Brouwer, 2019) and employee autonomy (Damman et al., 2015; Leclercq-Vandelannoitte, 2017). The purpose of the present case study is to explore how those critical ethical issues were addressed in a multidisciplinary research and innovation project on sensor technologies for three reasons. First, studies on sensor technologies tend to compartmentalize, by only looking at the development phase of sensor technologies (Aryal et al., 2017; Efstratiou et al., 2007; Motti & Caine, 2014; Saurabh, Rao, Amrutur, & Sundarajan, 2014) or the implementation phase (Kortuem et al., 2007; Leclercq-

Vandelannoitte, 2017; Sole, Musu, Boi, Giusto, & Popescu, 2013). This is calling for research how an integrative ethics approach can solve this compartmentalization. Secondly, ethical issues in research and innovation projects are often generalized, without acknowledging specific contingencies (i.e., situational concerns) that may play a role in the work context, for instance due to the hierarchical relation between worker/user and employer/provider of the technology (Palm, 2009). Lastly, little is known about how to represent and utilize the ethical responsibilities of the different stakeholders in research and innovation projects (Leclercq-Vandelannoitte, 2017). Therefore, in this case study we want to investigate the distinct ethical responsibilities of developer, employer and employee and how these distinct responsibilities can be effectively addressed. In what follows, we first describe the current literature about RRI, the autonomy and privacy of workers, and the responsibilities regarding the use of health-related sensor and intervention technologies. Secondly, we explore the case of SPRINT@Work (Bonvanie et al., 2020; de Jong et al., 2018; Roossien, Heus, Reneman, & Verkerke, 2020) to show how a context-sensitive ethics can address these issues regarding sensor and intervention technologies in the workplace, and how this approach can help to overcome issues as generalization and compartmentalization and to identify the relevant responsibilities.

## **Theoretical background**

### **Responsible research and innovation**

Responsible research and innovation (RRI) is the interdisciplinary approach that tries to guide the debate about the societal impact of innovations Grunwald (2014). This chapter focuses on responsible design and implementation of technologies aimed at the workplace. Publications in this field struggle with three important problems: compartmentalization, generalisation, and vagueness about responsible use (Efstratiou et al., 2007; Kortuem et al., 2007; Leclercq-Vandelannoitte, 2017; Palm, 2009).

First, there is a compartmentalization of focus problem. Studies until now mostly focus on ethical issues in either the design of new sensor technologies (Aryal et al., 2017; Efstratiou et al., 2007; Motti & Caine, 2014; Saurabh et al., 2014) or the implementation of existing technologies (Kortuem et al., 2007; Leclercq-Vandelannoitte, 2017; Sole et al., 2013). The former one-sidedness does not incorporate questions about the tension between intended and actual use of the design. The latter one-sidedness takes technologies as a given and does not question the inherent values in the design. This situation does not do justice to reality: if design and implementation do not acknowledge each other's ethical concerns and intended values, the final use of the technology will not reflect the intentions of both sides. A broader view on the transition between design and implementation is called for (Jakobsen et al., 2019), in order to facilitate responsiveness between these phases of RRI.

A second problem is generalisation. A single issue is identified as core problem and addressed in a general way without attention for the specific context. There is, for example, extensive attention for privacy as this is seen as one of the major issues in the development and application of new technologies that collect large amounts of data of individuals (Al Ameen, Liu, & Kwak, 2012; Conger, Pratt, & Loch, 2013; Nissenbaum, 2010; Zhu, Gao, & Li, 2016). However, this attention is aimed at technologies that are used in the public space, and there is no specific analysis of privacy issues regarding the use of sensor technologies in the work environment designed for health promotion. Therefore, specific issues that concern privacy in the worker-employer relationship are not addressed. Nor is there any discussion about how privacy is embedded in the broader context of thinking about the effect of sensor technology on autonomy of people, or in this case specifically the autonomy of workers. Research suggests that workers experience (Leclercq-Vandelannoitte, 2017) and fear (Damman et al., 2015) losses of privacy and autonomy due to the use of (preventive) technology in the workplace. This lack of context-specific knowledge on both privacy and autonomy makes that these ethical issues currently are not addressed properly in the development

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of new technologies for the work environment. Therefore, further research needs to address and contextualize these autonomy and privacy issues in the design and implementation of sensor technology for the workplace.

Third, the topic of responsible use of sensor technologies in the workplace remains vague and unaddressed. Providing transparency about what is responsible use and who is responsible for responsible use are lacking. Leclercq-Vandelannoitte, for example, observes that in the use of ubiquitous technologies in the workplace, workers nor employers recognize who is responsible for, and what is the importance of, responsible use of these technologies (Leclercq-Vandelannoitte, 2017, p. 151). Furthermore, designers do not provide insight into what a responsible use of their design is. Identifying responsible use is notoriously difficult due to the interdependent design-use dynamics (Kiran, 2012). These dynamics entail that design and use continuously impact one another, because a certain function is often the reason for the design of a technology application, but then the adoption of the design can substantially change the function. An example is the innovation of Short Message Service (SMS): the SMS function was designed to enable mobile owners to receive messages about incoming voice mails and bills from the mobile company (Taylor & Vincent, 2006), but then developed into a main function for communication between individuals, thereby posing additional design demands, as well as responsibilities that were not deemed relevant for the original function. These interdependent design-use dynamics make it hard to predict how a technology will be used, and whether it will be used as intended. This, however, should not withhold designers from at least sketching the responsibilities inherent in their designs.

These three problems are a major challenge for the development and implementation of new technologies from an RRI perspective. The main questions are: How to prevent compartmentalization of focus regarding inherent values in the design and its implementation? How to prevent out of context generalisation of ethical issues? How to

address and deal with inherent responsibilities of different stakeholders in the design and implementation of sensor technology in the workplace? In the case of SPRINT@Work (see Method), these questions were addressed with a context-sensitive ethics approach, i.e. taking the concrete setting seriously not only to further the application of ethical principles in that context, but also using the setting as a source of moral knowledge (Musschenga, 2005). In this way, we aim to explore the dynamics between developer and user in the design and implementation of sensor technology for the two critical ethical issues of privacy and autonomy, by testing our conceptualisation of the RRI ethical principles in the work environment, and further adjust them where deemed necessary.

### **Privacy of workers**

An important question is what kind of intrusions are acceptable in a work environment? Employers are supposed to guarantee a safe working environment for their employees, and they should be reluctant when it comes to meddling with the private lives or private data of their employees. Interfering with employees' health behaviour, especially when it is connected to lifestyle, is considered to be dubious at best, since it targets individuals (both at work and at home) instead of organizational or collective problems, even if it is aimed at sustainable employability (van Berkel et al., 2014). To ensure that the privacy of the worker is guaranteed, sensor and intervention technologies should comply to several criteria. Firstly, according to the EU General Data Protection Regulation (GDPR), the worker should be able to access all personal data and outcomes of the sensor and intervention technology, without interference of others (GDPR). Secondly, the employer should not have access to the data and outcomes of an individual worker or be able to derive them from data reported at a higher group level (GDPR). Current regulations on data collection and individual privacy limit the possibilities of data sharing (GDPR), as the only legal basis for data processing is formulated in article 6(1)(d) of the GDPR, stating that the data processing has to be necessary to protect vital interests of the subject, so it has to be a life-



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or-death situation. Legally, data sharing at group level is only allowed if the data does not contain identifiable information, i.e. personal data traceable to individuals (GDPR). When it comes to sensor data that cross the border between work and private life, serious legal questions arise as soon as data privacy and health privacy are at play (Brassart Olsen, 2020). For workplace improvements, however, non-identifiable information on group level should be possible to share (Arora, 2019). Third, the worker should be able to communicate (parts of) the data to relevant actors (such as general practitioners or therapists) without the knowledge of the employer (Arora, 2019).

A needs assessment among workers with physically demanding work in SPRINT@Work identified a demand for sensor and intervention technologies (Spook et al., 2019). However, respondents expressed concerns about what would happen with the personal data retrieved by the sensors, fearing their privacy would be infringed, especially if employers would have access to the data. These apprehensions confirm the findings of other studies (Choi, Hwang, & Lee, 2017; Jacobs et al., 2019). The GDPR, as described above, offers an extensive legal framework protecting the rights and freedoms of the data subjects, including ensuring data minimization, informed consent, good practice via e.g. Data Protection Impact Assessment, and privacy by design (GDPR, 2016; Lodge & Crabtree, 2019; Mulligan, Koopman, & Doty, 2016). Workers, however, also declared that they incidentally would like to share their data with their employer to explore possibilities to improve the working conditions, if they could retain full ownership of the personal data (Spook et al., 2019).

Absolutizing a legal framework endangers narrowing the basic questions of why privacy is an important moral value. Data protection is of major importance to ensure privacy, but data protection does not capture a full understanding of the concept and function of privacy. Numerous scholars have warned against a reductionist conceptualisation of privacy as merely about the protection of the personal sphere and raised questions about possible conditions under

which this can be overruled (Barocas et al., 2013; DeCew, 2015; Dwork, 2006; Mulligan et al., 2016; Nissenbaum, 2010; Solove, 2008). They have argued for a broader understanding of privacy as a value that receives its content by reflection on the practice and its context. Whereas a legal framework for privacy by its nature, becomes fixed, privacy as a value is shaped by the situation in which privacy is at stake. Nissenbaum succinctly summarized this as: “*what people care about is not simply restricting the flow of information, but ensuring it flows appropriately*” (Nissenbaum, 2010, p. 2).

Privacy as an essentially contested and malleable concept is dependent on, amongst other things, the context in which privacy is examined, and the social and technological circumstances that apply to that context. As the theoretical debate about privacy goes on, there is a need for a context-sensitive approach. Mulligan et. al have suggested an approach that can be summarized in four questions that need to be answered “*While dilemmas between privacy and publicity, or privacy and surveillance, or privacy and security persist, the question we more often face today concerns the plurality available to us amidst contests over privacy: “Which privacy? For what purpose? With what reason? As exemplified by what?”*” (Mulligan et al., 2016, p. 15). This enables researchers and practitioners to pragmatically define the relevant characteristics of the applicable notion of privacy.

### **Employee Autonomy and Sensor Technology**

A major challenge caused by a workforce that will have to continue working into relatively high age is to keep workers fit for work (Kenny, Yardley, Martineau, & Jay, 2008). “*Sustainable employability means that, throughout their working lives, workers can achieve tangible opportunities in the form of a set of capabilities. They also enjoy the necessary conditions that allow them to make a valuable contribution through their work, now and in the future, while safeguarding their health and welfare. This requires, on the one hand, a work context that facilitates this for them and on the other,*

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*the attitude and motivation to exploit these opportunities*” (van der Klink et al., 2016, p. 74). Maintaining and supporting the individual workability of workers largely depends on the ability of employees to adapt their work behaviour to changing circumstances. Employee autonomy in self-regulation of work behaviour is widely claimed to be crucial in this adaptation process (Ryan & Deci, 2006). Organizations are therefore introducing more and more smart devices on the work floor with which employees can regulate their own tasks and associated work behaviour, on the assumption that self-management devices ensure the autonomy employees need for their self-regulation.

Technological interventions can assist to maintain individual workability, for instance by developing technology that addresses the needs of aging workers in an objective manner, such as interventions to increase physical activity or ergonomically adapt workplaces (Truxillo, Cadiz, & Hammer, 2015), and workplace health interventions that create balance between workers’ capacity and workload (Kenny et al., 2008). Sensor technologies, such as activity monitors or heartrate monitors, can monitor workload in an objective manner. Additional intervention technologies, such as smart chairs (Goossens et al., 2012; Roossien et al., 2017) are aimed at supporting workers to alter their behaviour in order to prevent or solve health problems effectively.

Workers are willing to adopt sensor technologies when they perceive them as useful (Choi et al., 2017; Jacobs et al., 2019), but their willingness also depends on how their concerns regarding data security and misuse of technologies are met (Jacobs et al., 2019). From a philosophical point of view, autonomy is a notoriously complex concept and caution is necessary for narrowing the notion of autonomy to an idea of self-determination. Autonomy is a normative idea that gives direction to actions that are governed by a responsible commitment to the norms with which one binds oneself. It can be about one’s own willed ideals, but also a commitment to the norms and standards people encounter because of where they are, e.g. the work place, and take as their own normative standards (Kukla, 2005).

This concept of autonomy, coined by Kukla as conscientious autonomy, covers both the high moral values that give direction to peoples' lives, as well as those small practical commitments that give shape to ordinary lives. For instance, if someone values being healthy, the practical commitments could be to walk to work instead of taking the car, or taking the stairs instead of the elevator.

### **Responsibility in the work environment**

The ultimate responsibility for safeguarding the working environment lies with the employers. Employers are responsible for the workability of their workers and need to actively prevent harm and accidents (Arbeidsomstandighedenwet, 1999; Palm, 2009). In the case of workers with hard physical labour, the employer is obligated to protect the workers' safety during work by conducting a periodic occupational health examination and monitor the safety of employees (Arbeidsomstandighedenwet, 1999). Despite the employers' limited access to the outcomes of this regular health check, this examination is a manner to protect the workers and take responsibility, because the occupational physician can have access to this data and warn the worker if something is wrong. The occupational physician is bound to confidentiality due to the nature of the profession. To protect the worker while using sensor and intervention technology in the work environment, all stakeholders need to take their responsibility for a proper use of those technologies (Johnson & Powers, 2005). Taking this responsibility regarding health in the workplace is considered important, but employers may have different views on this responsibility than workers (van Berkel et al., 2014). The responsibility of the employer to prevent harm in the workplace is a responsibility that is acknowledged by both worker and employer, but the responsibility to stay healthy and fit for the job is considered by many employers to be the worker's responsibility while workers feel that they are autonomous in how they want to live their lives (van Berkel et al., 2014). These disagreeing views see health as either a safety discourse, or a lifestyle discourse (Allender, Colquhoun, & Kelly, 2006), and the responsibilities of worker and employer regarding

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both these discourses need to be examined with the context-specific ethics in mind, in order to prevent ambivalence in the worker-employer relationship (van Berkel et al., 2014).

### **Method**

This study is an instrumental case study description (Crowe et al., 2011) of SPRINT@Work, a project in which the aim was to develop sensor and intervention technologies for a sustainable workforce and to do so while including the perspective of implementation during design and vice versa. The case of SPRINT@Work addresses the difficulties in a real-life research setting of ‘doing ethics’.

### **Focus of this research**

The main ethical challenge in the project was how to achieve responsible development and implementation of sensor technologies aimed to enhance healthy behaviours in the workplace. Specifically, this challenge included the three problems of compartmentalization, generalisation, and vagueness about responsibilities and required an interdisciplinary research team to be addressed. First, we will describe the case and the ethical issue of workers’ privacy and autonomy in this specific setting. Secondly, a context-specific conceptualisation of privacy and autonomy was required and developed in the project to show how and where privacy and autonomy questions in the health at work context differed from the questions posed in the general discussion on these values. These new conceptualisations are described and provide useful insights into how the relationship between worker and employer alters the relevance of privacy and autonomy, and how this is reflected in concerns about technologies in the workplace. Finally, the values of these conceptualizations will be discussed in the context of the three major problems - compartmentalization, generalisation, and vagueness about responsibilities - for the development and implementation of new technologies, and we will conclude with the lessons learned.

### **Setting**

#### **Project description**

The project that is described in this paper is SPRINT@Work, an EU-funded interdisciplinary project, aimed at developing and evaluating sensor and intervention technologies that contribute to keeping the aging worker healthy and effectively employable (Bonvanie et al., 2020; de Jong et al., 2018; Roossien et al., 2020, 2017). The project team consisted of researchers and engineers from a variety of disciplines (cognitive neuroscience, information management, biomedical engineering and rehabilitation medicine, community and occupational medicine). Cognitive neuroscience and information management were both represented by one professor and one PhD candidate, biomedical engineering and rehabilitation medicine was represented by two professors and one PhD candidate, and community and occupational medicine was represented by two professors, one post-doctoral researcher and one PhD candidate. The four PhD candidates acted as executing researchers. By initiating both individual studies and collaborative research, the researchers aimed to develop innovative sensors and interventions that could make cognitive and physical performance objectively measurable, and that contribute to the employees' awareness of their own behaviour and its consequences for their health and employability.

#### **Aim and data collection**

The overall aim of SPRINT@Work was to provide individual workers with feedback, health self-management applications (HSMAs), to improve their mental and physical condition in order to keep them healthy at work and consequently promote long-lasting social participation. The team soon encountered two major overall questions: *'what kind of intrusion in the lives of employees is acceptable in a work environment?'* and *'what implications do sensor technologies have on the autonomous self-regulation of behaviour by workers?'*. The first question regards the privacy of workers, the second concerns employee autonomy. These two questions exemplify how design and implementation cannot be

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compartmentalized and generalized. Both questions also point at the need for a contextualized approach. The work environment is a setting that has its own rules and regulations and thus needs further specification about what privacy entails in this context. Finally, these questions also ask for reflection on *who is responsible for adequate responses to the ethical questions in both the design and the implementation phase.*

In several intervision sessions between the executing researchers, and later on the whole project team, the questions were addressed (a) whether the legal framework of privacy identifies sufficiently what is at stake in the specific context of the development and implementation of sensor technologies for sustainable employability, and (b) whether self-management devices aimed to promote self-regulation can be of assistance in enabling the autonomy of workers. The team developed a conceptual framework that contextualises data protection and privacy issues and the notion of employee autonomy into a framework of context-sensitive ethics that is helpful for both designing and implementing sensor technologies. This framework functioned as a benchmark for the researchers in SPRINT@Work, so they could continuously check whether their proposed design was in line with the context-specific ethics. During the project, this normative framework was continuously adapted using insights from the executed studies.

### **Context characteristics**

In SPRINT@Work, the employer decided whether a study with HSMA could be executed within the company. Workers then could voluntarily participate in the field studies where sensor and intervention technologies were used. This was articulated since the researchers adhere to the declaration of Helsinki on research involving human subjects (World Medical Association, 2013), stating that participants should voluntarily give an informed consent. This voluntary participation is similar to a non-research implementation of an HSMA in the work environment: employers are not allowed to

oblige workers to use HSMA, nor can they ask for data if the worker voluntarily uses an HSMA (Dutch Data Protection Agency, 2016). In the work environment however, the hierarchical relationship between worker and employer can make that workers do not feel as if they have this freedom. The workers' dependence on the employer for job security, career opportunities, and work pleasure makes the work environment a context that require a context-specific approach to addressing ethical issues that are inherently associated with the design and use of HSMA.

### **Results**

In the results section, we provide two examples of ethical issues that we have encountered during SPRINT@Work. With these examples, we show how protecting the privacy and autonomy of workers cannot be seen as stand-alone issues, but that there is an interplay between these values, the work context, and the responsibilities of worker and employer.

#### **Privacy in SPRINT@Work**

##### **The case of firefighters**

The regulations on privacy provided a framework but also provoked the question in SPRINT@Work whether legal requirements and regulations identify sufficiently what is at stake in the specific context of the development and implementation of sensor-technologies for sustainable employability. More specific, *what kind of intrusion in the lives of employees is acceptable in a work environment?*

In one of the SPRINT@Work studies, some workers declared that they would like to share their data with their employer to explore possibilities to improve the working conditions, while retaining full ownership of the personal data (Spook et al., 2019). Specifically, it became clear that firefighters would strongly benefit from sharing personal data about health measures such as bodily temperature acquired from wearable sensor and intervention technologies when entering a fire. The firefighters themselves are not allowed to be distracted by immediate feedback about the obtained data, because they need to focus on the situation at hand. They neither have time



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nor opportunity to monitor the feedback and data from their own sensors (Roossien et al., 2020). However, if the captains could monitor the current body temperature of their workers on site using the real-time information from wearable sensor and intervention technologies, decline of the health and/or safety of the workers could be prevented. Legally, an employer cannot ask permission to access this personal data of the worker (GDPR, 2016), despite it is in the workers' advantage and safety. This points at an ambiguity in the data protection law regarding the protection of workers' privacy opposed to the responsibility of the employer to safeguard their health and safety: employers cannot, under any circumstance, use personal sensor data for protection of health and safety of the employee, even though they have the responsibility for protecting the workers from harm in the work environment. Ensuing question for the research team was to explore more in depth how privacy can be conceptualized in the specific context of sensor technologies at the work place, despite this ambiguity.

### **Context-specific approach of privacy**

Following the pragmatic approach of Mulligan, we analysed this case of data sharing of firefighters. What would privacy provide the protected firefighters in this case? Control over personal information, i.e. the core temperature and heartrate of the firefighter, is the key target for protection. From the perspective of the GDPR as we explained earlier, this type of data can only be accessed under very strict circumstances and they must be handled by a health professional who is bound by professional confidentiality. In case of a fire no such health professional is available. The harm that supposedly would be prevented by privacy – access to personal information – might be superseded by prevention of a bigger harm: the information about the fire worker's temperature can prevent the fire worker from overexposure to heat. This example is illustrative of how information acquires ethical and normative significance not because it is about certain values, i.e. privacy, but because the context makes that it can be used for actions, in this case possible prevention of overheating. It

is not about what information one has but about what one can do with that information. Manson et al call this an agency-based model of informing and communicating (Manson & O'Neill, 2007). It is necessary to analyse what exactly the agent, in this case the firefighters' captain can do with the private information obtained. If overheating can be prevented, firefighters might want to have the option to share their sensor information with their captain, even though the captain is not bound by confidentiality as a health professional. The firefighters' permission to the captain to access this information is in this case based on the specific agency the captain has: protecting the firefighters from overheating. Another protection of the privacy of the firefighters could be that their captain should be bound by the confidentiality of his own profession.

The answer to the pragmatic questions Mulligan et al formulated 'Which privacy? For what purpose? With what reason? As exemplified by what?' is that in the case of the firefighters the privacy at stake is the ownership of personal data obtained by sensor technologies. The purpose of the privacy is to give the firefighters control over their own data, not to prevent the employer to use these personal data but also to give the firefighters the opportunity to share the data only in circumstances that they deem acceptable. This is exemplified by the agency-based model: in the ideal situation, the firefighter can opt to share data to protect himself from health hazards with a person, in this case the captain, who can act on these data for the specific purpose of preventing health hazards and who cannot use these data for any other purpose. The example of the firefighters shows that a narrow interpretation of privacy might result in diminishing their safety: if privacy is unidimensional, and the only choice would be whether or not to share the data with the employer, either the firefighter would have to accept greater risks during execution of the job because the data would be hidden (as it is in the GDPR), or the employer would have full access to all data, which could lead to misuse of data for other purposes.

### **Responsibilities of stakeholders**

If we look at the example of the firefighters, we see that the experienced responsibility for health of the workers is taken seriously by the employer. The GDPR, however, prevents the employer from using personal data to protect firefighters from overheating in an emergency situation. In this case, the workers themselves cannot do anything: letting themselves get distracted from their task could cause immediate risks to themselves or their colleagues, so it is impossible to self-monitor their current health parameters. This gap between the desired situation and the current regulations is still frustrating for the fire department, because the captains wish to protect their firefighters, but the law prevents that from happening.

### **Autonomy of workers in SPRINT@Work**

#### **Case of health care workers**

The use of sensor technologies to assist in sustainable employability seems to hinge on offering workers objective feedback and interventions that give them the opportunity to self-regulate their behaviour. In the context of SPRINT@Work, this initiated the question whether developing and implementing sensor technologies aimed at promoting self-regulation is a sufficient condition for ensuring the autonomy of workers?

Illustrative for the ideal of conscientiousness at stake in being autonomous, is a participant who reported to have overweight and being in bad shape and who was eager to partake in an experiment with an activity tracker. The employee was committed to improving her condition: *“I value a healthy lifestyle. I have difficulties keeping up with that for all sorts of reasons and this is an opportunity for me to get some non-intrusive and time-saving support. I also would like to be an example for the patients who visit here. They need people like me as role models, people who struggle but make an effort to improve their health”*. She refers to what she values, which is personal health. Receiving an activity tracker in itself does not give autonomy, but due to the HSMA, she can autonomously commit to her own value

of becoming healthy. This value, however, receives a different meaning in her work context, a health care organization, where she also wants to set an example for others. She wants to show that increasing your daily exercise, by walking more and taking the stairs, is an important commitment to improving health. For this employee, in the work context, in addition to achieving a healthy life style, the moral value of being an example plays a role. She translates both the personal value and the value resulting from her position at work into the daily practical commitment of taking more steps. The use of the HSMA helps her to achieve her ideal.

The commitment of the employee, however, was not only shaped by a momentous decision to accept the activity tracker. It was confirmed (by making small progress in walking more steps) but also disaffirmed over time. The employee felt disaffirmation when a colleague from higher management rebuked her when taking the elevator, saying that was not why she was given the activity-tracker. It made her question whether the entire experiment was about her own improvement in health and realizing her own values or was it about control and reducing costs for the organization?

### **Context-specific approach of autonomy**

This example, even though at first sight it might seem about an individual experience, illustrates how personal autonomy, as seen in the small every-day practical commitments, can easily be threatened in the context of a work environment if personal values are not acknowledged. Giving employees technologies, be it a health device or sensor technologies, is not only giving them a means for self-regulation. The technology is embedded in a context that can promote or disavow the responsible commitment to the norms with which one binds oneself. This calls for reflection on how the mere introduction of a technology can affect the autonomy of employees, and how the context of the implemented technology influences the perceptions regarding autonomy of the worker.

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Employee autonomy as a prerequisite for health self-regulation was empirically investigated in one of the studies of SPRINT@Work. It examined activity trackers, that give feedback information on health-related behaviours to employees. The example of activity trackers is of interest because it is used as a HSMA that enables employees to self-regulate a healthy lifestyle (Bravata et al., 2007; Mattila et al., 2013). The basic assumption was that the use of HSMA provides employees with autonomy, i.e., feedback information and the room to decide what to do with this information, to self-regulate their health-related behaviour. This autonomy assumption was empirically investigated. Findings revealed that the use of an HSMA did not significantly increase perceived autonomy, and may have even reduced it under certain conditions, especially for less healthy employees (Bonvanie et al., 2020). Additional to this, workers in this experimental study that had already used an HSMA themselves before they started to wear one that was provided by the employer, experienced the same decrease in autonomy as workers who used an HSMA for the first time. This shows that the activity tracker itself does not limit the autonomy of workers: it is the specific context of the work environment, with the hierarchical relationship between worker and employer, that makes that the perceived autonomy decreases.

Kukla coined the idea of conscientious autonomy, that autonomy can be about commitment to one's own willed ideals, but also a commitment to the norms and standards people encounter because of where they are, and take those as their own normative standards (Kukla, 2005). If we work with that idea, we can put a finger on why the autonomy of certain workers declines when they use an HSMA. The normative standards of the activity tracker that were applied were externally imposed: the goal was to walk 10.000 steps per day, and take 10 flights of stairs. Some of the participants agreed with this goal and internalized the normative standard; Others however did not, and perceived the feedback as pressure that forced them to still aim for 10.000 steps. The employer at the same time also showed they valued healthy workers: before the experiment there were several activities, such as a week of taking the stairs and a healthy cafeteria project,

which showed what the values and norms of the employer were. Participants that share the value of healthy living of the employer, but have other ideas about what healthy living means in daily life, feel as if the HSMA forces them to commit to someone else's normative standards. Therefore, there is a need for caution by employers about how HSMA can be responsibly implemented in the workplace.

### **Responsibilities of stakeholders**

In the case of health care workers, we see that participation in the study caused the employer to reconsider the workplace health promotion policies. Their workplace health promotion program was mainly aimed at physical health, using interventions such as providing employees with an activity tracker, a smoke-free property, a week of taking the stairs, and a healthy cafeteria. Seeing the impact this had on some of the employees with worse health, they realized that this approach may work counterproductive. Therefore, they decided to alter their strategy and include a more diverse group of workers in the decision-making process regarding new technologies. Thereby, they hope to facilitate a healthy workplace and lifestyle for all workers.

### **Discussion and conclusion**

Three unmet problems were identified in the literature about responsible development of sensor technologies that are used in the workplace: How to prevent compartmentalization of focus regarding inherent values in the HSMA design and its implementation? How to prevent out of context generalisation? How to make inherent responsibilities in the design and its implementation explicit? In SPRINT@Work, these challenges were met in several meetings aimed at identifying the core ethical questions. The two major overall questions, as explained above, were *'what kind of intrusion in the lives of employees is acceptable in a work environment?'* and *'what implications do sensor technologies have on the autonomous self-regulation of behaviour by workers?'*. We will now explain how using a context-specific approach to answer these core ethical questions contributed to answering the three unmet problems.

### **Compartmentalization of focus**

The identification in the project SPRINT@Work of two core ethical problems, resulting from reflection on both design and field experiments, made that the researchers needed to reflect on how they interpreted and used values as privacy and autonomy. The question about *'what kind of intrusion in the lives of employees is acceptable in a work environment?'* asked for clarification of the concept of privacy. The concept was discussed in the legal context, focussing on protection of the personal sphere, and from the perspective of privacy as a moral value. The analysis of privacy as a moral value resulted in the description of an agency-based concept of privacy. The agency-based concept of privacy frames the problem in such a way that design and implementation phase need to be seen as a continuum. The need to protect data from unwanted intrusion from the employer while making the data available for monitoring the health of the employee has two consequences. On the one hand, the design should incorporate all conditions set by an agency-based privacy. The design should include the possibility that employees can share data with designated persons. In the example of SPRINT@Work, the firefighter indicates that the captain may view the data in the context of fire-fighting. On the other hand, agency-based privacy indicates that where the technology is implemented, the designated persons need to have the possibility, and power to act on what is requested on predefined terms. In the example this means that the captain is equipped with the power to use the data, but that is only possible in the context of the fire extinguishing work, with explicit consent of the individual firefighter, and when confidentiality is guaranteed.

### **Prevention of out-of-context generalization**

A responsible decision to provide workers with smart devices that can help them sustain their workability requires careful analysis of the values at stake in the context of the specific workplace and individual worker. The examples provided in SPRINT@Work showed that generalized ideas of privacy as protection from unwanted intrusion and autonomy as self-regulation were insufficient because these

generalized ideas did not answer contextualized questions specific for the work environment. Concepts that guide reflection towards identifying what is at stake in a specific context are more helpful. Both the agency-based model of privacy and the notion of conscientious autonomy set up a framework of specific description of what is at stake in a specific context. The examples of the firefighters and of the healthcare professionals using an HSMA are illustrations of how these concepts help identifying bottlenecks, implicit norms, and what to act on. These examples go beyond merely being examples. They also were a source of moral knowledge as the experiences in the field informed the researchers about what users value. The dynamics between developer, employer, and user were used by testing our conceptualisation of ethical principles in the work environment, and further adjust them where deemed necessary.

### **Making implied responsibilities explicit**

The two core ethical concepts of privacy and autonomy are used to contribute to identifying responsibilities. Both the example of firefighters and healthcare professionals using an HSMA demonstrate that designers and researchers of such technologies need to reflect explicitly on which ethical principles are critical to what they design and what the implications of these principles are for the implementation and use of the design. A commitment to ensuring privacy as described in the context of SPRINT@Work gives the team the responsibility to design an agency-based data handling.

The reflection on this responsibility of worker and employer is not a one-time action. As stated before, differences in interpretations of responsibilities can cause large problems between worker and employer (van Berkel et al., 2014) and the use of a technology often alters the original function (Kiran, 2012). When using new technologies, workers and employers should therefore, together with the designers, discuss the responsibilities and intended actions they identify when using the technology. This also entails a continuous reflection of the employer on whether or not the conscientious



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autonomy of the worker is improved: the example of the healthcare workers using an HSMA indicated that with sensor technologies, workers might be enabled to take their responsibility to target work-related health parameters within the workplace. In general, however, this is most effective when workers feel autonomous in the self-regulation of their health-relevant actions. Due to the reflection of the employer on the decrease of autonomy felt by some employees when they were provided with activity tracker, and the actions taken in order to alter the workplace health promotion program, this taking of responsibility is enabled. The employers ought to be alert for non-intended effects of sensor technologies and should ensure an environment that facilitate workers to take their responsibility. Especially if there are shared values between worker and employer, such as health, HSMA that support the workers' personal goals could increase the conscientious autonomy of the workers, thereby improving their self-regulation of healthy behaviour.

### **Final remarks**

In the project SPRINT@Work, we learned that focusing on a contextual conceptualization of the core ethical principles identified during the project helps to avoid compartmentalization, generalization and neglect of identifying responsibilities. By using the design-use dynamics and context-specific ethics in a reiterating process of development and small-scale implementation, we have overcome these three large challenges for responsible research and innovation of sensor and intervention technology for a sustainable workforce. This method of developing a context-specific ethics makes it possible to look at the particular implications of a certain value for a specific situation, and we feel this can be applied in many real-life development and implementation projects. We have shown how a context-specific ethics can improve worker conscientious autonomy, how the balance between privacy and health can be improved by using an agency-based approach, and how focusing on values in their context can improve the responsible use of technologies. Thereby, we add an interesting view on the responsible research and innovation of

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health-related technologies to be used in the workplace, and we give employers more hands-on advice on how to responsibly implement these technologies.

