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HUMAN FACTORS

Dossier Teamwork

Working from home during COVID-19

Afgestudeerd - Eva Jonkman

Colofon

Human Factors streeft naar het zodanig ontwerpen van gebruiksvoorwerpen, technische systemen en taken, dat de veiligheid, de gezondheid, het comfort en het doeltreffend functioneren van mensen worden bevorderd.

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Inhoud

Voorwoord

De afgelopen maanden waren er in de redactie van dit tijdschrift een paar wisselingen van de wacht waar nog weinig aandacht aan is gegeven.

Marieke Sonneveld stopt na ruim 6 jaar als redactrice. We willen haar hartelijk danken voor haar tijd, inzet en bijdrages in al die jaren. We gaan haar warme persoonlijkheid en kennis op de gebieden van fysieke en mentale gezondheid zeker missen.
Met Maxim Smulders (TU Delft) hebben we een mooie aanwinst binnen de redactie. Ook in zijn werk staat fysieke en mentale gezondheid centraal, bijvoorbeeld in zijn focus op de human factors die een rol spelen bij slapen tijdens het reizen. Daarover in aankomende nummers zeker meer.
Naast Maxim verwelkomen we ook Travis Wiltshire (Tilburg School of Humanities and Digital Sciences) als nieuwe redacteur. Bij het samenstellen van de redactie streven wij zowel diversiteit als een goede afspiegeling van de Nederlandse Human Factors gemeenschap na. Travis is naar mijn weten het eerste redactielid dat Engels als moedertaal heeft. Zowel gezien het aantal Engelse bijdrages dat wij ontvangen, als het groeiende deel Human Factors professionals met een niet-Nederlandse achtergrond, zijn wij erg blij met de komst van Travis. Uiteraard stellen wij ons regelmatig de vraag in welke mate bijdrages in het Engels thuishoren in het tijdschrift. Maar zowel op onderzoeksinstellingen als in het bedrijfsleven zien wij een steeds meer internationale verdeling in Nederland. Dat is ook te zien in de verschuiving naar Engels als de voertaal op diverse instellingen en bedrijven. Om te vermijden dat wij in Nederland wonende en werkende HF professionals of geïnteresseerden uitsluiten zien wij het dan ook als een logische stap dat het tijdschrift zich beter instelt op Engelstalige bijdrages. Los daarvan zijn wij uiteraard ook erg blij dat Travis deel is van de redactie vanwege zijn kennis op het gebied van teamwork, problem solving (om maar eens wat Engelse woorden te gebruiken) en de interactie met cognitieve systemen.

Travis verzorgde ook het dossier over Teamwork in deze editie, met een focus op de luchtvaart en gezondheidszorg.
Samenwerken in een tijd waar thuiswerken de norm is brengt ook andere uitdagingen met zich mee. Ineens moeten workshops, brainstorms, evaluaties e.d. op afstand worden gedaan. De verwachting is dat ook na het intrekken van de coronamaatregelen er in verhouding meer thuis gewerkt gaat worden.

Maar hoe het vele thuiswerken op langere termijn wordt ervaren is nog maar langzaamaan duidelijk aan het worden. Net als de factoren die van invloed zijn op die ervaring. Een tipje van de sluier wordt in een los artikel opgelicht door Daniel Hesselman en Peter Vink (TU Delft).

Tenslotte vindt u nog een bijdrage van Eva Jonkmans, waarin ze haar afstudeerproject beschrijft gericht op de arbeidskwaliteit ondersteunen door middel van bedrijfsprocessmanagement software.

Ik wens u veel leesplezier met deze eerste editie van 2021!

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ORGANISATIE

Teamwork

Across many work domains including business, education, science, technology, governance, and manufacturing, a majority of work is done, at least in part, by teams comprised of members with differing roles and expertise that exhibit interdependence on each other and their technological systems (Fiore & Wiltshire, 2016; Wildman et al., 2013). The science of teams is a multi-disciplinary endeavor that draws on multiple facets of human factors as well as the organizational, cognitive, and computational sciences. This area of inquiry is crucial to ensure that we are able to form, develop, and maintain teams that can cope and adapt to increasing complexity in the workplace.

Travis Wiltshire

Not only this, but effective teamwork is also fundamental to solving many of the societal challenges we currently face such as the global COVID-19 pandemic, the risk of ecological collapse as a result of the unyielding imperative for economic growth, and widespread propagation of misinformation about public health and societal governance. Of course, these challenges are not directly addressed in the scope of this dossier, but facilitating the advancement of the science of teams is an effort, I argue, that can work toward these general aims. Thus, I am glad to present a few different aspects of teamwork research here.

The first article by Martine Bruijne and Marijke Melles combines design, healthcare, and teamwork. They discuss the Human-Centered Design (HCD) approach and summarize two case studies, which demonstrate team work can be scaffolded by innovative technological designs.

Next, the second article by Jan Maarten Schraagen and Lida David incorporates elements of systems thinking and explains the concept of resilience, how it applies to teams and teamwork with a particular focus on team communication. They discuss some of their work studying team communication in medical and spaceflight contexts, and discuss how to use methods that further the investigation of resilience in a team contexts.

Lastly, we have an article advancing best practices for providing teams with feedback based on work by Catherine Gabelica, for example, examining training and feedback for aviation crews. These are evidence-based, yet practical recommendations that can be readily adopted into many of our own current teamwork practices. And, by doing so, it can help to ensure that our teams are able to continue to perform well together in the future.

The study of teamwork is vast and growing regularly. By incorporating aspects of design, resilience and communication, and team feedback into this Teamwork Dossier, a few of the critical areas have been explored. Of course, future work is needed to not only progress the promising areas that our authors present, but also other aspects that integrate team dynamics, sensing technologies, and computational advances to better our understanding of what contributes to teams that are cohesive and effective (see for example Kozlowski, 2015; Stevens & Galloway, 2019; Wiltshire & Fiore, 2014).

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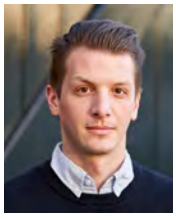

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COGNITIEF

Human-centered design for teamwork

Creating actionable solutions for increasingly complex teamwork in healthcare

Teamwork in healthcare is challenged by increasing complexity due to ongoing specialization, innovative technology and the urge for growing patient participation. This article explains the basics of teamwork in healthcare and human-centered design methods and presents two examples how teamwork can be supported by human-centered design.

Martine de Bruijne and Marijke Melles

Teamwork in healthcare

Few industries match the scale of health care. In the Netherlands alone, yearly an estimated 69% of the population visits a general practitioner and 40% visits a medical specialist (CBS Statline, 2020). A single hospital visit requires collaboration among a multidisciplinary group of clinicians, administrative staff, patients, and their loved ones. Many patients pay multiple visits across different clinicians working in different organizations. Therefore, ineffective care coordination and the underlying suboptimal teamwork processes are a public health issue. Health care delivery systems exemplify complex organizations operating under high stakes in dynamic policy and regulatory environments. Thus, the coordination and delivery of safe, high-quality care demands reliable teamwork and collaboration within, as well as across, organizational, disciplinary, technical, and cultural boundaries. In the Netherlands, with a health care system among the most effective in Europe (OECD, 2017), the health burden and patient harm experienced due to unsafe care remains a challenge. There is ample evidence that effective teamwork is a key resource to maintain safe and effective patient care. Due to technological advancements, increasing specialisation and decentralization of healthcare, and the urge for growing patient involvement in care complexity is rapidly increasing, posing new challenges to healthcare teams (Manser, 2009). In this paper, we explain how human-centered design can support teamwork in healthcare. We provide theoretical principles and two examples of human-centered design for teamwork.

What is teamwork?

A team is an identifiable group of two or more people who work together towards a common goal (e.g., football teams, aviation teams and surgical teams). Where taskwork is limited to "the performance of specific tasks that team members need to complete in order to complete team goals", teamwork includes the "adaptive, dynamic, and episodic process that encompasses the thoughts, feelings, and behaviour among team members while they interact toward a common goal" (Salas, 2014). In the last decade significant progress has been made in describing and understanding teamwork behaviours that support safe and effective team performance in healthcare (Burtscher, 2011). These teamwork behaviours are supported by clinicians' non-technical skills: a combination of cognitive (e.g. situation awareness (Endsley, 1995), social (e.g. leadership) and self-regulation skills (e.g. stress and fatigue management) that complement knowledge and technical skills needed for safe and efficient care (Flin, 2008). Thus, human factors play a central role in task and team performance. Until recently, the main focus of teamwork in healthcare has been on acute care teams, working in emergency care, surgery or intensive care (Verbeek-van Noord, 2015; Kemper, 2014). Human factors science combined with medical science has led to effective training programs for acute care teams, which have become widely available. Also, tools to support teams, mainly directed at communicating and sharing information, have been developed. Examples are checklists for handovers, timeout procedures to prepare or evaluate operations and whiteboards to provide an overview to the whole team (de Vries, 2012, Romijn, 2016).

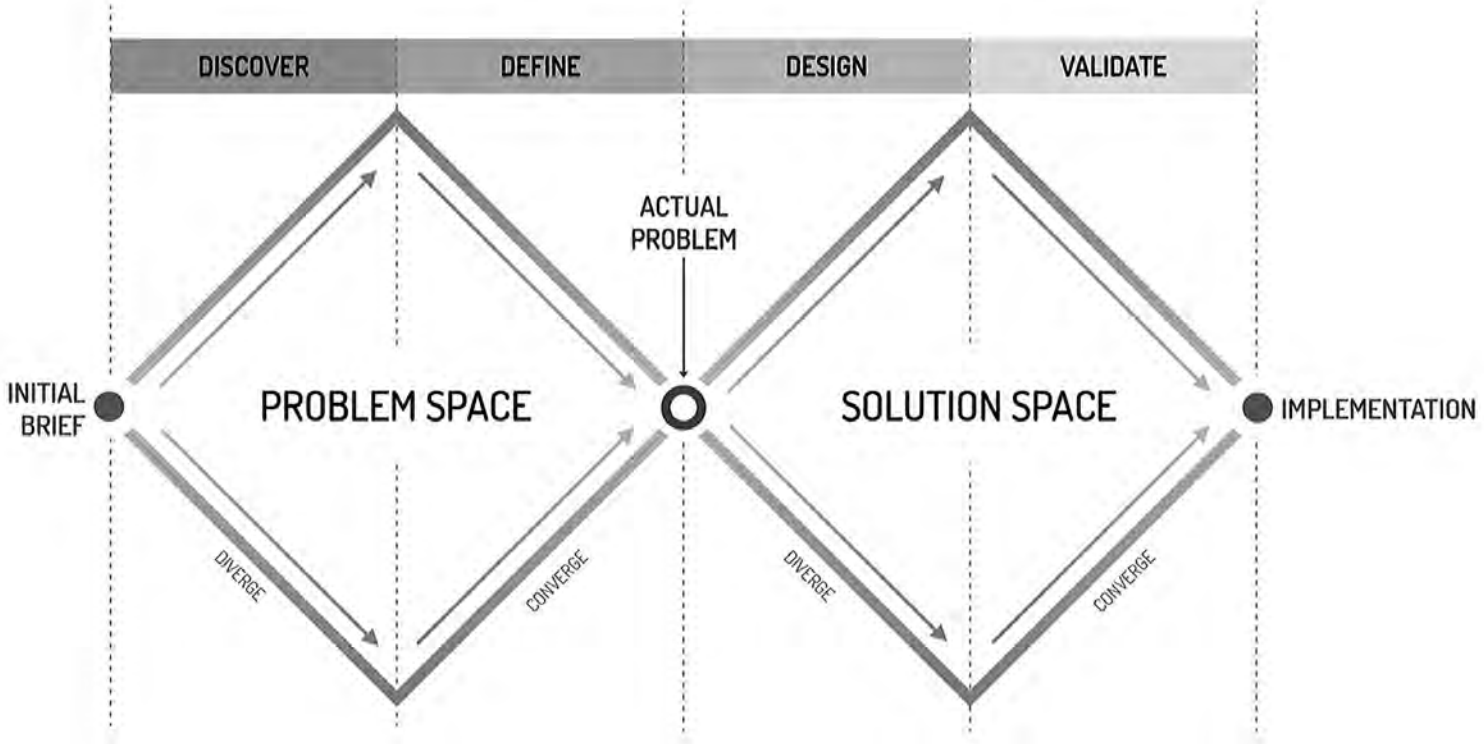


Figure 1. The Double Diamond Model (adapted from www.designcouncil.org.uk; see also Melles et al., 2021), visualizing the HCD process.

Challenges for healthcare teams

Modern healthcare is rapidly developing towards people-centred care, where individuals and their networks co-create their health (OECD, 2017; World Health Organization, 2016). This development requires patient involvement in teamwork, in which heterogeneous team members often work at different places at varying time intervals. For instance, patient portals to health records and tools for shared decision making have been developed to improve participation. Innovative medical technology is rapidly introduced to support medical tasks for professionals or patients, but may at the same time hamper teamwork. A well-known example is the surgical robot, which by design isolates the surgeon from the surgical team. As with acute care teams, at the start many of these new developments are dominated by medical science rather than human factors science. In order to optimize safety and effectiveness of the teamwork involved, medical innovations need to be complemented with human factors science, such as human-centered design (HCD).

Human-centered design

HCD revolves around understanding human needs, so as to design products or services that respond to these needs. Characteristic of HCD is its purpose-driven, participatory and systemic approach towards human needs, ensuring that solutions fit the dynamics of the (complex) socio-technical system the user is part of. Its three key principles include (1) developing a thorough understanding of people and their values, goals and needs; (2) engaging users and other relevant stakeholders from early on and throughout the design process; and (3) adopting a systems approach by systematically addressing interactions between the micro, meso and macro-levels of sociotechnical care systems (Melles et al., 2021). The HCD discipline is closely related to that of Human Factors (HF) and the terms are often used interchangeably (Dul et al., 2012). The HCD process roughly consists of two phases. In the first phase, the so-called problem space is investigated; what is the real underlying problem that needs to be addressed, what tasks do people have to or want to perform, what influence does the context have. In the second phase, the solution space is investigated; what solutions are possible and which solution is the most optimal. A widely-used visualization of the HCD process is the Double Diamond Model (see figure 1), developed in 2004 by the British Design Council. The double-phased model emphasizes the essence of HCD: first finding the right problem ('designing the right thing') and then fulfilling human needs by design ('designing things right'). The diamond structure affirms the divergent and convergent stages of the design process, referring to the different modes of design thinking; a process of exploring an issue more widely or deeply (divergent thinking) and then taking focused action (convergent thinking).

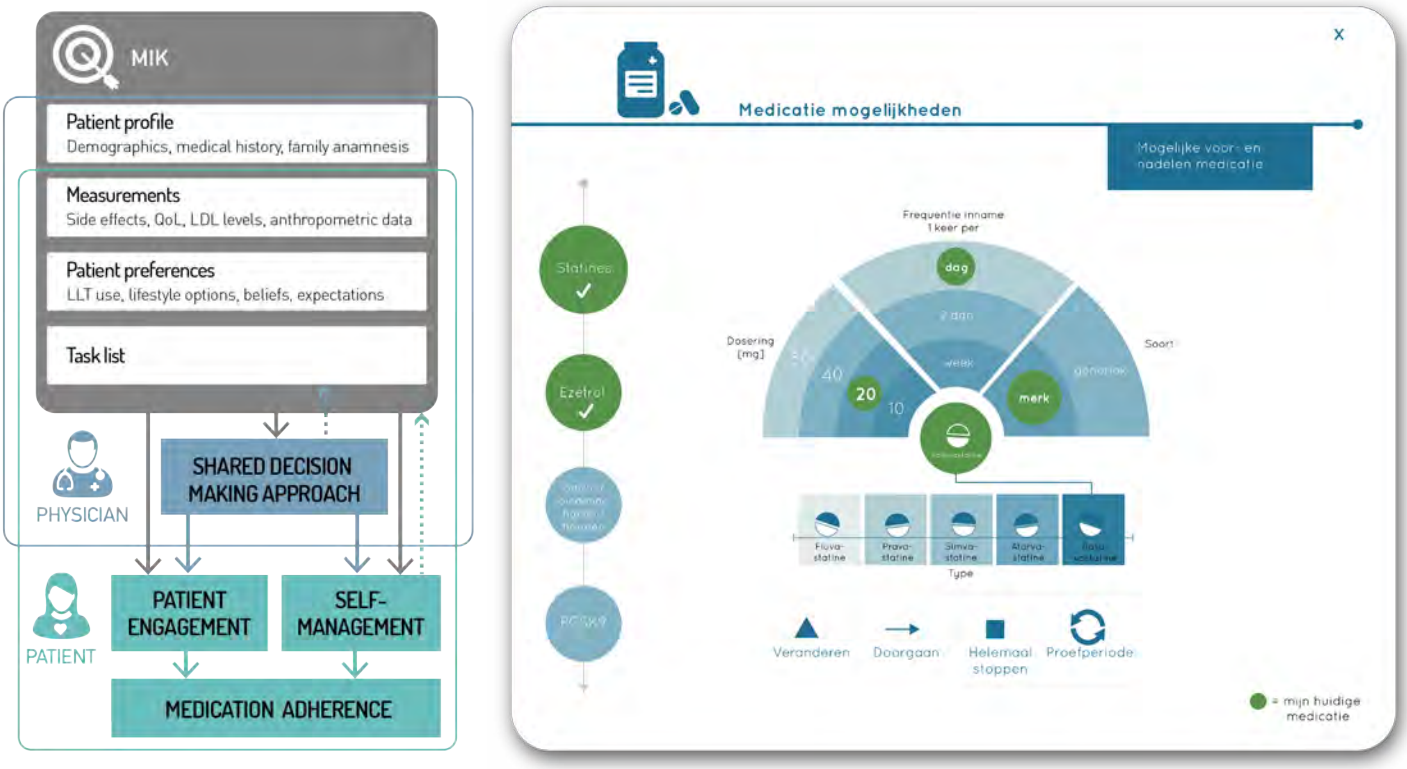


Figure 2. Left: Schematic overview of the functions of MIK. LLT: lipid lowering therapy; QoL: quality of life; LDL: low density lipoprotein (adapted from Thomson et al, 2018). Right: Example screen design MIK

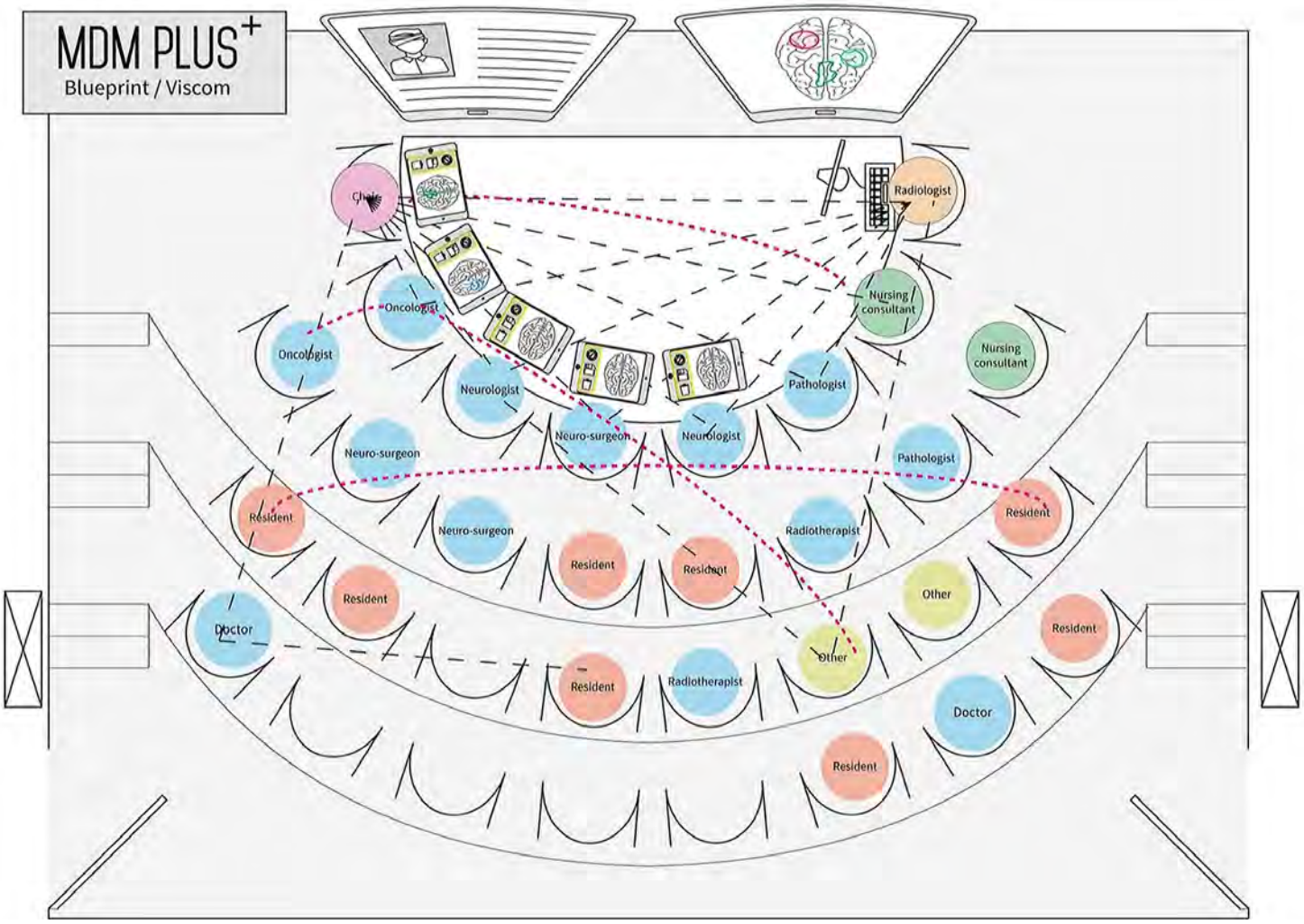
In HCD the term 'design' is used for both the process of designing and the outcome of that process. Moreover, design is no longer used as a process to create products only, but increasingly as a process that leads to the creation of any type of intervention that changes existing situations into preferred ones (Bijl-Brouwer & Dorst, 2017; Melles et al., 2021). This includes services, procedures, strategies, and policies. The design process itself is also more and more acknowledged as an outcome, in which a participatory design process contributes to broad support for change.

HCD designers rely heavily on the tools, methods and insights from the HF discipline. Examples of HCD methods range from shadowing and contextual inquiry to investigate human needs to participatory design and usability testing to develop and evaluate solutions. Tools often used for investigating teamwork dynamics, include patient journey mapping and contextual design techniques. Patient (or client) journey mapping is a tool to visually record the dynamics of a multi-stakeholder system over time, by including all actors, interactions between actors and experienced emotions (Melles et al., 2021). Starting from the patient journey, HCD designers can identify problems and how these problems arise, and thus identify human needs. Contextual design (Beyer & Holtzblatt, 1998) provides another structured approach to the interpretation of data from fieldwork with the purpose of using it for product or service development. One of the method's steps involves work modelling which is aimed at analyzing actual activities of users in their actual work environment from five different perspectives: ranging from the influence of the physical environment, the (actual) use of artifacts and the sequence of tasks to (in)formal communication patterns and cultural constraints. These different interpretations are expected to lead to a better understanding of the constraints posed by a (complex) work context and the needs of all the stakeholders (team members) who are part of a work system. Both tools aim to map out the larger sociotechnical system, to identify human needs in context, and to provide starting points for design.

HCD, with its systemic humane approach and creativity towards change, can play an essential role in dealing with complex teamwork challenges, as shown by the following examples.

Case 1. MIK: improving patient involvement and shared decision making

Medication non-adherence poses a serious and hard-to-tackle problem for many chronic diseases. Involving patients in care teams by increasing their engagement in their own care process and in decision making with their physician (i.e. Shared Decision Making (SDM)) seems essential to improve treatment adherence. In this project, we focused on people with Familial



MDM Environmental design guidelines (in order of importance):

1 Seating arrangement: enough places to seat a minimum of 30 people.
2 Spatial layout: possibility for at least two big screens on the wall, for presenting both relevant patient details and patient scans.
3 Everybody seated should be able to see the presented data on screen.
4 Every participant should be able to see everyone else.
5 Core members should be able to see each other without having to turn over 90 degrees.
6 Extended members should be able to see the core members' faces to allow for verbal and nonverbal communication.
7 Everybody who is seated should be able to hear each other without having to speak loudly.
8 Workstation placement: everybody should be able to hear and see the screen operator.
9 Movement: the door should be located in such a way that no one disturbs the meeting when entering or leaving the room. Therefore, the door should not be placed along the same wall as the screens.
10 Additional architectural requirements: good acoustics, dimmable light and control over ambient noise are highly desirable.

Figure 3. MDM Plus+. Top: lay-out of an MDM-room for neuro-oncology MDMs based on the environmental design guidelines for MDM-rooms (bottom). At the front row the five core members are seated, using the Viscom application.

Hypercholesterolaemia (FH), a metabolic disorder that causes the cholesterol levels in the blood to rise, which seriously increases the risk for developing cardiovascular diseases at a young age. Lifelong, daily medication in combination with a healthy lifestyle is essential to lower this risk. On top of this, finding the right medication for FH patients is often a trial-and-error process and FH patients typically do not (yet) experience actual health complaints. This lowers their sense of urgency to adhere to their medication and makes medication adherence among FH patients challenging.

We developed a digital app aimed to improve medication adherence of FH patients named "MIK" (Dutch for "to aim") (Thomson et al, 2018). MIK triggers

patients to have an active role in their own care process and makes implicit information regarding treatment preferences of patients explicit and in this way easier to discuss during consultations. Figure 2 lists the four main functions of MIK and how these are expected to impact patient engagement, SDM and medication adherence. The application lets the patient prepare for the consultation by filling in short questions regarding lifestyle factors, their values, and their treatment preferences. During the consultation MIK serves as a supportive communication tool by giving easy to understand graphics of the medication options and cholesterol results. Next to this, insights in patient preferences helps the physician to tailor individual treatment advice. This way MIK facilitates physicians and FH patients in a more equal way of communicating through shared information and decision-making.

MIK was developed through an iterative HCD approach involving FH patients and health care professionals throughout the design process to ensure that the design met the needs of both user groups. First the problem space was investigated by means of consultation observations, interviews and an analysis of posts on the FH patient Facebook page. This investigation resulted in a map of the current patient experience journey, which confirmed that physicians are in the lead throughout the care process, FH patients are more reactive, and decisions regarding medication are mainly based on medical data. Also, during consultations there is limited time and opportunity to discuss preferences, lifestyle and quality of life. After multiple follow-up co-design sessions, an interactive prototype of MIK was developed and evaluated in role-play simulations. Our studies confirmed that the functionality of MIK has the potential to improve patient engagement and SDM. Insights are used for further development of MIK and eHealth apps in general aimed at improving patient engagement and SDM (Thomson et al., 2018).

Case 2: MDM PLUS+: improving multidisciplinary team meetings

In hospitals Multi-Disciplinary Meetings (MDMs) are frequently used to discuss complex medical patients and to decide on the treatment strategy. The goal of this project was to create a set of feasible modifications to improve efficient MDM decision-making, and to introduce a product-service system for the medical staff to further develop their communication during the MDM and inter-collegial teamwork. The project took place at the neuro-oncology MDM at the Amsterdam UMC. The neuro-oncological MDM is challenged by the environment, which needs to be dark enough to assess radiography on a large screen, while at the same time a decision-making dialogue involving three to five professionals out of a large group of participants needs to take place. The discussion is fueled by the information on visible scans and the knowledge of the members. However, verbal and non-verbal communication are hampered by the theater lay-out, low light and large number of participants.

Fourteen neuro-oncology MDMs were observed and team members were interviewed. Work modelling techniques (Beyer & Holtzblatt, 1998) were used to analyze the interaction patterns between MDM attendants in relation to different factors such as the setup and influence of the space, lines of communication, and cultural rules and practices. This resulted in the identification of problem areas and opportunities for improvement (Beem, 2016).

MDM PLUS+ was developed to enable information exchange and discussion during multi-disciplinary team meetings (Beem, 2016). MDM PLUS+ consists of two parts:

1. The MDM Blueprint is a list of MDM room layout requirements, which are drafted as checklist. It can be used for two goals. First, to make feasible modifications to a current MDM environment and second, to design the most optimal interior suited for a neuro-oncology MDM (see figure 3).
2. The Viscom application aims to minimise differences in communication and proposes a way to visually explicate communication of core members by dynamic drawing on a live-synced tablet.

It was concluded that the core of the MDM is the discussion, which is fueled by the information on visible scans and the knowledge of the members, but the 'raison d'être' of the MDM is the information exchange. The final 'MDM PLUS+' concept proved to complement both the layout and the potential to let the top-specialists further develop themselves in inter-collegial teamwork and communication, thus resulting in a more efficient multidisciplinary meeting. The recommendations entail different future perspectives of the implication of the MDM PLUS+ to other MDMs and initial proposals to test the Blueprint and Viscom for future development, in general and for the Amsterdam UMC.

Conclusions and recommendations

As shown by the examples of MIK and MDM PLUS+, HCD offers a way to create actionable solutions for teamwork challenges related to the growing complexity of healthcare. By co-creation of new solutions HCD not only supports teamwork taking into account medical and human factors, but also facilitates teambuilding and engagement of all team members with the solution. Both are important prerequisites for implementation in daily practice. Thus, HCD offers an

action oriented approach to promote solutions that are medically sound as well and human-centered.

We recommend to foster design thinking in medicine, by education and experiential learning, to find innovative ways to support quality and safety of increasingly complex healthcare.
The examples presented took place in the Design Lab Quality of Care, a collaboration between the department of Human-Centered Design, TU Delft, and the section Quality, Safety and Organisation of Care of Amsterdam UMC (onderzoekpatientveiligheid.nl).

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ORGANISATIE

Resilience and team communication processes

This research shows that studying team communication processes is important for understanding a team's resilience. Resilience is defined as the ability to manage trade-offs and to offer and accept support. Resilient team communication patterns are characterized by processes related to taking initiative, team members helping each other out (back-up behavior), and closed-loop communication structures. Human factors professionals can help in making teams more resilient by providing feedback on successful team communication patterns, helping teams train in these patterns, and assisting them in ways to reflect upon their own performance. It is important to study teams in their multi-level context and over longer periods of time.

Jan Maarten Schraagen and Lida Zoi David

The world is becoming increasingly interconnected, forming complex interdependencies that can make it more susceptible to global disturbances (e.g., COVID-19). To ensure safety and effectiveness in closely intertwined systems and infrastructures, it is crucial to understand resilience, alongside how resilient behavior is generated and promoted. Teams play an important role in these systems and infrastructures, as work is increasingly organized in teams. We believe that studying communication processes in teams provides the key to understanding resilient team behavior.

Defining resilience

We define resilience as the continuously changing ability to manage trade-offs, and to use or provide comprehensive systems of support in contexts of adversity. This may seem like a very esoteric definition of resilience that has little to do with its original meaning of 'rebound from adversity' or 'ability to absorb disruptions' (Woods, 2015). Yet, these original meanings of the word resilience do not apply to complex sociotechnical systems that have the capacity not only to anticipate and learn (Hollnagel, 2011; OECD, 2018), but also to transform (Keck & Sakdapolrak, 2013) and manage trade-offs (Hoffman & Woods, 2011; Ungar, 2018), unlike physical or ecological systems. A society is not resilient in the face of adverse events when it chooses to always put the short term over the long term; neither is it resilient when it always does the reverse. Rather, it is resilient when it is able to manage trade-offs on a continuous basis, depending on the situational demands, and irrespective of outcomes (that cannot be predicted anyway at the time trade-offs need to be made). A company that doggedly chooses to always focus on one particular product is not particularly resilient in a world of changing and competing customer demands. It may survive for a long time, seemingly well-adapted, until a sudden transformation makes it obsolete (e.g., Kodak's inability to adapt to digital photography).

Managing trade-offs and providing systems of support in teams

Teams follow plans to achieve goals, while different goals have different requirements and are executed under constantly changing environments. Therefore, a necessary adaptive resource is the ability of a team to remain alert and constantly manage trade-offs in order to assess the tenability and correspondence of a certain plan to the requirements of the situation. For instance, Mrs. Elaine Bromiley was to undergo elective sinus surgery on 29 March 2005, a seemingly routine operation (Harmer, 2005). Prior to the operation, the anesthetists unsuccessfully tried to intubate her for a prolonged period of time. Despite this being a clear case of a "can't intubate – can't ventilate" emergency, the anesthetists lost track of time and continued to intubate. Suggestions by theatre nurses to perform a tracheostomy were ignored. In this case, the members of the anesthetist team did not properly manage the trade-offs 'securing access to airway' versus 'loss of oxygen saturation', and failed to recognize that their plan to secure Elaine's airway did not meet the requirements of the situation anymore, as oxygen saturation had dropped to a dangerously low level of 40%. Elaine Bromiley passed away 13 days later, having suffered irreversible hypoxic brain injury. Clearly, this team was not resilient to the adversity it was

confronted with. Not only did the team fail in its ability to manage trade-offs, it also neglected to use the support offered by the nurses in the form of a tracheostomy set.
Another example of a system of support that may strengthen the ability to manage trade-offs is the provision of real-time indicators on the system's various goals, which can be developed through cognitive analysis. For instance, weak resilience signals, defined as signals indicating a tendency towards system degradation in adaptability, may indicate that a certain plan no longer meets the requirements of the situation. Such signals must be presented to the agents involved early upon emergence so that they can then be discussed with the team; sharing perspectives is valuable and crucial to promote resilient behavior (Siegel & Schraagen, 2017a, b). Yet, an overemphasis on efficiency, cost savings, and other short term benefits can lead to negligence towards signals that underlie the management of trade-offs, thus depriving the system of the ability to develop true resilience.

Resilience in team communication patterns

Initiative and reciprocity are two essential characteristics of resilient teams (see figure 1). Initiative is needed when plans no longer match the situation. It takes willingness or even courage to adapt the plan to the changing environment, without waiting for permission from other members of the team or within the organization. Research on medical teams has shown that resilience is promoted by initiative from all team members, especially in difficult and unexpected situations (Barth & Schraagen, 2015; Schraagen, 2011). Reciprocity is necessary to distribute restrictions of attention, time, workload and energy among team members. A less stressed team member takes over tasks from an overburdened team member, in the hope and expectation that the overburdened team member will do the same in the future for the less stressed team member. Such backup behavior constitutes a support system that may be provided in contexts of adversity, and is therefore an example of resilient behavior. For example, we found (Schraagen, 2011) that the assistant surgeon took over the communication tasks of the first surgeon when the latter was so busy with the operation that he could no longer keep the rest of the team informed of the situation; the assistant surgeon took over and informed the rest of the team.
We recently applied Relational Event Analysis (Butts, 2008) to investigate the development of team communication patterns over time in critical and non-critical situations. We studied both a medical pediatric cardiac surgical team and the NASA Mission Control team during the Apollo 13 incident (for details, see Van den Oever and Schraagen, in press). Our findings indicate that more adaptation in communication takes place during highly critical situations, while less adaptation was observed during less critical ones. Further, we found that during highly critical situations, teams adapt their communication patterns, but will adhere to institutional roles and use closed-loop communication for as long as possible before doing so. Furthermore, teams can be expected to display closed-loop communication, an on-plan trained procedure, in both critical and non-critical situations (Davis et al., 2017), but may find it more difficult to maintain closed loops in critical situations due to more interruptions and changes of communication partners. Besides that, our findings suggest that teams display information seeking communication patterns in both critical and non-critical situations, which may be a way to deal with complexity (Manser et al., 2009).

Our study has provided valuable insights into the adaptation of communication patterns, but more research on the topic is warranted, particularly given the possibilities of providing real-time feedback on communication patterns to teams in training (e.g., Gorman et al., 2019; Grimm et al., 2017; Kiekel et al., 2002).

Capacity of adaptive resources

Adaptive resources can also be depleted. All resources are finite and can only handle a certain set of situations. This is the basic adaptive capacity or competence envelope of any system – that which the system can handle without the risk of saturation (Woods, 2018). As systems approach the boundaries of their competence envelope and basic resources become depleted, there is a risk of saturation. A unit in a system then has to ask for help from other units – other team members, other departments, other organizational units. Whether and how this help is requested, and how it can be stimulated, is a crucial question in resilience engineering. In certain situations, the saturation of resources can go so fast that the system can no longer expand itself and only reacts locally. In the cockpit of Air France Flight 447, this happened when the aircraft ended up in a 'high-level stall' (at the hands of one of the pilots) and the crew was no longer able to understand what was going on (partly because speed information was temporarily missing due to the freezing of so-called pitot tubes). The communication patterns that radiated reciprocity and initiative before the stall were then characterized by ad hoc responses to each other (David & Schraagen, 2018).

Methods for resilience engineering in team communications research

As a closing remark, we would like to point our readers to the methodological approaches that may foster the investigation of resilience as defined in the current article. As has been shown above, building and

Figure 1. Illustration of team resilience as the continuous management of trade-offs, regulated through communication patterns of initiative, reciprocity, and closed-loop communication structures, supported by comprehensive systems of support.

maintaining adaptive resources is a phenomenon that a) depends on trade-offs made by an organization or team and b) a process that takes place over time. This implies the following for research methods in the field of resilience:

a. Resources at an individual, team or organizational level are closely interrelated and are best studied from a multi-level perspective. They also depend on trade-offs that emphasize, for example, the short or the long term, or efficiency or thoroughness (Hoffman & Woods, 2011). An interdisciplinary approach that involves several levels at the same time seems indispensable in this field.
b. The "time" factor has long been ignored in psychology (Klonek et al., 2019). Recent developments of analysis techniques in the field make it possible to discover diverse communication patterns in time series of communication events, thus assisting in the investigation of how adaptive resources are built, maintained, or lost over time. For example, relational event analysis (Butts, 2008) enables the discovery of diverse communication patterns in a time series of communication events. It assumes that previous interactions influence current interactions, and is performed by modelling the sender and receiver(s) of information in a sequential order, in a system comprised by two, or (ideally) more agents. The robustness of the analysis is influenced by the number of events, with longer timescales yielding more stable patterns. Other analysis techniques, such as pattern analysis (Magnusson, 2018) can also help explore interaction as it evolves over time by modelling other pattern aspects, such as the content or type of communication data. In addition to traditional forms of assessing resilience, such as questionnaires (Van der Beek & Schraagen, 2015), longitudinal measures are therefore also useful and required to fully grasp the concept of resilience (Schraagen, 2013; Van den Oever & Schraagen, 2021).

Conclusions and practical implications

Studying team communication processes is important for understanding a team's resilience. The way team members communicate with each other can both help or hinder team resilience. Resilient team communication patterns are characterized by team members taking initiative, helping each other out (back-up behavior), and closed-loop communication. Teams need to be assisted in detecting early-warning signals, so they can

flexibly adjust their plans to the changing circumstances. Human factors professionals can help in making teams more resilient by providing feedback on successful team communication patterns, helping teams train in these patterns, and assisting teams in ways to reflect upon their own performance.

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GEDRAG

Feeding team success

The art of giving and facilitating effective team feedback

We all know how much feedback about performance or behaviors is important for a team to function well. But, giving and receiving feedback is a practice that requires explicit attention, skills that must be learned, and practice. This article provides recommendations based on my prior work on how best to provide feedback to teams.

Catherine Gabelica

In today's fast-paced and ever-changing environment, we want teams to adapt, learn, and innovate. However, teams are not perfect on their first day. They learn to become high performing. For that to happen, we need to support them at key points of their team trajectories so they can make smart adjustments over time. Besides explaining why some teams thrive and others disappoint, research and practice have questioned possible ways to move entire teams forward. Providing "effective" feedback, conceived as information concerning teams' actions, events, processes, or behaviors relative to task completion or teamwork (London & Sessa, 2006), is one of the frequent answers. Unquestionably, leaders, coaches, and trainers know that they can motivate teams by providing feedback. Nevertheless, they might not be aware that they can also help teams learn from feedback to improve their teamwork. And, teams that enhance their teamwork are 20% to 25% more likely to succeed (LePine Piccolo, Jackson, Mathieu, & Saul, 2008). Additionally, the latest employee performance management trends companies are turning to are the increased use of teams, networks of teams, and "superteams" integrating humans and technology; a shift from rewards based on work output to rewards based on capability development; the consideration of team-based work in the company reward strategies; assessment of employees' ability to cope with constant change; and a tighter feedback calendar cycle (Deloitte, 2020).

These trends suggest that teams should not be waiting for their annual review to find out how they have performed and what they can do to develop their capabilities. Instead, modern organizations should embed feedback as a key component of their daily culture. But, feedback itself is not a magic bullet. In a society where the demand on our time is rapidly increasing, learning moments in teams are sparse. Turning teams into high-performing and learning entities takes conscious effort from the team and support from facilitators. To further develop a team's capabilities, companies should implement better designed feedback interventions and coaching. In order to realize such feedback interventions, this article advances several recommendations based on my own empirical work.

Do not assume you give "enough" feedback

Generally, feedback givers and receivers have different perceptions of the quality of feedback interventions, whereas congruent feedback perceptions are likely to contribute to an effective update of feedback, and thus learning gains such as improved collaboration and increased performance (Gabelica & Popov, 2020). Feedback givers tend to perceive feedback they provide more favorably than feedback receivers do, and they have little insight in receivers' perspectives (e.g., how teams feel and think about feedback). Teams usually claim they do not get enough nor "good enough" feedback.

If feedback is not frequent and/or is not perceived as being useful, they will not be able monitor their progress to build on what's working and repair what isn't. Conversely, teams valuing feedback they receive are more likely to modify their strategies and behaviors (Walter & Van Der Vegt, 2013). In a survey study, 357 team workers rated the overall effectiveness of team-level feedback they received as low (Hey, Pietruschka, Bungard, & Joens, 2000). In fact, they felt that only a part of the feedback helped them perform and collaborate better. They also indicated that feedback was not regular, nor given immediately after a certain performance or behavior, and was not received directly nor it was specific enough. Yet, we found in our review study (Gabelica et al., 2012), that the most effective feedback in teams was specific, well-timed, regular, non-threatening, shared, directed at teams it targets, and fairly distributed amongst team members. Importantly, next to trying to provide high quality feedback, we should ask teams if they perceived it this way. Monitoring team members' perceptions of feedback is crucial to ensure its implementation. We may have to probe for specifics:

"how has feedback about your performance on Project X helped you better coordinate?" Also, we should look for signs that indicate whether team members have positive feedback handling intentions following feedback delivery. Do they seek our input and clarifications about feedback? Do they voice how they feel and think about feedback? While we like to believe that the feedback we provide is perceived as relevant and useful, we should monitor for signs to the contrary.

Provide feedback about team processes

My prior work shows that giving performance feedback can help teams perform better (Gabelica, Van den Bossche, De Maeyer, Segers, & Gijselaers, 2014), but there is also another underestimated type of feedback that can help teams better collaborate. Whereas performance feedback (e.g., "our department improved profitability by 9 percent this quarter") indicates whether a task was successfully performed, process feedback indicates how the task should be (or was) performed and how the team behaves. Messages such as "your team bore upon each other's areas of expertise to solve the problem", "you provided a clear, compelling, purpose-orientated direction to the team during this meeting", or "you built a positive atmosphere by listening to each other when different viewpoints were being expressed and thanking members for offering their point of view" consist of process feedback. Process feedback can describe the team processes or specific team members' behaviors. In order for a team to function effectively, it is essential for its members to improve their team skills and communication.

These team skills necessitate different feedback interventions conveying, for example, information about how teams/team members:

(a) communicate and interact (e.g., do they deliver clear messages, ask effective questions, listen actively to others?),
(b) deal with conflicts (e.g., do they disagree constructively, use collaborative conflict styles?),
(c) define their team vision, objectives and strategies,
(d) monitor their performance,
(e) come to a common understanding of their task and its requirements,
(f) build upon each other's expertise,
(g) make team decisions, and
(h) coordinate their actions.

Process feedback helps team members identify specific areas for improvement and ways to improve. If, for example, teams are only provided performance feedback, they may not have realized that that their communication was problematic or that they displayed irrelevant task strategies, thus they would lack information about what and how to improve.

Do not only provide feedback at the end of a project or a training

To optimize feedback effectiveness, it is important to observe and monitor teams on a regular basis. Regular feedback will facilitate and reinforce positive team attitudes (such as balanced contribution) and in turn, performance. Moreover, feedback gives a prescriptive reference against which teams can evaluate their own behaviors. It helps team members understand what is meant by effective (team) work in their specific unit and provide them with an opportunity to learn. A team itself can also evaluate its progress and team members can be additional sources of feedback. For example, asking members to evaluate each other's attitudes in the team using validated peer feedback instruments (Ohland et al., 2012; O'Neill et al., 2018) can make them better aware of effective and less desirable team behaviors and inform you on how the team is doing when constant observation is not possible.

Consider feedback as a conversation and not a one-way practice

Even when the importance of two-way interactions is acknowledged, feedback often remains a one-way process from the supervisor to the employee. If you just got assigned the leadership of a team, it is important to progressively install a feedback culture by, for example, explicitly recognizing the value of feedback, modeling the use of constructive feedback, acknowledging an open-door culture, and implementing regular feedback moments in the team daily life. Also, periodically asking team members for their feedback ("How did I do?" "What am I doing that helps and what can I do better?") would communicate the message that you are open to their input to improve your feedback practices.

Provide time for reflection on feedback and guide these debriefings

In my prior work, I have demonstrated that forwarding performance feedback to teams is not sufficient to improve performance since feedback is purely evaluative by nature (Gabelica, et al., 2014). The reflective process that follows this feedback is the most important part of the procedure if you seek to improve a team ability to draw lessons from prior experiences and eventually help a team change its behavior. In the reflection procedure that follows feedback delivery, team members need to take an active part in the analysis of their performance data and in the generation of reasons why things went right or wrong (Peñarroja, Orengo, & Zornoza, 2017; Phielix, Prins, & Kirschner, 2010).

However, a potential challenging issue is motivational. For most individuals and teams, reflection is possibly the least preferred activity. Therefore, teams need

support to help them systematically analyze the decisions that produced their performance outcomes. Research has shown that teams gain even more when occasions are provided for "guided reflexivity" (e.g., Konradt, Schippers, Garbers, & Steenfatt, 2015). The latter provides teams with a guided opportunity to learn from past experiences, and to discuss consequences for future actions. In a study, we showed that teams that exhibit the capacity to reflect on their experience outperformed teams with performance feedback or no feedback (Gabelica, et al., 2014). However, we also found that teams that engaged in activities for reflexivity also encountered higher likelihood of conflict. This implies that teams should be trained to deal with reflexivity (looking forward) without getting engaged in situational or personal conflict. This requires preparing teams on how to use the results of reflective activities for their own benefits, without getting immersed in conflict situations.

One day, a project leader in a tech research and development department told me "the best learning moments in my team happen after low performance. Instead of rushing to catch up, I sit with my team and ask them "ok, we were not able to meet the deadline... but what did we do to reach this situation and importantly, how can we still make it happen?" This is a good example of "guided reflexivity" on negative performance feedback. What is important about this example is how this project leader focused the team attention on how to create the results they wanted to accomplish instead of spending energy on blaming members. The following questions are likely to instigate reflection in order to prevent negative performance: "How well is our team performing? Where are we progressing vs. struggling? Are our adjustments effective? Where should we pay additional attention? Given the situation, what changes should we make or be prepared to make if needed?"

Provide both "positive" and "negative" feedback

In my latest work, I have found that teams that are consistently performing better than the other teams do get in an upward spiral of positive beliefs and emotions about themselves. They feel more cohesive, they experience less interpersonal conflict, and they believe they have the best experts in their team. And, the other way around: when teams perform consistently below their peer teams, they report more intrateam conflict, low cohesion and peers' credibility. However, when teams receive feedback that is not consistent over time (feedback informing that they outperformed on one task and underperformed on another one), they start to learn. These mixed signals seem to make them stop and reflect. They report more knowledge sharing, constructive discussions, and reflection on what happened and why. I do not conclude that we need to give teams more 'mixed' feedback to avoid overconfidence or conversely conflict escalation. Instead, you need to ensure that high-performing teams keep on learning and provide challenges to those who might rest on their laurels and/or miss

learning and development opportunities. Performance is dynamic. Teams need to keep on analyzing how they do, why they performed well or not up to expectations and what they can do to improve, repair, or stay high performing (Konradt, Otte, Schippers, & Steenfatt, 2016).

Practice feedback delivery

Teams need to be supported in their teamwork skills, but leaders also need to be supported in developing strategy-focused approaches. For example, they should learn to anticipate the emotional responses to feedback they give, offer appropriate facilitated support, and stimulate the search for practical solutions. They need to be trained and resourced to provide the high-quality facilitative support needed to increase the positive effects of their feedback. The creation of a feedback culture also takes time since feedback needs to get embedded implicitly and explicitly in all activities in which team members can get valuable feedback and in turn ask for feedback and give feedback to each other openly. Early training and repeated experience with feedback delivery and reflection facilitation may improve the feedback culture and overall performance over time. Feedback opportunities must be actively sought and encouraged, and data should be constantly collected to discuss plans for learning and development at the team level.

Conclusion: designing team feedback that works

To conclude, while people assume they "know" how to provide feedback, the challenge of turning knowledge into action is a key issue in organizations. Consequently, the art of giving and receiving feedback must be learned and necessitates training, coaching, and practice.

To start designing team feedback interventions that work, I suggest three steps. First, establish clear, agreed-upon team norms for behavior. Team norms are a set of rules that shape team members' interactions. Second, practice observing behaviors that help/hinder team success. Record actions performed by the team or team members and distinguish between observed behaviors and interpretations (e.g., "Tom did not share his opinion during the discussion about team norms" versus "Tom is shy and/or does not seem to care about his team"). Third, prepare your first feedback conversation with your team. Specifically, (a) relate the feedback content to team norms and team or organizational outcomes you want to see. (b) Anticipate possible difficulties in discussing behaviors you observed, possible team members' reactions, and ways to overcome those. (c) Think about what you know and do not know about the current team situation. (d) Plan how you will frame the feedback broadly and questions you will ask. (e) Finally, ask team members to provide feedback about your feedback and what you can do to better support them and reflect on how the process went.

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Working from home

The negative influence of single-room-houses on work satisfaction

In preserving jobs and production in the context of the Covid-19 crisis, many students and employees of all ages work from home. However, their home situation might not be optimal for working from home. Working from home is not new, but the COVID-19 pandemic forced our hand in working from home and probably after COVID-19 more people might also continue to work from home.
This paper studies the working environment at home during the COVID-19 situation in the Netherlands and supports the development of ideas to facilitate a better working environment at home. This research, amongst 40 home situations, shows the importance of the number of rooms at home. Since this variable seems related to the ability to create a dedicated desk, to get away from the work you do, or the ability to separate work and private life.
All these factors influence the change in satisfaction of working from home compared to at an office or a university, and consequently influences productivity.

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When there was no COVID-19 yet, of the teleworking group less than 20% received compensation for creating an ergonomically sound home work station, or advice on how to set-up a home office space (Mastrigt e.a., 2011). This could imply that there is a chance people do not have a suitable work station at home and that their workspace is not following the ergonomic guidelines. Furthermore, a non-suitable workspace, for example the lack of a sit-standing desk, limits the ability to vary their posture leading to problems related to static posture loading such as musculoskeletal discomfort (Robertson e.a., 2013).

Other problems workers might face when working from home, is the lack of control over some environmental factors. For example, the local news reported an observation by a student that showed the temperature in his room reached 40 degrees Celsius (Omroepwest.nl, 2020). Working under high-temperature conditions leads to a decrease in productivity, as was shown by Kosonen and Tan (2004). Participants were 30% less productive in a room of 27 degrees Celsius compared to a room of 21 degrees Celsius.

Other ergonomic factors, besides having no control over the environmental factors, can also be burdensome at home, such as controlling the entry of daylight and the air quality, since we might assume that installations

such as air-conditioning units are not common in households in The Netherlands. This lack of control also decreases the perceived comfort (Bazley, 2015).

Another aspect to take into consideration is the personal wellbeing (PWB) of working from home. According to Robertson & Cooper (2011), PWB consists of physical, social and psychological well-being, and is linked to physical health and happiness of office workers. This PWB is influenced by multiple work-related factors, such as the work itself, work relationships and social support at work, the purpose and clarity of the work performed, as well as management and leadership that relates to improving PWB.

While working from home, some factors such as social support and the clarity of work goals might be disturbed, which could also lead to a reduction in PWB. A reduction in PWB is also linked both to negative physical and negative mental effects, such as stress, a burn-out, or muscle injuries. A reduction in wellbeing furthermore also correlates to a reduction in productivity (Robertson & Cooper, 2011).
In this paper, we will answer the question how the satisfaction of performing the work from home has changed with the change from working at an office or university to working from home, and which factors influence a possible change in this satisfaction.

Method

This study looked at the factors which influenced a change in satisfaction of working from home, compared to working at an office or university. This study was performed using an online survey which was sent out to 40 participants who worked or studied largely from home during the COVID-19 pandemic.
Of the respondents, 13 are students, and 27 are employees. The distribution of age can be seen in figure 1.

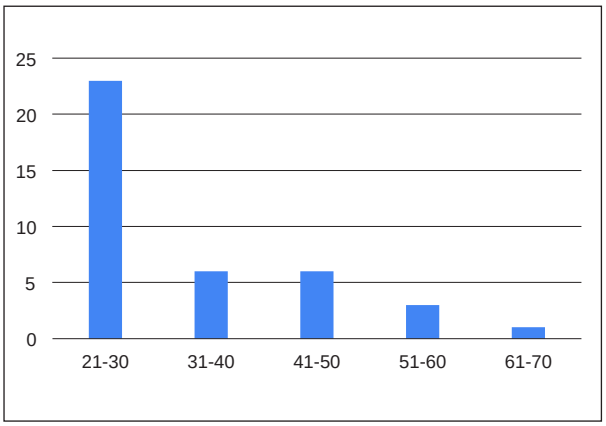

Figure 1. The age distribution of the 40 respondents.

Respondents were asked to indicate their satisfaction or hindrance on several aspects in their work environment, like temperature, space, number of rooms, work station, quality of the internet, light, adjustability of the chair etc. Averages were calculated and plotted in graphs.

Their satisfaction with performing the work from home might be lower in one-room-apartments compared to working at an office or university. An unpaired t-test ($p<.05$) was used to compare this satisfaction score of the one-room-apartments with the two or more room apartments (5 point scale: much lower, lower, equal, higher, much higher). The same test is used to see if there is a difference between the students and employees regarding this satisfaction score (5 point scale: much lower, lower, equal, higher, much higher).
In this questionnaire, the following aspects were addressed: change in satisfaction of performing the work from home, productivity and workspace ergonomics.
To measure the change in satisfaction, the following question was asked during the online survey: "What is your overall satisfaction of working from home, compared to working at an office or the university?"
We asked a similar question to measure productivity: "How would you rate your overall productivity of working from home, compared to working at an office or the university?"
Finally, for the workspace ergonomics, respondents had to mark factors on a list derived from factors presented in the literature by Rolfö, Eklund, & Jahncke (2017) and Blok e.a. (2012), whether these are of importance for the respondents. One question was related to which factors they perceive to be important for a nice work environment, in another question the respondents are asked to mark which factors they find most disturbing.

Results and discussion

Table 1 shows elements in the home environment that could influence a change in satisfaction of working from home compared to at an office or a university. In the columns, a distinction is made between the change in this satisfaction with a certain number of rooms.
The columns show the percentage of respondents who reported that factor.
Looking at the hindrances that affect this satisfaction, we can see that for respondents in a single room the main factors are: Temperature, room layout, no dedicated studying desk and a non-adjustable desk. Interesting to see, is that also the quality of the internet at home is mentioned. This has been described before (e.g. Vink, 2017). The internet is a crucial element for the main contact with the office.

Figure 2 shows that in total, most respondents are less satisfied with working from home compared to working at a university or an office. In total, 23 answered lower or much lower satisfaction compared to 10 answers of higher or a lot higher.

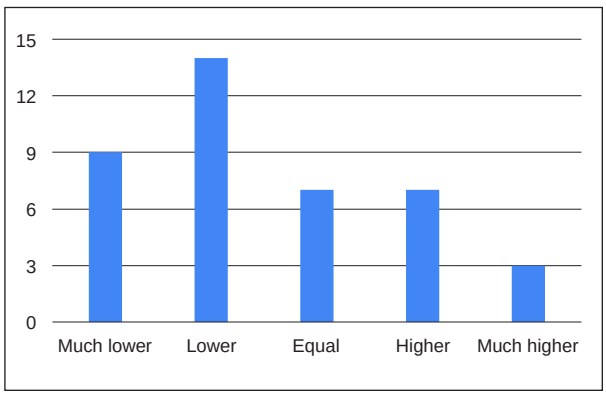

Figure 2. The score of 40 participants on the change in satisfaction of working from home compared to the 'old' situation (the number of participants who score the category is on the y-axis).

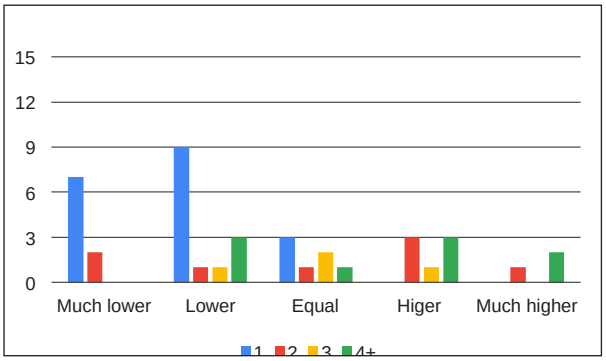

Figure 3. The score of 40 participants on the satisfaction while working from home compared with the 'old' situation, divided over the amount of rooms available to work from (the number of participants who score the category is on the y-axis; 1 = one room, 2 = two rooms, etc.).

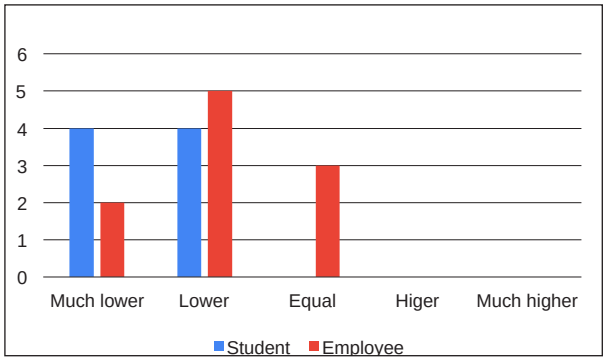

Figure 4. The sum of the scores of 18, out of the 38 participants, who have a single room to realistically work from, on the change in satisfaction of working from home compared to the 'old' situation, divided over students and employees.

Analysing the factors that play a role in the change in satisfaction of performing the work from home, the one-room participants showed a significantly lower satisfaction than the two or more room situations (the two tailed p value was 0.0001 (t=4.29; df=38) (also see figure 3).

Further analysing this satisfaction of respondents which only have a single room, we can see that in figure 4 both students, as well as employees, have an overall reduced satisfaction when working from home compared to at an office or a university.

We additionally looked for demographic differences in the change in satisfaction of performing the work from home, compared to at an office or a university. As can be seen in figure 5, students are more likely to have lower satisfaction compared to employees. The scores were higher for the employees compared to the students. The unpaired t-test showed that the difference was just significant (p=0.046; t = 2.07; df = 36). In this case, two persons being student as well as employee were deleted from the sample. We should be careful with the interpretation as two-third of the student respondents live in a single room.

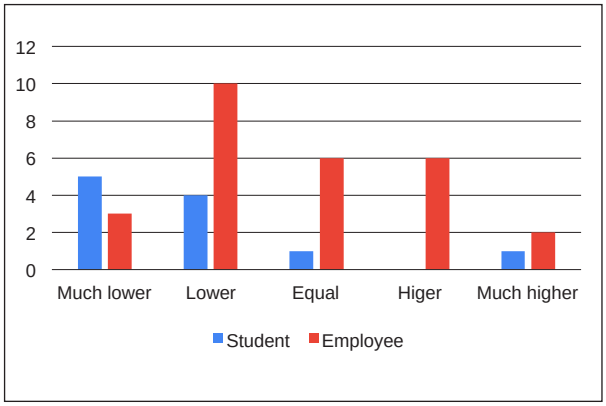

Figure 5. The sum of the score of 38 participants on the change in satisfaction of working from home compared to the 'old' situation, divided into student or employee (the number of participants who score the category is on the y-axis).

Change in satisfaction	Satisfaction of working from home compared to working at an office or at the university																			
	Much lower				Lower				Equal				Higer				Much higher			
	Amount of rooms availible to work from																			
Hinderances	**1**	**2**	**3**	**4+**	**1**	**2**	**3**	**4+**	**1**	**2**	**3**	**4+**	**1**	**2**	**3**	**4+**	**1**	**2**	**3**	**4+**
Temperature	57%	0%	0%	0%	44%	0%	0%	0%	67%	0%	100%	100%	0%	100%	0%	67%	0%	100%	0%	0%
Lighting	14%	50%	0%	0%	22%	0%	100%	0%	33%	100%	0%	0%	0%	67%	0%	0%	0%	100%	0%	0%
Air quality	29%	0%	0%	0%	22%	0%	0%	0%	0%	0%	0%	0%	0%	33%	100%	0%	0%	0%	0%	0%
Room layout	57%	100%	0%	0%	33%	100%	0%	67%	67%	100%	0%	0%	0%	67%	0%	33%	0%	0%	0%	0%
Non-adjustable chair	29%	50%	0%	0%	33%	0%	0%	67%	67%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
No dedicated studying desk	86%	50%	0%	0%	22%	0%	0%	33%	33%	0%	0%	0%	0%	33%	0%	0%	0%	0%	0%	0%
Non-adjustable desk	57%	50%	0%	0%	44%	0%	100%	100%	67%	0%	50%	0%	0%	100%	0%	33%	0%	0%	0%	50%
Communication	0%	50%	0%	0%	11%	0%	0%	0%	33%	0%	0%	0%	0%	33%	0%	0%	0%	0%	0%	0%
Being disturbed	29%	50%	0%	0%	22%	0%	100%	67%	67%	0%	0%	0%	0%	67%	0%	0%	0%	0%	0%	0%
Lack of ownership of the space	14%	50%	0%	0%	11%	0%	0%	33%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Visual distractions	14%	0%	0%	0%	11%	0%	0%	33%	67%	100%	0%	0%	0%	33%	0%	0%	0%	0%	0%	0%
Quality of internet	29%	100%	0%	0%	22%	0%	100%	33%	67%	0%	50%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Quality of electronics	0%	0%	0%	0%	0%	0%	0%	0%	33%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Quality of software	0%	0%	0%	0%	0%	0%	0%	0%	67%	0%	0%	100%	0%	0%	100%	0%	0%	0%	0%	0%

Table 1. The responses on the ergonomic hindrances (y-axis) grouped in the satisfaction of working from home compared to the 'old' situation (x-axis), and further divided over the amount of rooms available to work from (x-axis; 1= one room, 2= two rooms, etc) shown as a percentage of responses of that x-axis.

When analysing the difference of this change in satisfaction for students and employees with two or more rooms available (figure 6), a clear difference between the levels of satisfaction is not visible. As such, the living situation might play a larger role than being a student in itself.

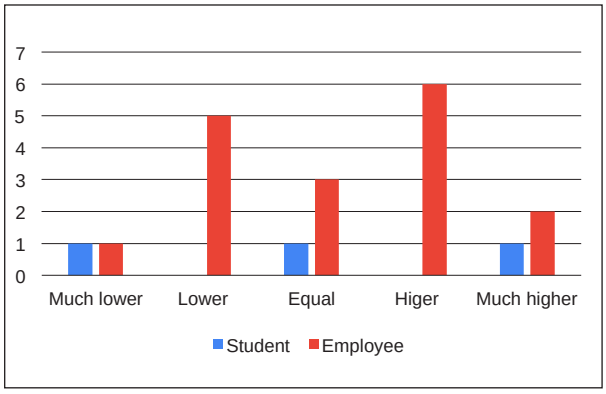

Figure 6. The sum of the score of 20, out of the 38 participants, who have two or more rooms available to realistically work from, on the change in satisfaction of working from home compared to the 'old' situation, divided into student or employee (the number of participants who score the category is on the y-axis).

Furthermore, the other factors were analysed; the availability of a dedicated desk for work or studying, difficulty in separating work and private life, and the room layout. Their effect on the change in satisfaction with working from home compared to working at an office or a university is shown in figure 7. In this figure, we can see that all three factors seem to be linked to lowered satisfaction.

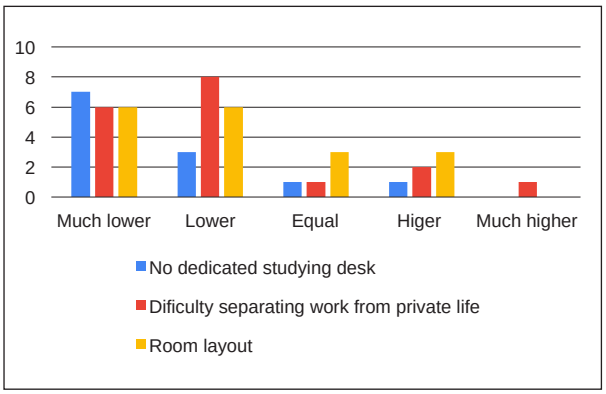

Figure 7. The score of 40 participants, who marked one or more of the factors in the legend, on the change in satisfaction of working from home compared to the 'old' situation (the number of participants who score the category is on the y-axis).

These factors were compared to the availability of the amount of rooms (figure 8). As can be seen, all three factors are mostly mentioned by the participants living in a single-room-home. People living in a single-room-home seem to have difficulty in setting up a dedicated study desk. This might also seem related to the difficulty of separating work and private life.

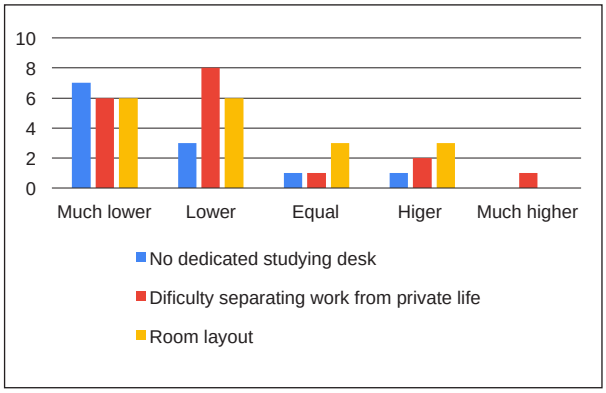

Figure 8. The score of 40 participants, who marked one or more of the factors in the legend, divided over the amount of rooms available to work from. (the number of participants who score the category is on the y-axis; 1 = one room, 2 = two rooms, etc.).

Lastly, when analysing productivity, Robertson & Cooper (2011) described a link between productivity and work satisfaction. Our data shows a similar link, as participants who mentioned lower perceived productivity also mentioned lower satisfaction of performing the work from home, as can be seen in figure 9.

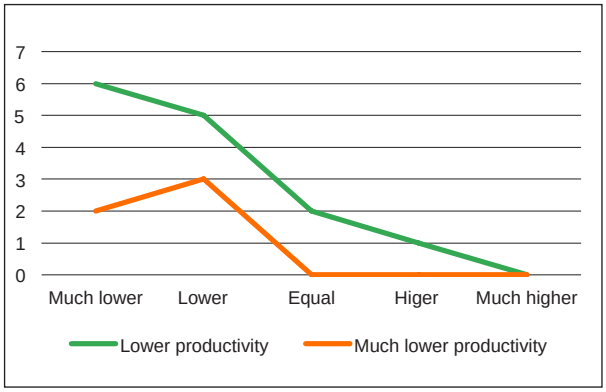

Figure 9. The sum of the scores of 19, out of the 40 participants, on the change in satisfaction of working from home compared to the 'old' situation, divided into two groups; lower and a lot lower productivity of working from home compared to the 'old' situation.

Reflection and discussion

This research shows the factors which influence the satisfaction of performing the work from home compared to working at the university or an office. The biggest problems can be found in situations when workers and students living in single-room-houses. This is not often mentioned in the literature and a factor that might be overseen. However, this study shows the importance of this factor.

Persons with one room do not have the ability to go to another room or to walk away from work. Neither do they have the space available to create a dedicated workspace. As such, it is assumed that some respondents work, eat and relax at the same desk.

Seeing your work when you go to sleep might also have a negative effect on your sleep quality. Furthermore, their workspace might always be in their peripheral vision, which ties into the fact that respondents who live in a home with a single room, might find it difficult to separate work and their private life.

But people working from home face many other factors influencing them in the creation of a suitable work environment, like the setup of a dedicated workspace, the quality of the internet, and environmental factors. To solve the above-mentioned issues attention is needed for improvements. In the given circumstances, employers could support or advise on setting up an ergonomic workspace. However, Mastrigt e.a. (2011) showed that employer support is an area that needs much attention. Additionally, more research into and attention for the work-life balance is needed, which might mean that additional coaching or attention from the management is required (Robertson & Vink, 2012). As currently there is not a clear end in sight to the current COVID-19 pandemic, we can assume that for the foreseeable future, students and workers will have to continue to work from home. For those that live in a single-room-home, the effects of not being able to walk away from work, or to create a good balance between work and private life, should not be overlooked.

We advise investigating the possibilities of workspaces near the homes of all that need to work from home. For example, cafes and restaurants could be transformed into temporary working spaces, to reduce the impact of having to live and work in the same space. Another solution, of course in line with the Covid-19 regulations, could be rental of private office spaces provided by several companies. Initiatives for shared working spaces are already taken like for instance 'seats2meet.com', 'spacesworks.com', 'regus.nl', 'tribes.world' and 'mindspace.me'.

For future research, we advise to pay attention to the working environment and include the number of rooms in the study.

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Vraagstelling

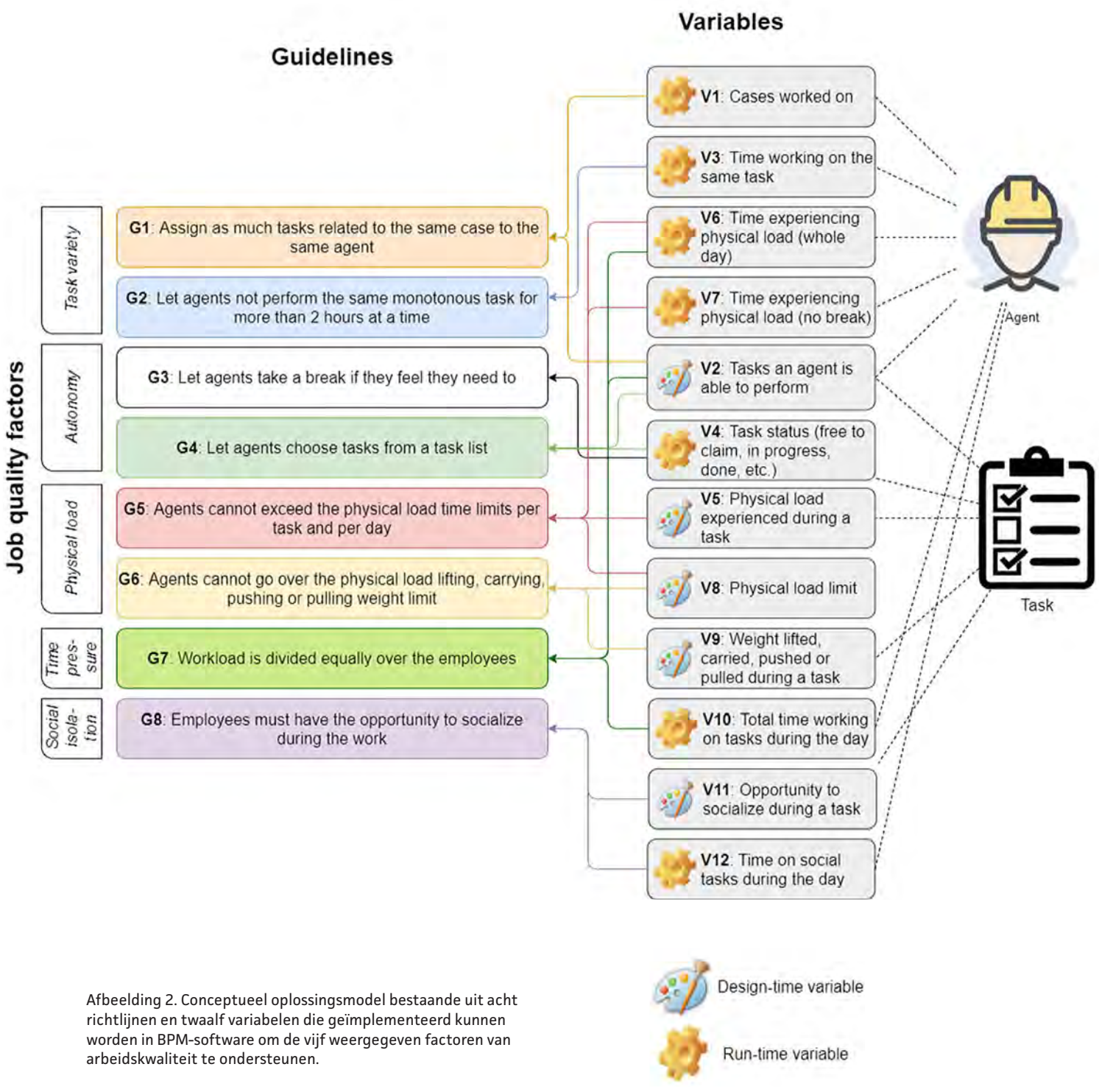
De maakindustrie van vandaag kenmerkt zich door een hoge mate van modernisering: in veel productiebedrijven worden steeds meer delen van de productielijn geautomatiseerd of gerobotiseerd, extensieve IT-systemen worden geïnstalleerd en steeds meer beslissingen worden automatisch genomen op basis van data-analyse. Deze ontwikkelingen veranderen het werk van de mens in productieomgevingen en dat komt niet altijd ten goede van de arbeidskwaliteit.

Ondertussen wordt in steeds meer bedrijven Business Process Management (BPM)-software ingezet. Deze software neemt als het ware de taak van een manager over en wijst aan de hand van procesmodellen en analyse van verzamelde data automatisch taken toe aan mensen en aan eventueel robots. Deze functionaliteit kan nuttig zijn om de eerder genoemde uitdagingen aangaande arbeidskwaliteit aan te pakken. Het is daarom zeer waardevol om te onderzoeken of en hoe het mogelijk is om arbeidskwaliteit in de maakindustrie te ondersteunen met behulp van BPM-software.

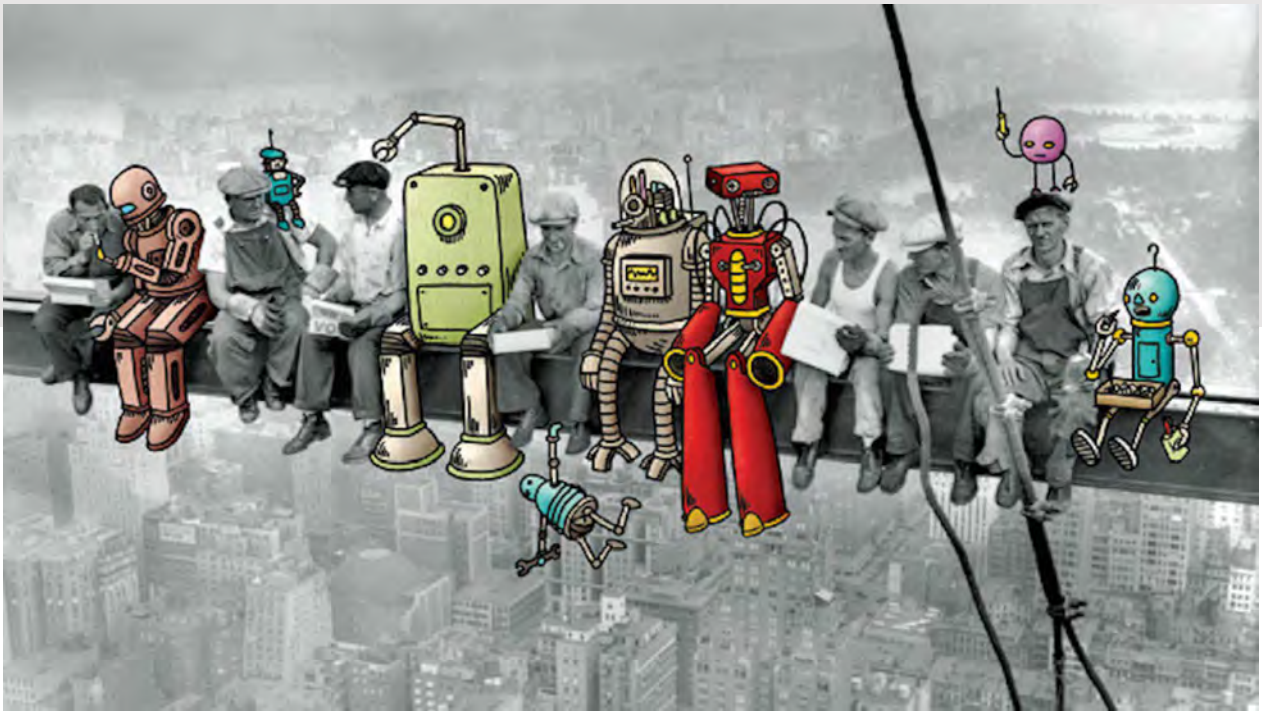
Methode

Met behulp van literatuuronderzoek en zes semigestructureerde interviews met experts op het gebied van arbeidskwaliteit is onderzocht welke facetten van arbeidskwaliteit momenteel onder druk staan in de maakindustrie. Op basis van deze selectie is vervolgens onderzoek gedaan naar richtlijnen en variabelen die geïmplementeerd kunnen worden in BPM-software om arbeidskwaliteit te ondersteunen. Deze conceptuele oplossing is daarna toegepast op twee processen bij twee productiebedrijven door middel van implementatie in

Afbeelding 1. Een handmatige taak in een productieproces met een hoge mate van fysieke belasting en lage mate van taakvariatie.



Afbeelding 2. Conceptueel oplossingsmodel bestaande uit acht richtlijnen en twaalf variabelen die geïmplementeerd kunnen worden in BPM-software om de vijf weergegeven factoren van arbeidskwaliteit te ondersteunen.



BPM-software. In deze implementatie werden de desbetreffende processen gemodelleerd en werd de logica achter de richtlijnen van de conceptuele oplossing geprogrammeerd. Deze demo is ten slotte geëvalueerd door middel van semigestructureerde interviews met twee casusexperts.

Resultaten

In totaal werden 45 facetten van arbeidskwaliteit vastgesteld, waarvan vijf factoren de grootste uitdaging bleken in de maakindustrie van nu: autonomie, taakvariatie, sociale isolatie, fysieke belasting en tijdsdruk. Een voorbeeld hiervan is te zien in afbeelding 1.

Aan de hand van deze vijf factoren is vervolgens een aantal richtlijnen en variabelen geformuleerd in een conceptueel oplossingsmodel (zie afbeelding 2). Deze richtlijnen en variabelen kunnen in BPM-software worden geïmplementeerd om arbeidskwaliteit te ondersteunen. Een voorbeeld uit het model is richtlijn 5 (G5): 'Agenten kunnen de tijdslimieten aangaande fysieke belasting per dag en per keer niet overschrijden.' Als deze richtlijn succesvol wordt geïmplementeerd, zou de BPM-software bijhouden hoe lang werknemers bepaalde vormen van fysieke belasting ervaren en deze tijd vervolgens begrenzen.

Het derde resultaat is een implementatie en evaluatie van het conceptuele oplossingsmodel. Er werd een demo gecreëerd in BPM-software, waarin vijf van de acht richtlijnen (aangaande autonomie, taakvariatie en fysieke belasting) werden toegepast op twee productieprocessen. De demo werd voor beide casussen succesvol geëvalueerd als het gaat om haalbaarheid. In termen van nuttigheid werd de implementatie van de fysieke-belastingrichtlijnen als zinvol geëvalueerd, terwijl de implementatie van de autonomie- en taakvariatierichtlijnen als twijfelachtig werd beschouwd.

Conclusie

Bepaalde aspecten van de kwaliteit van werk in productieprocessen kunnen worden geïntegreerd in BPM-software, maar de mate waarin zo een implementatie de arbeidskwaliteit ondersteunt, hangt af van welke factoren ondersteund worden door de software en van de context waarin deze implementatie plaatsvindt.

Persoonlijke impressie

Ik denk dat er nog veel winst te behalen valt op het gebied van arbeidskwaliteit in de maakindustrie. Zeker in de huidige overgang richting volledig geautomatiseerde productielijnen, waarin nog altijd taken voor mensen blijven bestaan, is het belangrijk de invloed van deze ontwikkeling op het werk van de mens niet te onderschatten. In mijn onderzoek heb ik oplossingen onderzocht voor de verlaagde werkkwaliteit vanuit het BPM-perspectief. Ik ben van mening dat BPM te vaak over het hoofd wordt gezien als oplossingsrichting en denk dat het zeer zinvol kan zijn deze manier van denken vaker in te zetten. Ik hoop dat er door mijn onderzoek extra aandacht komt voor de impact van automatisering en robotisering op het werk van werknemers in maakbedrijven.

Human Factors NL steunt de campagne

‘Hoe TOP werk jij? Pak lichamelijke belasting aan!’

Hoe TOP werk jij?

Factsheet Lichamelijke Overbelasting 2020

2 op de 5 werknemers in Nederland heeft te maken met lichamelijk belastend werk. Daardoor lopen zij het risico om ziek te worden.

WAT IS LICHAMELIJKE BELASTING?

Iedere werknemer heeft te maken met lichamelijke belasting. Bijvoorbeeld bij het verplaatsen van producten (tillen, dragen, duwen, trekken). Bij lichamelijke overbelasting worden de spieren en gewrichten in rug, schouders en armen zo zwaar, lang of vaak gebruikt dat er gezondheidsschade kan ontstaan.

Ook lichamelijke onderbelasting, bijvoorbeeld in zittende beroepen, kan leiden tot schade aan de gezondheid. Gemiddeld geeft 46% van de werknemers aan op een werkdag 6 uur of meer te zitten op het werk.

WERKNEMERS HEBBEN HET MEEST TE MAKEN MET DE VOLGENDE VORMEN VAN LICHAMELIJKE OVERBELASTING:

- **32%** Het maken van herhalende bewegingen
- **11%** Werken in ongemakkelijke werkhoudingen
- **20%** Veel kracht zetten
- **9%** Werken met trillend gereedschap of een voertuig dat trillingen veroorzaakt

WELKE GEVOLGEN HEEFT LICHAMELIJKE OVERBELASTING?

Werknemers kunnen door lichamelijke overbelasting gezondheidsklachten en zelfs een beroepsziekte ontwikkelen. Meer dan de helft van de werknemers geeft aan gezondheidsklachten te hebben, waarbij klachten aan arm, nek en schouder (KANS) het meest voorkomen.

41%

- **nek**
- **schouder**
- **arm**

Door langdurige klachten lijden in totaal **460.000 werknemers** aan een beroepsziekte aan hun rug, arm, nek, schouder, knie of heup. Dat zorgt niet alleen voor veel persoonlijk leed, uitval en arbeidsongeschiktheid, maar ook bijna **500 miljoen** aan kosten voor werkgevers.

460.000

€500.000.000

- **63%** Agrarisch & Groen
- **55%** Vervoer & Opslag
- **51%** Bouw
- **48%** Industrie
- **45%** Zorg

WAAR EN BIJ WIE KOMT LICHAMELIJKE OVERBELASTING VOOR?

Blootstelling aan lichamelijke overbelasting komt relatief veel voor in de volgende sectoren en beroepsgroepen:

- Agrarisch & Groen (63%): tuinders, akkerbouwers en veetelers; hulpkrachten landbouw; bestuurders voertuigen en bedieners mobiele machines.
- Vervoer & Opslag (55%): machinemonteurs, medewerkers persoonlijke dienstverlening, bestuurders voertuigen en bedieners mobiele machines, hulpkrachten transport en logistiek.
- Bouw (51%): bouwarbeiders; elektriciens en elektronicamonteurs; bestuurders voertuigen en bedieners mobiele machines.
- Industrie (48%): metaalarbeiders, machinemonteurs; voedselverwerkende beroepen en overige ambachten; elektriciens en elektronicamonteurs; productiemachinebedieners en assemblagemedewerkers; hulpkrachten bouw en industrie; bestuurders voertuigen en bedieners mobiele machine; hulpkrachten transport en logistiek.
- Zorg (45%): vakspecialisten gezondheidszorg; verzorgenden; medewerkers persoonlijke dienstverlening; schoonmakers en keukenhulpen.

HOE KUN JE LICHAMELIJKE OVERBELASTING VOORKOMEN?

Door veilig en gezond werken onderdeel te maken van de dagelijkse werkroutine. Start met het in kaart brengen van alle risico’s op het gebied van lichamelijke belasting op de werkvloer. De werkgever of preventiemedewerker is hiervoor verantwoordelijk en stelt een risico-inventarisatie & evaluatie (RI&E) op. Raadpleeg het Stappenplan Lichamelijke Belasting op arboportaal.nl om tot een gerichte aanpak te komen. Nadat de risico’s duidelijk zijn, kunnen er maatregelen getroffen worden om deze te minimaliseren. Onderzoek of je de oorzaak van de lichamelijke overbelasting kunt wegnemen en volg daarbij de TOP-strategie.

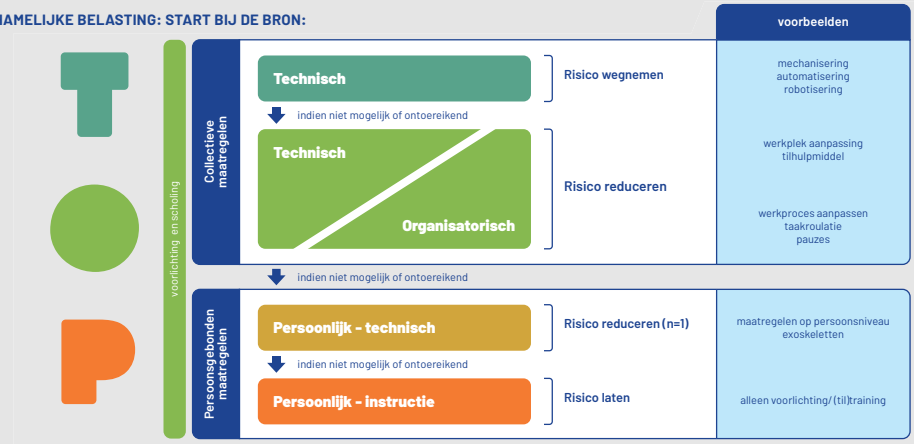
→ Technische maatregelen:
Kijk eerst met welke technische maatregelen de bron van lichamelijke overbelasting kan worden weggenomen, zodat werknemers gezonder kunnen werken. Denk aan machines of hulpmiddelen om het werk lichter te maken, zoals een tillift in de zorg of een platentiller in de bouw. Als dat niet kan of niet genoeg is, kijk je naar de O van organisatorische maatregelen.

→ Organisatorische maatregelen:
Overweeg of aanpassing van het werkproces mogelijk is. Onderzoek daarnaast of werknemers zware met minder zware taken kunnen wisselen of meer pauzes kunnen nemen. Als dat ook niet kan of onvoldoende is, volgen persoonsgebonden maatregelen.

→ Persoonsgebonden maatregelen:
Biedt maatwerk oplossingen, individuele adviezen voor uitvoering van taken of individuele aanpassingen in de functie van een werknemer. Voorlichting en training zorgen ervoor dat werknemers de risico’s herkennen en weten wat de maatregelen hen opleveren.

Pas voorlichting en training altijd toe in combinatie met technische en/of organisatorische maatregelen. Het toepassen en opvolgen van de maatregelen is een gedeelde verantwoordelijkheid van de werkgever en werknemers.

AANPAK LICHAMELIJKE BELASTING: START BIJ DE BRON:



MEER INFORMATIE OVER LICHAMELIJKE BELASTING?

- Doe de test op: **www.hoetopwerkjij.nl**
- Kijk voor meer informatie op: **www.arboportaal.nl/campagnes/hoe-top-werk-jij**

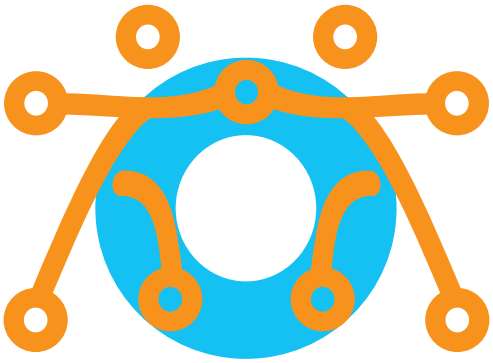
- **Bronnen:** Nationale Enquête Arbeidsomstandigheden 2018 en 2019 (TNO/CBS)
- **TNO rapport:** Preventie Beroepsziekten door Fysieke Belasting (2020) **https://www.fysiekebelasting.tno.nl/nl/links/**

https://healthy-workplaces.eu/nl

Samenwerken

Samenwerken zit in ons HFNL DNA. We werken samen met elkaar, met andere deskundigen en met onze gebruikers. En soms is samenwerking ook ons onderzoeksgebied, zoals dit themanummer laat zien. Samenwerking is dan ook een onderwerp dat hoog op de agenda staat van het HFNL bestuur.

Zo was er begin maart het webinar 'Hoe TOP werk jij? Pak fysieke belasting aan!', gezamenlijk georganiseerd door Human Factors NL en de Nederlandse Vereniging voor Bedrijfs- en arbeidsfysiotherapeuten (NVBF). De TOP-campagne vormde een goede aanleiding om elkaar en elkaars werkwijze op het gebied van fysieke belasting te leren kennen. Met ruim 100 inschrijvingen van zowel leden als andere geïnteresseerden en enthousiaste reacties na afloop was het webinar succesvol. Reden genoeg voor ons als bestuur om vaker dit soort gezamenlijke activiteiten met de NVBF te organiseren. En ook om te kijken met welke andere beroepsverenigingen dit interessant is, zoals de verenigingen voor bewegings-wetenschappen, arbeidshygiëne, veiligheidskunde en arbeids- en organisatiedeskundigen. Maar ook verenigingen op het gebied van computer-human interaction (CHI), engineering en design. Want uiteindelijk streven we allemaal hetzelfde doel na:
"*(...) to contribute to the planning, design, implementation, evaluation, redesign and continuous improvement of tasks, jobs, products, technologies, processes, organisations, environments and systems in order to make them compatible with the needs, abilities and limitations of people*" (Dul et al, 2012).
Gezamenlijke bijeenkomsten en webinars zijn een eerste praktische stap om elkaars werk en perspectief te leren kennen. Meer overleg en wederzijds advies op bestuursniveau zijn een belangrijke volgende. Naast deze activiteiten zijn we als bestuur ook aan het kijken naar meer samenwerking op beleidsniveau. Zo zijn we in gesprek met het Ministerie van SZW of er ruimte is voor een formele rol voor de human factors specialist bij het toetsen van de Risico-Inventarisatie & -Evaluatie. En we hopen binnenkort aan te schuiven bij het kennisnetwerk van het Arboplatform van de Sociaal Economische Raad.



Heb je interesse mee te denken over en bij te dragen aan de strategie van Human Factors NL? We zoeken leden voor een nieuw te vormen commissie op het gebied van samenwerking en communicatie. Daarnaast zoeken we een redacteur voor het Tijdschrift voor Human Factors, een penningmeester (tevens bestuurslid) en een enthousiast extra lid voor de congrescommissie. Neem voor informatie contact op met Sander Vries, secretaris Human Factors NL (secretaris@humanfactors.nl).

Tot slot, bekijk de voorkant van dit tijdschrift nog eens goed. De foto toont één van de reusachtige marionetten van het Franse straattheatergezelschap Royal de Luxe. Deze indrukwekkende reuzen bewegen zich voort door middel van touwen, machines en menselijke spierkracht en zijn ontwikkeld door een bevlogen multidisciplinair team van theatermakers en technici. De documentaire 'De Reuzen' (Jean-Michel Carre, 2018; te bekijken via YouTube) over Royal de Luxe is dan ook een aanrader. Visie, daadkracht, twijfel, veerkracht, leiderschap en de romantiek van het samen reizen en creëren om mensen in vervoering te brengen, het komt allemaal voorbij. Samenwerking in al zijn inspirerende vormen!

Marijke Melles
voorzitter Human Factors NL