

Employee-Developed Ways to Enhance Information Ergonomics

ACCEPTED MANUSCRIPT

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ABSTRACT

Information intensity has increased in many work tasks, requiring employees to process large quantities of information using ever-changing technologies. This increased load can have a negative effect on employee well-being, which has increased the need to pay attention to information ergonomics. This paper examines the strategies and practices that employees have developed to enhance information ergonomics. A qualitative content analysis was applied to the research data, which was collected from group discussions conducted in nine workshops (n = 36). The results indicate that social conventions and practices, such as the shared understanding of rules within a work community, are important in decreasing information load. Methods for enhancing information ergonomics are divided into four main themes: digital communication rules and etiquette, opportunities for uninterrupted work, end-user-driven technology implementation, and prioritization of work. The findings are discussed with respect to previous research.

1 INTRODUCTION

1.1 Information Load and Employee Well-Being in Digitalizing Work

Digitalization has influenced work life in many ways, affecting how work is organized. Working life statistics show that the use of computers at work by workers in various fields is increasing [1]. The use of robots and smart systems is also growing. These developments offer advantages and disadvantages. For example, employees may be more easily connected to each other, but they are also available all the time, which can have a negative impact on work–life balance [2].

The expanded use of information and communication technology (ICT) has increased the information intensity in many tasks. Workers are often required to process massive quantities of information, an amount that grows as the number of information and communication channels increase. This workload can be difficult to manage, and even cause information overload [3]. The digital work environment, especially communication channels, may inflict continual interruptions, which can decrease control over one's work, increase one's workload, and cause frustration and stress [4–6].

A type of stress related to the use of technology at work is technostress. Typical symptoms include anxiety, exhaustion, and cynicism [7]. Technostress stems not only from direct human interaction with ICT but also from attitudes and thoughts regarding ICT implementation in organizations and the digitalization of society (e.g., fear of losing one's job because of technological innovations; [8, 9]). Typical technostress creators include techno-overload (e.g., an employee is forced to change work methods due to a new technology), techno-invasion (e.g., constant availability or connection to work due to technology), techno-complexity (e.g., technologies are difficult to use), techno-insecurity (e.g., fear of losing one's job due to a new technology), and techno-uncertainty (e.g., constant changes in technology) [9, 10]. Technostress may have

various individual- and organizational-level consequences, such as lower job satisfaction and organizational commitment [11], decreased productivity and performance, as well as increased stress regarding organizational roles [9, 12, 13].

Stress and events occurring in the digital environment have been found to be correlated [14]. It seems that when a person can work at the pace and with the methods he or she is accustomed, he or she experiences ease of work and control, both of which are associated with lower stress levels. Even a certain number of habit- and experience-induced automatic behaviors in ICT use can be beneficial in streamlining work [15]. Conversely, changing tasks or task types can trigger increased stress levels [14].

Although Okkonen et al.'s [14] findings did not necessarily show that multitasking and task switching have negative effects, changing tasks or task types caused increases in measured stress levels. To gain a more comprehensive view of this issue, external interruptions (such as incoming emails, messages, or phone calls) should be extracted from the rest of the data, because they cause significant distractions from the workflow. Self-inflicted interruptions and non-moderated digital work environments also seem to cause stress [16, 17]. Further analyses of such events are needed to determine the actual causes of stress in the digital work environment.

As information intensity has increased, the ergonomics of the digital work environment is also important. Information ergonomics is a developing branch of ergonomics that focuses on the management of information- and technology-related workloads. This concept has been refined over the past several decades; key themes include optimizing information search and selection, cognitive information processing [18], and aspects of information organization and retrieval [19]. Previous research focused on burdens such as cognitive load [20], mental workload [21], and information overload [22]. Overall, the goal of information ergonomics is to ensure an optimal match between humans and information technology by identifying and managing information-intensive workloads. This is done by developing processes, conventions, and practices that help workers better cope with work demands. In the current paper, we suggest that enhancing information ergonomics can also decrease technostress. Until now, studies that combine these two research traditions are lacking.

1.2 Strategies and Practices for Managing Information Load

Information ergonomics focuses on assessing the load and stress levels caused by different working conditions, as information load and stress are indicators of the quality of the user experience and human-computer interaction. Information ergonomics is a multifaceted approach that considers the infrastructure (e.g., the digital work environment), social factors (e.g., shared practices and social norms), individual factors (e.g., technology habits), and the role of technology itself (e.g., digital tools) in assessing and enhancing human well-being and system performance in a work environment [23, 24].

Several methods measure information ergonomics and stress in the digital work environment. Subjective methods include surveys and interviews covering individual experiences, while objective methods include psychophysiological measures and activity tracking. The present study used a qualitative, subjective, collaborative approach to measure the phenomena; however, the participants also based their discussions in part on the results of the log data and psychophysiological measurements of stress gathered at the beginning of the project.

Technostress inhibitors are mechanisms that help manage technostress in practice and offset the intensity and outcomes of technostress-triggering conditions. These mechanisms may appear at the organization,

leadership, team, and/or individual level. Typical organization-level mechanisms include literacy support (e.g., training and knowledge sharing), technical support and assistance, facilitation of technology involvement (e.g., including employees in the planning process), and innovation support (e.g., encouraging new ideas and risk-taking) [10].

In practice, constant availability, which is commonly seen as a stress-inducing aspect of ICT at work, can be decreased by discouraging or even banning employees from using ICT outside working hours or establishing support groups to help manage work–family conflicts. Furthermore, the communication quality could be improved by training employees how to write more constructive emails and other forms of communication [25]. Adaptive coping strategies (e.g., actively solving and controlling “technostressful” situations), which seem to be associated with lower work exhaustion, could be promoted among employees and supervisors as well [26].

Team-level mechanisms for decreasing technostress can include providing informal social support to co-workers and voluntarily teaching colleagues to adopt and learn new technologies [11]. In a study among Finnish teachers, the authors showed that a higher level of school support, which included support from the work community for using educational technology, jointly agreed goals, a positive atmosphere toward novel educational technologies, and tips for technology use and teaching, was associated with less technostress [27]. The findings indicated that team-level practices are important but understudied factors in decreasing technostress and enhancing information ergonomics.

It seems that effective management of technostress and enhancement of information ergonomics require multiple interwoven actions at different organizational levels. For example, when an individual wants to improve work recovery by decreasing constant connectivity, he or she must be supported by organizational policies and practices, as well as the actions of his or her supervisors and co-workers.

As the present study used the participatory data collection approach, it is possible to draw conclusions about employee views on organization- and team-level practices for enhancing information ergonomics—not just individual coping strategies. Although some practical methods for managing the demands of ICT use were presented in previous studies, the methods were not necessarily proposed and developed by the employees themselves, but by the researchers. Focusing on employee-developed strategies and practices is important, considering that active solving and controlling are critical for enhancing ICT-related well-being in the work environment [26]. Involving employees in this process is considered an effective way to reduce technostress [10].

Overall, it seems that previous studies focused on measuring information load and technostress using various methods but did not extensively cover the strategies and practices that employees develop and use to manage ICT-related demands and stress (with the exceptions of [25] and [26]). Therefore, the main research question of the present study is the following: What kinds of strategies and practices do employees develop in collaboration to enhance information ergonomics in their work environments?

2 METHODS

2.1 Data Collection

The data was gathered between May 2015 and May 2016 as part of a larger, mixed-method action research project that focused on the role of information ergonomics in workplace well-being. The larger dataset

included questionnaires, heart rate variability (HRV) measurements as a stress indicator, log data, and workshop discussions. The data used in the development of this paper was collected from group discussions conducted in nine workshops.

Thirty-six employees representing three organizations (i.e., an industrial enterprise, $n = 13$; an insurance company, $n = 13$; and a financial administration services company, $n = 10$) participated in the study. Each organization held three workshops on its respective premises. The workshops were facilitated by the authors. Not all participants were able to attend all three workshops. The average number of participants at a single workshop was nine, with the smallest number of participants seven and the highest 13.

The objective of the workshops was to develop methods for enhancing information ergonomics. In each workshop, the participants formed two or three smaller groups to discuss topics provided by the facilitators. The discussions were recorded, and the facilitators were not present during the discussions. After the small group discussions, all participants and the facilitators gathered for summary discussions, which were also recorded.

Results from the HRV, log, and questionnaire data provided a starting point for the discussions. According to Okkonen et al. [14], the combined measures of logging and HRV provide beneficial background information for developing information ergonomics. Summaries of preliminary results from the log data, psychophysiological measurements, and questionnaire responses were distributed to the workshop participants, which gave them an overview of their computer-mediated tasks, stress levels, and subjective assessments. Based on these results, the participants reflected upon and discussed their digital work environment, information loads, information ergonomics, and well-being at work. All the recordings were transcribed. The recorded data totaled 17 hours and 41 minutes of discussion, and the transcription was 110,006 words.

2.2 Participants

The participants volunteered for the study and were recruited through a contact person in their organization. Thirty-four participants were women, and two were men. The insurance company and the industrial enterprise had one male participant each, while all participants in the financial administration company were women. The participants' ages were between 26 and 61, with an average age of 42.5 years. In the financial administration company, participants' tasks were mostly related to payroll; in the insurance company, customer service or insurance claims handling; and in the industrial enterprise, financial administration or human resources.

2.3 Data Analysis

The workshop discussion data was analyzed with qualitative content analysis. Content analysis was chosen because it is flexible and data driven [28, 29]. It provided a fruitful approach for analyzing the development-oriented group discussions with minimal presuppositions. The discussion transcriptions were reviewed, and all the text related to methods for enhancing information ergonomics was highlighted. In the next round of reading, short phrases that described methods for managing information load and enhancing information ergonomics were written next to the highlighted text. Then, similar methods were grouped together and given preliminary codes. The contents were grouped, coded, and organized until four main themes emerged.

3 RESULTS AND DISCUSSION

In the analysis of the group discussion data, the participants' ideas for enhancing information ergonomics were divided into four main themes: digital communication rules and etiquette, opportunities for uninterrupted work, end-user-driven technology implementation, and prioritization of work. These themes primarily covered methods for reducing and managing information load among work communities, as participants seemed to prefer discussing issues at the team level. Some individual- and organization-level strategies were also mentioned. These themes are presented briefly in Table 1 and are discussed in more detail in the following subsections, along with short quotations from the workshop discussions.

For the quotations, participants were assigned anonymous identifiers, including a participant number (p), a discussion group number (g), and a workshop number (ws), as well as the field of their organization (e.g., financial administration). For example, participant 3 in discussion group 2 of workshop 1 at the industrial enterprise is represented as p3, g2, ws1, industrial enterprise. In addition to the participant number, group and workshop identifiers were created because the same organization could have more than one participant with the same number in different groups, and participants could have different participant and group numbers in each workshop.

Table 1: Participants' Methods for Enhancing Information Ergonomics in the Workplace

Theme	Description of the theme
Digital communication rules and etiquette	Shared understanding of the channels used, general rules for the use of shared email/ticketing accounts, reducing unnecessary messaging in the organization
Opportunities for uninterrupted work	Establishing a standard of service, determining response times, respecting the need for uninterrupted work
End-user-driven technology implementation	Tailored orientation and training, allotted time for the training, study groups, sharing of knowledge and best practices in technology use
Prioritization of work	Recognizing one's basic role and task, learning to block out or ignore irrelevant stimuli, logging out of communication tools when needed

3.1 Digital Communication Rules and Etiquette

During the workshop discussions, the participants agreed that it is important to establish a shared system of digital communication rules and etiquette within the organization, as digital communication is perceived to be a highly demanding feature of the digital work environment. The participants decided to aim for a shared understanding of which communication channels should be used and for what purpose. Although this cannot always be achieved at the organization level, and it is not always possible to require that clients abide by the same rules, the participants felt that even a team-level agreement on digital communication rules and etiquette could be beneficial for reducing relative workloads: "We began [...] pretty much from the team perspective; that teams would think about shared rules and tools depending on the target audience" (p1, g1, ws3, industrial enterprise).

The participants also decided it would be beneficial to establish general rules for the use of shared email accounts and tickets: "How about those unnamed [tickets]? I was thinking maybe we should create a rotating system in who is naming those" (p1, g1, ws3, financial administration). In this way, the shared communication

tools would be easier to manage, and the risk of unnoticed and unanswered messages and tickets would decrease.

Participants also discussed that a shared understanding of how many recipients emails are sent to could make them easier to manage. The participants were hoping to reduce the number of bulk emails sent out and avoid sending unnecessary copies of an email to many recipients. Some mentioned that it might be beneficial to check whether the number of mailing lists used in the organization could be reduced. They also discussed how, at the individual level, meticulousness in crafting an email could reduce the digital communication load: "When you're writing an email, [...] it pays off to take a minute or two to write it with more care, because if you send it incomplete, the same email is going back and forth" (p2, g1, ws3, insurance company).

Some participants wondered if the organization could provide general instructions for how to compose a good email and whether this would be beneficial in improving message quality: "A moment ago when we walked past the info TV, I had an idea that there could just as well be playing something like 'How to title an email'" (p1, g1, ws3, industrial enterprise). A good email was described as clearly written, preferably short, and includes all the essential information on the matter, as well as the sender's current contact information. The tone of the email should be polite, and text effects, such as all caps and highlighting, should be used in moderation. The sender should always think about whom the matter concerns and send the email only to those recipients, to reduce the number of unnecessary messages. Finally, the sender should indicate the urgency of the message by, for example, expressing the date by which he or she needed an answer.

Getting external clients to abide by the same instructions was perceived as difficult. For this reason, the participants proposed that the easiest way to get adequate information from clients is to use structured communications, such as digital templates or forms, which could guide clients in providing all the information needed.

3.2 Opportunities for Uninterrupted Work

During the workshop discussions, one of the main problems cited was the constant risk of interruption in the digital work environment. The participants agreed that there should be ways to provide employees with more opportunities for uninterrupted work. They perceived that this would require supervisors and employees discussing and establishing practices that enabled periods of uninterrupted work for everyone. This goal could be achieved, for example, by establishing a standard of service, such as defining how many employees on a team should be logged on at a certain time and how many could log off, or determining response times (i.e., how soon a sender can expect to get an answer): "I was just thinking if each team should have a defined standard of service, which would give the opportunity of not answering immediately" (p7, g1, ws3, industrial enterprise).

Many employees who worked in direct customer service already had standards for response times, but some thought that the concept might be beneficial in completing other tasks, too: "In the olden days, [...] the matters had response times [...]. Now those have disappeared completely. [...] Could we establish some kind of response times inside the organization, so people would be able to calm down a little?" (p1, g1, ws1, insurance company). This idea was cited as a method for balancing employees' workloads and reducing task fragmentation caused by interruptions, by providing clear instructions on which matters do not require immediate handling.

Participants discussed how the needs and possibilities for uninterrupted work varied between roles and tasks; for some, several hours every now and then would be sufficient, but for others, whole workdays would be required. Periods of uninterrupted work could occur at set times or could arise unexpectedly while performing tasks. Therefore, the participants perceived that opportunities for uninterrupted work should be determined at the team level and there should be some flexibility in the rules.

Participants also mentioned that respect for uninterrupted work should be an organizational norm: "The second thing is Lync, [being unavailable] should be respected; there should be shared rules" (p2, g1, ws2, insurance company). The participants agreed that colleagues and supervisors should refrain from contacting and disturbing employees who are concentrating on their work; however, this goal was perceived as more difficult to achieve with clients. The participants planned to space out the checking of client tickets, thus reducing the number of client-caused interruptions: "It would be really wonderful if [the ticketing tool] was not open all day long [...], you would actually have time and you wouldn't have to go back and forth [between the ticketing tool and other applications]" (p1, g1, ws1, financial administration).

The participants also discussed how, with a little foresight, they could reduce the number of emails during periods that were generally busy. The participants proposed building a shared understanding that during predicted busy periods, internal digital communication should decrease, and everyone should refrain from sending messages about non-urgent matters. This idea was considered a method for avoiding unnecessary interruptions.

3.3 End-User-Driven Technology Implementation

Many participants perceived that adopting new technology was demanding. To manage and decrease the workload caused by new technology, the participants proposed a more end-user-driven implementation. Participants felt that their teams' needs and the characteristics of their work should be taken into account when implementing new technology. Participants hoped for a more tailored orientation and training program that stemmed from their duties, instead of general instructions: "It would be wonderful if someone from IT could visit every team, ask a couple of questions [...]. Then they would create a sensible environment for the team and give just the right tips" (p2, g1, ws3, industrial enterprise).

The participants felt that too often they were unable to fully utilize new technology, as the general instructions were not clear about how the technology best served their jobs. User-centered training and consulting were perceived to be the answers. The participants also discussed how to allot time for training, because learning new technology in the middle of other work was perceived as very difficult. Participants cited scheduling group study periods with colleagues and supervisors as important: "For example, once every two weeks you could go and study something. And there would be someone who knows how to help you, instead of you spending three hours [alone] on your computer, mulling over the same thing" (p1, g1, ws3, insurance company).

In addition to initial training, the participants also proposed establishing shared practices for using new technology in the work environment. Similar to the discussions regarding digital communication, the participants suggested that when new technology is implemented, all employees on a work team should build a shared understanding of how to use the tools and for what purposes. The participants also mentioned that sharing knowledge and best practices in technology use should be promoted, as they viewed peer support as an effective method for reinforcing skills acquired in official orientation and training programs: "The little tips should be shared. Otherwise, the know-how [of the team] won't increase; [everything] just swirls and rolls" (p1, g2, ws2, industrial enterprise).

3.4 Prioritization of Work

Although the three themes presented above primarily cover team-level methods for managing information and technology loads, discussions about the prioritization of work largely concentrated on individual-level strategies. Prioritization of work was mentioned in particular in relation to asynchronous communication demands. Participants discussed the importance of recognizing one's basic role and task and determining the most important and pressing matters regarding that task.

Participants suggested that by recognizing what is most relevant, employees would, for example, be able to distinguish between more and less urgent messages and learn to block or ignore distracting irrelevant stimuli: "If the knowledge about your basic task is clear, then when you receive information, email, or Lync, you know how to categorize [it], when you're going to do it, how important it is, and what your basic task is" (p3, g1, ws2, insurance company). In addition to distinguishing urgency, the participants proposed that employees should recognize and accept that even if they received an important email or ticket, it was not necessarily something they could handle at that moment.

Some participants mentioned the term "self-management" within the context of managing information load. They suggested that in addition to establishing shared practices that enable uninterrupted work, employees should make choices individually to reduce their information load. The participants agreed that this would require prioritization of work, as well as self-discipline to avoid switching between tasks and applications all the time: "One also has to recognize if a task causes stress, then one needs to manage oneself and change working habits, for example, checking email just once an hour" (p3, g3, ws1, industrial enterprise).

The participants planned to reduce interruptions and distractions by logging out of communication tools when possible, especially during tasks that required undivided attention. The participants saw email and tickets in batches as an underutilized method for managing the information load: "About adjusting one's attitude [...], it would be a lot better if you thought, 'I'm handling these between 1 and 3 o'clock.' Close those [applications]; don't even open them" (p2, g1, ws3, financial administration).

3.5 Discussion

The aim of the present study was to explore the methods employees have developed for enhancing information ergonomics in their work environments. The novelty of the study lies in its application of the participatory data collection approach, in which employees were gathered to discuss and identify methods for reducing information loads and enhancing information ergonomics. The findings were obtained from an action research process, not a single measurement or interview, which meant that the participants had a more active role and were more than just informants. The discussions covered wider, work community-level practices, not just individual coping strategies. Participants were also provided with the results from objective measurements (i.e., activity logging and HRV as a stress indicator) of their digital work environments, which gave the participants more comprehensive background information about their workplace situations than their subjective experiences could offer alone.

The methods discussed for enhancing information ergonomics mainly covered team-level practices for reducing technology-related workloads, but participants also proposed organization- and individual-level strategies. The findings indicate that the practices and strategies for managing information load and enhancing information ergonomics are multifaceted and intersecting. For example, to engage in quiet, uninterrupted work, employees should be supported by the team and organization in logging out of communication applications. There should be a shared understanding among the work community regarding

when or in which situations this activity can be practiced. The work community should respect quiet times, and the employees themselves, for example, should refrain from engaging in communication activities that could interrupt their work.

Together, these findings indicate that team-level practices are especially important in decreasing technostress and enhancing information ergonomics. Accordingly, future research on identifying group-level ICT-related stress experiences, as well as identifying team-level technostress inhibitors and coping strategies, is needed. The current technostress scales do not seem to capture the team-level factors extensively. For instance, in Ragu-Nathan et al.'s [11] widely used scale of technostress inhibitors, only the literacy facilitation methods, such as knowledge sharing and teamwork in dealing with new technology-related problems, are mentioned as team-level technostress inhibitors. Based on the findings of this study, team-level practices for supporting uninterrupted work and shared digital communication practices and rules seem to be important aspects to consider in future studies. These social factors (e.g., shared practices and social norms) seem to be covered in discussions on information ergonomics more than in technostress discussions. In future studies, the similarities and differences between these two research traditions, which evidently have a lot in common, could be discussed in more detail.

The findings of this study support the basic notion of information ergonomics that in addition to the technology and infrastructure, it is important to consider the social and individual factors [23]. During the workshop discussions, social conventions, such as shared rules and practices, were mentioned for nearly all matters. During discussions on the implementation of end-user-driven technology, participants frequently mentioned organizational support of technology use. This result is in line with findings in previous research [10], which list, for example, literacy support and facilitation of technology involvement as technostress inhibitors.

The individual strategies mentioned in this study were primarily related to the prioritization of work (i.e., knowing one's basic tasks and priorities and actively managing the workflow based on this knowledge). This result is in line with previous research [26] that showed that active coping strategies can be beneficial for reducing technology-related workloads.

Although the present study provides new insights into employees' views on enhancing information ergonomics, there are limitations that must be addressed. First, the number of participants was small, which means that the results are not generalizable. However, as a qualitative study, it provides useful insights into the ways in which information ergonomics could be supported in workplaces. Second, the participants represented specific fields (i.e., insurance, financial administration, and industrial support services, such as human resources), and thus, the results may not apply in other fields. However, the methods for managing information load and enhancing information ergonomics proposed by the employees of the participating organizations are, for the most part, very similar; this similarity indicates that the demands of the digital work environment are commonly experienced in various information-intensive tasks.

4 CONCLUSIONS

As part of a larger action research project, qualitative data was gathered from group discussions among workshop participants and analyzed to determine the methods that employees have developed for enhancing information ergonomics in their work environments. The analysis of the group discussions revealed four main themes into which the methods were categorized: digital communication rules and

etiquette, opportunities for uninterrupted work, end-user-driven technology implementation, and prioritization of work. The findings emphasize the socially constructed aspect of information ergonomics, indicating that social conventions, rules, and practices play integral roles in reducing information load and enhancing information ergonomics.

Although the results are context-sensitive, the themes fit well into the general framework of information ergonomics because organizational and individual habits and conventions are key issues when sense of control and information ergonomics are considered. The data gathered is somewhat representative of knowledge work organizations; therefore, the findings are applicable with the limitations described in the discussion above. In conclusion, this pathfinding study introduced four critical themes in enhancing information ergonomics and how to address them.

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