# Relationship Between Digital Stress and Innovation Capacity

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## ABSTRACT

Digital stress poses one of the most significant challenges for organizations because of the emerging digital transformation. Numerous reports have discussed the impact of digital work on employees' perceived physical and mental health. Continuous exposure to digital information flow, multitasking, and constant connectivity may lead to cognitive overload and mental fatigue, affecting attention, memory, concentration, and even one's capacity for innovation. This study aimed to investigate the relationship between perceived digital stress, work engagement, and innovation capacity. A large survey was conducted among companies and public organizations in Finland, with 121 respondents. Data were analyzed using SPSS-28, employing Pearson correlations and descriptive methods. The study revealed an indirect association between digital stress and innovation capacity, with digital load and work engagement acting as mediators. However, a moderate correlation was observed between work engagement and innovation capacity. In summary, it can be suggested that moderate digital workload combined with good digital competence may have a positive association with eustress, work engagement, and innovation capacity.

**Keywords:** Digitalization, Technostress, Assessment, Online work

## INTRODUCTION

Digital stress, also known as technostress, is one of the most relevant issues related to digital transformation and the forthcoming super smart society 5.0 (Narvaez Rojas et al., 2021). At the same time, as digital transformation accelerates the platform economy and the use of data to find new data-based business opportunities, it has also encouraged people to work anytime and anywhere, resulting in perceived stress symptoms.

It has been noted that competition between companies is intense, requiring them to promote employees to generate novel ideas (Chen et al., 2016) while also managing the related work stress factors (Khedhaouria et al., 2017). Although digital transformation has been reported to improve organizations' productivity, it has also increased ethical challenges and employees' cognitive load, blurring the relationship between free time and work, thus leading to increased work stress (Stacey et al., 2018) and related negative stress symptoms such as anxiety (Salanova et al., 2013).

While digital overload has been shown to be associated with negative stress (distress), recent studies have indicated that digital work can also

increase so-called positive eustress and improve organizations' performance (Hargrove et al., 2013; Tarafdar et al., 2019). However, the mechanisms for eustress are diverse and not necessarily related to increased digital workload. Turja et al. (2023) reported that even increased digital workload can make work more satisfactory, whereas decreased workload due to digitalization can result in a bored employee. Hargrove et al. (2013) stated that stress factors are inherently neutral, and stress responses are dependent on individuals' resources. Therefore, we cannot define what kind of digital stressors and stress symptoms are associated with an employee's innovation capacity.

We can consider the Yerkes-Dodson stress theory (Cohen, 2011), job demands–resources theory (Gardner and Cummings, 1988), and the model by Turja et al. (2023), which indicates that there is an optimum area and workload when the performance and cognitive load of an individual are high, and they are motivated and able to innovate. However, we should also consider that digital overload as well as decreased digital workload associated with distress may activate individuals to create new innovations to achieve better working conditions and health. Montani et al. (2020) reported that moderate workload and employees' innovative behavior have an association through work engagement. They introduced the inverted U-shaped pattern, which replicates the Yerkes-Dodson stress theory (Cohen, 2011), and we can argue that perceived moderate digital stress is positively associated with good performance and the innovation capacity of an employee.

## THEORETICAL BACKGROUND AND RELATD FRAMEWORKS

The framework of the study encompasses both theories and concepts of digital transformation and stress. The framework of digital transformation (Kraus et al., 2021) defines how technology impacts the operations of organizations and society as a whole. Within the framework of digital transformation are concepts such as the platform economy (Kenney & Zysman, 2016) and organizational digital culture (Leal-Rodríguez et al., 2023), which define how an organization utilizes digital platforms and builds a positive culture conducive to digitalization.

A connecting factor between the frameworks of digital transformation and stress is the research of cognitive ergonomics (Kalakoski et al., 2020). Knowledge work utilizing digital platforms and systems is largely cognitive work, which may lead to technostress (La Torre et al., 2018). From the perspective of stress, the theoretical basis of the study is the Yerkes-Dodson stress theory (Cohen, 2011), where low and high levels of stress are believed to reduce an individual's performance, while moderate stress levels produce optimal performance.

Another theoretical basis is that stressors are neutral (Hargrove et al., 2013) and cannot be predetermined as producers of negative or positive digital stress; rather, the experience of stress effects as positive, neutral, or negative depends on an individual's cognitive ability to process stressors (Cartwright & Cooper, 1996). LePine et al. (2004), however, mention that stressors are not always neutral; they can either produce distress or eustress.

The terms digital stress and technostress are used interchangeably, and currently, research on technostress is primarily focused on examining stressors

and effects of IT systems. The origins of digital stress lie in stress research (Lazarus & Folkman, 1984) and technostress research (Salanova et al., 2013), where stress is understood as a factor negatively affecting well-being. Recently, there has been exploration into the positive effects of stress and technostress (Tarafdar et al., 2019), and it has been observed that increased digital workload can make work more enjoyable (Turja et al., 2023) and increase work engagement (Mäkiniemi et al., 2019). A key component of digital stress research is the measurement (Salanova et al., 2013) and anticipation of stressors and effects. There has been relatively little development of measures in this area (Porcari et al., 2023).

## MATERIAL AND METHODS

An online survey was conducted among employees who were using technologies at work. The respondents represented Finnish healthcare, education, and business sectors. The data were managed using MS Excel and SPSS-28 statistical packages. Statistical analyses were conducted using correlations and descriptive methods.

The dependent variables in the analyses were the sum variable of the Cohen-4 stress measure (Cohen et al., 1994) and the constructed innovation sum variable, which consisted of three following innovation questions: 1) perceived creativeness, 2) perceived ability to test new issues, and 3) perceived willingness to play with new ideas. The independent variables were selected from participants' background information and their attitudes concerning digital stress, technostressors, and technostress. Items on the creators of technostress were presented on a 5-point Likert scale with options ranging from strongly disagree to strongly agree. The perceived stress level was assessed with the Cohen-4 measure, which consists of four items on a five-point scale from 0 ("never") to 4 ("very often"). Although Cohen-4 has shown good internal consistency and reliability, it may not be the best option for assessing digital stress (Syvänen et al., 2022).

The number of respondents was 121, with 101 women and 20 men. The mean age of the studied population was 45.3 years (SD 10.2). The mean work experience was 18.0 years (SD 10.6). The mean perceived mental health was 7.7 (SD 1.8), and perceived physical health was 8.1 (SD 1.7) on a validated ten-point scale (Ilmarinen & Tuomi, 2004). The perceived stress level of the respondents was 4.6 (SD 2.8) on a 0 to 16-point scale, indicating a low stress level.

## RESULTS

From a theoretical standpoint, the Yerkes-Dodson stress theory (Cohen, 2011) and the inverted U-shaped pattern identified in the research by Montani et al. (2020) suggest that moderate workload may enhance work engagement, innovative behaviour, and work performance. Both models indicate that both low and excessively high workloads or stress levels may result in poor performance and innovation. However, there are numerous mediating factors, and the concept of workload should be defined and investigated

more precisely. Both theories assert that an increase in workload is not necessarily negative for employees if the workload and associated stress do not exceed the optimal level (see Figure 1).
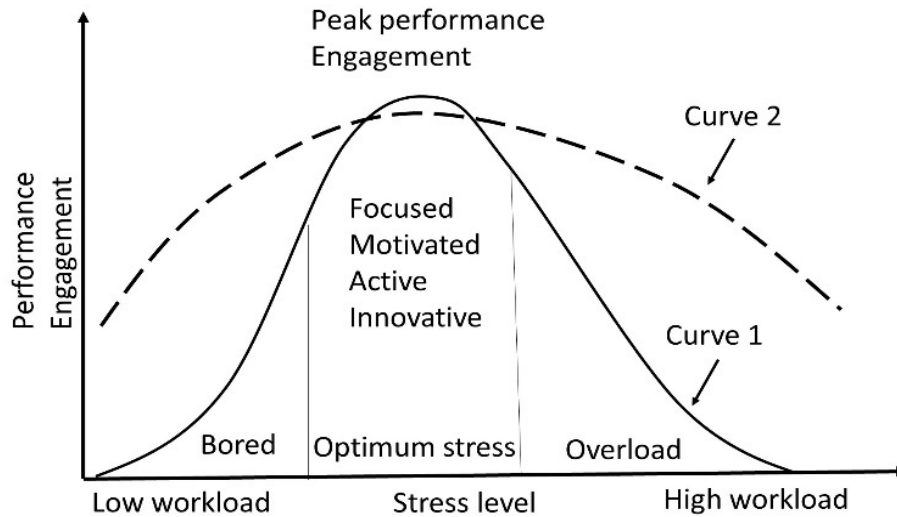


**Figure 1:** Combined stress, performance and engagement curves. Modified from Montani et al., 2020 (Curve 2) and Cohen, 2011 (Curve 1).

The impacts of global digital transformation were identified from the participants' survey responses. Table 1 presents the attitudes of participants toward the future trend of digitalization concerning their work and organization. The respondents agreed that digitalization will change their work tasks and organizations' processes in the near future. The majority, approximately 65% of the respondents, perceived that digital transformation is positive but may require a good introduction and training regarding the use of new technology. However, about 20% of respondents stated that digital transformation is a negative issue.

**Table 1.** Mean values of attitudes towards digital transformation on five-point scale. 1 = strongly disagree, 5 = strongly agree. (N = 121).

|  | Mean | SD |
|---|---|---|
| Impact of digitalization on work tasks is positive | 4.02 | 0.89 |
| Digitalization may change my work tasks in near future | 3.88 | 0.98 |
| Digitalization will be developed in our organization within next 3 years | 4.15 | 0.80 |
| Digitalization is a part of our organization's future | 4.21 | 0.74 |

Table 2 presents the Pearson correlations between perceived workload, stress, work engagement, competence, innovation capacity, and other relevant factors. There appears to be a negative correlation between perceived stress and the competence to use digital tools, indicating that competence may reduce digital stress. Additionally, work engagement decreases digital

stress, while an attitude that digital technology is strenuous correlates positively with perceived stress. The digital workload resulting from systems or tools, or the number of technical tools did not show a significant correlation with perceived stress. Innovation capacity appears to correlate positively with the possibility to use digital tools and with work engagement.

**Table 2.** Correlations between workload, stress, work engagement, and other factors (N = 90).

| | | Innovation Capacity | Competence to Use Digital Tools | Possibility to Use Digital Tools | Perceived Stress | Work Engagement | No. of Technical Tools | No. of Digital Systems | Digital Load |
|---|---|---|---|---|---|---|---|---|---|
| Innovation capacity | R | 1 | 0.170 | 0.262$^*$ | −0.142 | 0.260$^*$ | 0.262$^*$ | 0.237$^*$ | 0.118 |
| Possibility to use digital tools | R | 0.262$^*$ | 0.597$^{**}$ | 1 | −0.116 | 0.144 | −0.018 | 0.031 | 0.097 |
| Perceived stress | R | −0.142 | −0.325$^{**}$ | −0.116 | 1 | −0.436$^{**}$ | −0.030 | 0.216$^*$ | 0.279$^{**}$ |
| Work engagement | R | 0.260$^*$ | 0.284$^{**}$ | 0.144 | −0.436$^{**}$ | 1 | 0.277$^{**}$ | 0.083 | −0.069 |
| no. of technical tools | R | 0.262$^*$ | −0.045 | −0.018 | −0.030 | 0.277$^{**}$ | 1 | 0.547$^{**}$ | 0.446$^{**}$ |
| no. of digital systems | R | .237$^*$ | −0.108 | 0.031 | .216$^*$ | 0.083 | 0.547$^{**}$ | 1 | 0.534$^{**}$ |
| Digital load | R | .118 | −0.110 | 0.097 | 0.279$^{**}$ | −0.069 | 0.446$^{**}$ | 0.534$^{**}$ | 1 |

Pearson's correlation.**Correlation is significant, p <0.01, *Correlation is significant, p < 0.05 (2-tailed)

Table 3 presents the correlations between perceived stress, perceived competence, attitudes towards digital transformation, creativity, and other factors related to work. The competence to use digital systems correlates negatively with perceived stress, as does a positive attitude towards digital transformation. Additionally, perceived creativity shows a weak but significant negative correlation with perceived stress. All positive attitudes towards digital work appear to decrease perceived stress. Furthermore, we found no significant correlation between perceived stress and age or work experience. However, perceived mental work ability (R = −0.62, p < 0.01), physical work ability (R = −0.39, p < 0.01), and health (R = −0.42, p < 0.01) exhibited significant negative correlations with perceived stress.

**Table 3.** Correlations between stress, competence and other factors (N = 121).

| | | I Feel Energetic | Work Inspires Me | Competence (Digital Systems) | Digital Transformation is Posivite | Digital Systems are Streneous | We are Creative |
|---|---|---|---|---|---|---|---|
| Perceived stress | R | −0.367$^{**}$ | −0.381$^{**}$ | −0.362$^{**}$ | −0.209$^*$ | 0.358$^{**}$ | −0.195$^*$ |
| Age | R | 0.203$^*$ | 0.166 | −0.128 | 0.005 | 0.209$^*$ | 0.089 |
| Work experience | R | 0.072 | 0.023 | −0.095 | −0.006 | 0.132 | 0.055 |

Pearson's correlation.**Correlation is significant, p < 0.01, *Correlation is significant, p < 0.05 (2-tailed)

## DISCUSSION

The digital transformation is an emerging yet multidimensional topic among companies and public organizations. It is evident that digital transformation impacts all organization's business processes and employees' work tasks. The use of digital platforms, APIs, and digital tools is already prevalent, but new technologies such as the effective use of AI will be the next step in digital transformation. It has been well-reported that digital technology improves organizational performance and productivity but may also increase employees' cognitive load and affect their health (Stacey et al., 2018).

Traditional technostress research has shown that an increased digital load may increase stress and related symptoms such as anxiety (Salanova et al., 2013). However, recent technostress or digital stress research suggests that increased digital load is not always detrimental and can lead to positive outcomes such as better work satisfaction and productivity (Turja et al., 2023). The association between increased digital workload and digital stress is related to an employee's current digital workload, work tasks, competence, and available technology.

Digital workload as a stressor is inherently neutral (Hargrove et al., 2013), but an employee's stress response depends on their competence and the organization's digital culture, strategies, processes, and available digital systems and tools. Too many dysfunctional systems or digital tools may decrease employees' motivation to utilize digital technology. The digital culture of the organization plays a crucial role in how organizations perceive digital transformation and how they make use of novel digital technology. Montani et al. (2020) reported that competition between companies is fierce, and organizations must find ways to promote employee innovation and idea generation while also managing workload to avoid stress.

In this study, we combined the Yerkes-Dodson stress (Cohen, 2011) and workload-work engagement theories (Montani et al., 2020), which suggest that moderate workload is positive for performance, work engagement, and innovation capacity. The results showed associations between innovation capacity and work engagement. Perceived digital stress was not directly associated with innovation capacity, but perceived stress had a significant association with workload, work engagement, and an employee's competence. Therefore, we can suggest that moderate digital workload with good digital competence may have a positive association with eustress, work engagement, and innovation capacity.

## CONCLUSION

The combination of the Yerkes-Dodson stress theory (Cohen, 2011) and workload-work engagement theories (Montani et al., 2020) provides new insights for designing organizations' workloads and employees' tasks. Moderate workload may be associated with positive eustress and opportunities for generating novel innovations. It can be concluded that the association between digital stress and innovation capacity is multidimensional and warrants further research. Digital stress should also be assessed using objective methods (Awada et al., 2023), and perceived workload should be evaluated

more precisely. However, digital transformation impacts all organizations, and positive digital stress, eustress, can enhance organizational performance.

## ACKNOWLEDGMENT

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