VILNIUS TECH
Vilnius Gediminas Technical University

12th International Scientific Conference

BUSINESS AND MANAGEMENT 2022

May 12–13, 2022, Vilnius, Lithuania

ISSN 2029-4441 / eISSN 2029-929X
ISBN 978-609-476-288-8 / eISBN 978-609-476-289-5
Article Number: bm.2022.737
https://doi.org/10.3846/bm.2022.737

BUSINESS TECHNOLOGIES AND SUSTAINABLE ENTREPRENEURSHIP *http://vilniustech.lt/bm*

IDENTIFICATION OF HUMAN FACTORS AND USER EXPERIENCE IN A REMOTE ENVIRONMENT

Harikrishnan KODERI, Vladimirs ŠATREVIČS*, Irina VORONOVA

Faculty of Engineering Economics and Management, Riga Technical University, Kalnciema 6, Riga, Latvia

Received 25 January 2022; accepted 24 March 2022

Abstract. The pandemic had caused a worldwide disruption introducing new and extraordinary challenges. Social distancing and new protocols ensuring safety for people derived new models of work environments. Moreover, when we deal with our physical health, introducing new ways to interact and work in this new remote covid workflow it is also essential to take care of our mental health. Globally, due to the new adjusted routines in all aspects had opened a new remote world. The research identified human factors and user experience influencing the remote environments, there is a significant negative relation between stress and user experience while working in a remote environment. High stress levels result in poor user experience. Moreover, the findings also reveal us Human interface in a remote set up is bringing the most dissatisfaction and contributes to stress in a human-machine level. Furthermore, the different aspects of stress were also categorised and identified in the study.

Keywords: human factors, user experience, stress, workplace stress, remote environment.

JEL Classification: Q44, Q47, J28, L15, D23, D24.

Introduction

The effect of the Covid-19 on the world is unfathomable, moreover, if we look more specifically it is hard to explain and comprehend different industries and the impact of pandemic. Each industry had their great share of damage.

Lockdowns and quarantines have pushed millions of people to adopt work from home while the virus broke through the technological and cultural barriers of remote workers. In contrast, half of the work cannot adopt remote work as it requires collaborating with others or usage of machinery which are at a risk from digitalization and automation. Nonetheless, remote work has proven to be more efficient than done in person during the pandemic where people are confined in their homes. The consumption patterns of remote workers may also vary as they only require less expense on transportation, lunch, and wardrobe suitable for office use. On the other hand, undisturbed internet connectivity and quality equipment are a necessity for an efficient remote working experience.

The research aim is to identify the human factors and user experience of remote environment models to that of a regular office environment.

The research is directed at finding the human factors and user experience of people working in a remote environment. This exploratory research aims to highlight the significant factors that are responsible for the stress levels and user experience when working in a remote environment. A quantitative approach is adopted for the research. The prime factors that determine human factors and user experiences were gathered using a bibliometric analysis of scientific journals and research papers. The questionnaire for the survey was formed using the help of factors that were identified using the bibliometric analysis.

Our aim is to identify the correlations and relationships between human factors and user experience in the context of stress in a remote environment. Sawyer explained human factor as a study that develops and enhance maximum performance by facilitating the optimal requirements with the needed hardware and software design (Sawyer, 1996). They improve the equipment and resources for better work efficiency.

* Corresponding author. E-mail: *vladimirs.satrevics@rtu.lv*

1. Human factors and user experience in remote environment models

The study of Human factors is very closely related to system interface. Better human interface accelerates good user experience. A complex interface that are puzzling and complicated can prompt serious errors. Scientists (Law et al., 2009) stated the definition of user experience (UX) as "A person's perceptions and responses that result from the use or anticipated use of a product, system or service". User experience and user interface are very closely related. The human machine interaction, the human interface determines the experience of the user. It is of at most importance to accommodate the requiring range of user capabilities for a smoother operation. An organization should ensure that their infrastructure and interface are within this standard and provide the optimal User experience. Hence, these terms Human factors are closely correlated. Organizations study these effects and optimize their efficiency and effectiveness.

When an organization fails to meet the expectations and satisfy the employees, they will experience stress. Moreover, stress can invoke adverse effects on the organization. (Mohammad Mosadeghrad, 2014) explains on an organizational level, stress influence the performance of the individual and takes a decreasing toll on job satisfaction and commitment towards the job (see Figure 1).

Stress is generally understood as a byproduct of the imbalances caused when the environmental demands exceed individual resources. This study will apply both human factors and user experience that causes individual stress.

The authors design a conceptual framework (Figure 2, UI – User Interface) that explains the effect of stress on employee's outcome.

The transition in the technology had improved the overall system usability and experience into whole new levels, designs that are concentrating more on the portability and the compatibility of the devices. Kaindl (2020) discussed the new challenges and providing solutions relating to the major shift in the devices with new human interfaces. Samara et al. (2018) highlights the importance of designing and building a system interface

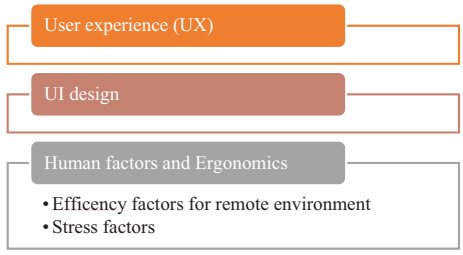

Figure 2. Conceptual framework of remote environment (source: created by authors)

that is capable of adaptive human-computer interaction (HCI) and digital empathy which is like human-human interaction which boosts user task completion and user engagement. The paper focuses on the adaptive intelligent interaction and detection of user's emotion with the next generation of the machines. Peruzzini and Pellicciari defined the definition of user experience to be "The entire set of affects that is elicited by the interaction between the user and product, that consists of all aspects in which all senses are satisfied (aesthetic experience), the meaning s we attach to the product (experience of meaning), and the feelings and emotions that are elicited (emotional experience)" (Peruzzini & Pellicciari, 2018).

1.1. Bibliometric Analysis of Human factors and user experience in remote environment models

To find the relevant information and credible resources for the study of Human factors and user experience in remote environment models, a systematic bibliometric analysis was carried out. The search was done in Scopus scientific database. Firstly, the basic parameters were defined as the following: search by the name, by the period of the time the paper was published (1990–2021), type of documents analysed – "articles" and "conference papers". Using the keywords "Human factors" AND "User experience", "Workplace Stress" were searched using the Scopus scientific database. The bibliometric analysis is carried out using the help of Microsoft office Excel and VOS viewer. The total search results were 549 documents from both the keywords. According to analytic data from Scopus database out of 549 papers, the major share of

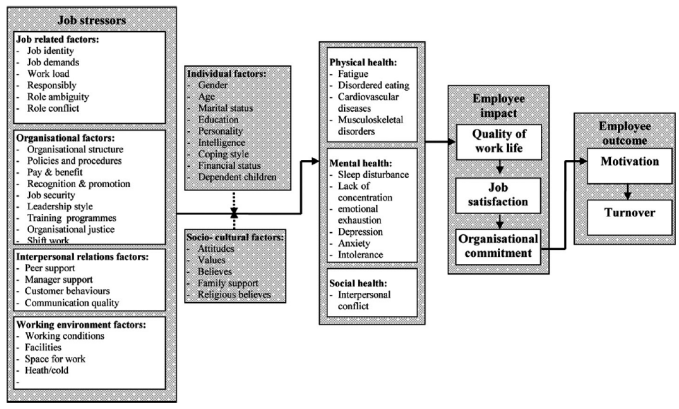

Figure 1. Conceptual framework of relationships among occupational stress and employees' outcomes (source: Mosadeghrad, 2014)

the results or publications were found under Computer science of about 332 articles (33.6%), Engineering 214 articles (21.6%), social sciences of about (17.1%). These are the primary categories that consists of the most relevant publications for our work.

To narrow down the number of articles, it is important to evaluate and categorize the articles obtained in the primary search – Figure 3.

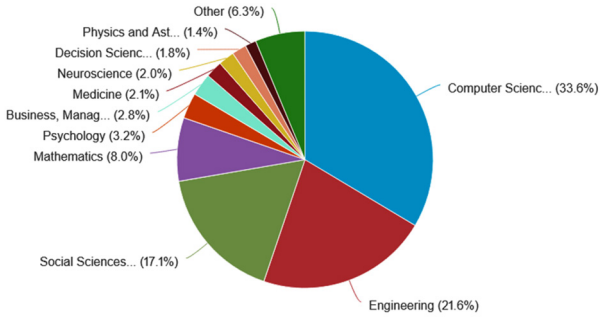

Figure 3. Documents by subject area
(source: Scopus data base)

It is clearly indicated that almost 10 authors have been contributed, the Figure 2 shows the authors that contributed the most for the relevant articles and journals for our research. The highest contributions were from the author Peruzzini, M, he had contributed about 8 papers. Secondly, Pellicciari, M. contributed about 6 papers tallied with Von Niman, B who also contributed 6 papers for the associated keywords – Figure 4.

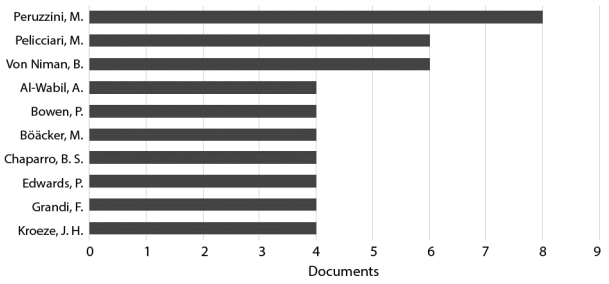

Figure 4. Documents by authors
(source: Scopus data base)

In total of the 549 articles that are related to our search, the country with the most contribution is United States about 192 articles from the period of 1990 to 2021. The other countries with most publications after United States are Germany and China. The Figure 5 depicts a network of total 85 countries. The greatest number of articles were originated from the United States (Red cluster, 196 documents). The other clusters are comparatively less in number compared to the red cluster.

The cluster associated with the item 'User Experience' IS selected as relevant for forming the framework. The Figure 6 below shows the bibliometric map of co-occurrence of the most significant factors selected for our research.

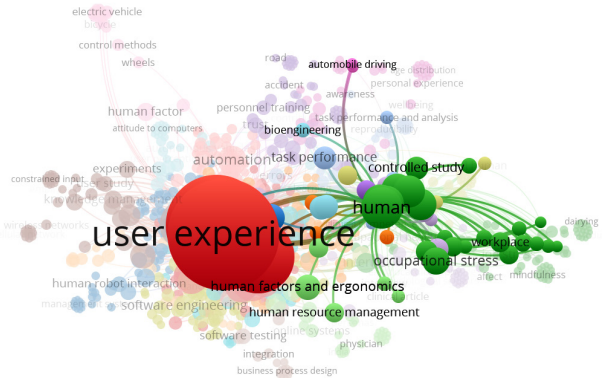

Figure 6. Cluster of critical keywords
(source: by VosViewer in Scopus)

From the chart based on the importance and size of the circles and strengths of the relationships represented by the lines are:

- Red cluster: User experience, Human factors, and User interface.
- Green cluster: Human, occupational stress, human factors, and ergonomics.
- Blue cluster: User experiences UX, Industrial research.
- Violet cluster: Stress, workplace.

The most important and viable resources were from the red cluster as it covered most of our search keywords.

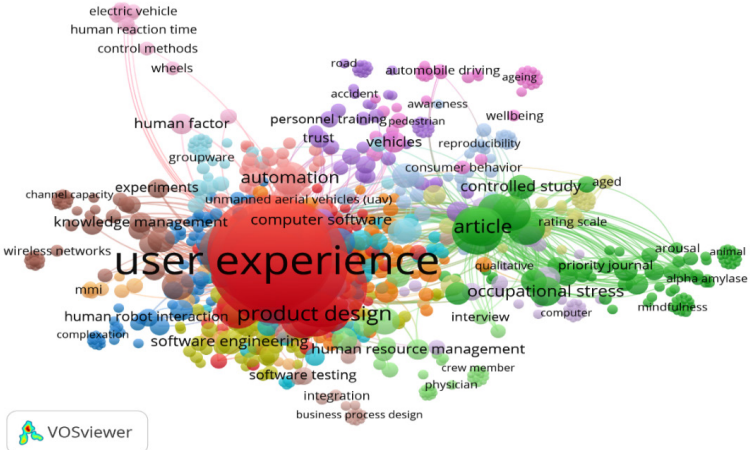

Figure 5. Cluster of keywords (source: by VosViewer in Scopus)

Table 1. Essential features of Human factors and user experience in remote environment models (source: research results)

No.	Groupers	Description of the parameter used for the analysis	Authors
1	Human-machine Factors	Human interfaces, usability problems, user centred and usage entered design. Interaction design. Multimodal interfaces. Mobile devices. Human-Robot interaction. Accessibility and interactive products. User experience, system usability. System usability scale (SUS). Usability metrics: task success and time on task. Usability and User experience. Experience levels. Source orientation. Autonomous entities, Human factors. User interaction. Networked environments, user-centered technologies. Usability and reliability. Context-aware interactions. Sustainable manufacturing. User satisfaction, product design. Workstation Ergonomics. Usability of tools, devices, and interfaces. Visual requirements and postural comfort. Ease of use. Sustainability oriented design. User building interaction. Unified task-representative interface. User-building interface. Building interaction design; (cause-effect postulates operation protocol, and stake holder objectives). Allocation of control. Recommender system, uncertainty, and risk. User perplexity	(Kortum & Johnson, 2013), (Akbar et al., 2019), (Kaindl, 2020), (Solomon & Wash, 2000), (Peruzzini & Pellicciari, 2018), (Kalvelage & Dorneich, 2014), (Valdez et al., 2016), (Samara et al., 2018)
2	Occupational factors	Occupational stress inventory. Effectiveness, efficiency, and satisfaction. Occupational stress. Decision latitude. Job type. Commitment. Stress management. Overall work stress. Absenteeism. Health care costs. Worksite stress management. Occupational safety. Coping strategies. Occupational attributional style. Lay representations. Role ambiguity, Role conflict and Role overload. Stress management training. Lack of opportunity, inadequate salary. Occupational stressor. Attitude towards change	(Arthur, 2005), (Briner, 1994), (Denny et al., 2011), (Eisen et al., 2008), (Kinman & Jones, 2005), (Kortum & Johnson, 2013), (Mensah et al., 2021), (Vagg et al., 2002), (Vakola & Nikolaou, 2005), (Welbourne et al., 2007)
3	Indirect factors	Affective cost: attitude, feelings, and interests of workers. Risk Behaviors: Smoking habits, high blood pressure and irregular sleep patterns. Depression and dissatisfaction items. Accomplishment, connection, identity, and sensation. Attention, mental representations, mental models. Social pressure. Anxiety, Depression. Mental Health problems. Nervousness, Social isolation. Social behavior. Family relationships	(Akbar et al., 2019), (Denny et al., 2011), (Kaindl, 2020), (Solomon & Wash, 2000), (Arthur, 2005), (Kinman & Jones, 2005), (Vagg et al., 2002)
4	Occupational factors	Occupational stress inventory. Effectiveness, efficiency, and satisfaction. Occupational stress. Decision latitude. Job type. Commitment. Stress management. Overall work stress. Absenteeism. Health care costs. Worksite stress management. Occupational safety. Coping strategies. Occupational attributional style. Lay representations. Role ambiguity, Role conflict and Role overload. Stress management training. Lack of opportunity, inadequate salary. Occupational stressor. Attitude towards change	(Kortum & Johnson, 2013, pp. 197–201), (Denny et al., 2011, pp. 93–103), (Arthur, 2005, pp. 273–280), (Eisen et al., 2008, pp. 486–496), (Welbourne et al., 2007, pp. 312–325), (Kinman & Jones, 2005, pp. 101–120), (Mensah et al., 2021, pp. 29–42), (Vakola & Nikolaou, 2005, pp. 160–174)
5	Organizational factors	Overloading, efficiency. Cognitive tasks: multitasks and serial tasks. Workplace stress. Temporal costs, Temporal affects. Time available to complete the task; poor communication and feeling unsupported at work. Security; troubleshooting; recommender systems. Stress in workplace settings. Efficacy of workplace. Self-reported stress, perceived stress scale, daily stress inventory and experience sampling. Stress management. Stress Reduction. Personal, environmental, and societal factors. Workload; quantitative and qualitative workload. Situational constraints (red tape, bureaucracy, faulty equipment, inaccurate information). Social characteristics of workplace. Interpersonal conflicts, abusive supervision, Organizational politics. Effect of stress on gender levels in an organization. Job stress survey. Organizational commitment, organizational change. Handling conflicts, building supportive work relationships and effective communication	(Akbar et al., 2019), (Arthur, 2005), (Denny et al., 2011), (Kortum & Johnson, 2013), (Solomon & Wash, 2000), (Eisen et al., 2008), (Kinman & Jones, 2005), (Mensah et al., 2021), (Vagg et al., 2002), (Vakola & Nikolaou, 2005), (Cooper & Cartwright, 1997)
6	Physiological factors	Postural stress, musculoskeletal disorders, and visual fatigue. Stress monitoring. Health problems. Autonomic Nervous system, sympathetic nervous system; sympathetic activation. Unobtrusive stress. Abbreviated progressive relaxation training (APRT). Acute physical problems. High cholesterol and cardiovascular diseases	(Charpe & Gupta, 2019), (Akbar et al., 2019), (Denny et al., 2011), (Eisen et al., 2008), (Briner, 1994)
7	Cognitive factors	Psychological job strain, job strain. Psychological job demands, social support, job insecurity and psychosomatic strain. Cognitively demanding tasks, social pressure, and interruptions. Memory and emotion expression biases. Job satisfaction. Cognitive restructuring. Job control, decision making process. Career related concerns. Lack of learning and advancement opportunities. Work interference with no-work domains. Job conditions. Acute stressors. Cognitive behavior therapy. Job requirements. Job future	(Akbar et al., 2019), (Kortum & Johnson, 2013), (Welbourne et al., 2007), (Kinman & Jones, 2005), (Mensah et al., 2021), (Briner, 1994), (Vagg et al., 2002), (Cooper & Cartwright, 1997)

The following table listed below was constructed referring to relevant journals. Based on these literatures, the factors that influenced these categories were identified.

According to the Table 1 essential features were distinguished as the most significant:

- Human machine factors;
- Indirect factors;
- Organizational factors;
- Occupational factors;
- Physiological factors;
- Cognitive factors.

2. Research methodology and results

Research started with secondary data collection, a systematic bibliometric analysis was done to find out the relevant scientific journals. The Data collected was compared, related, and analysed. After the research of appropriate scientific journals important factors were identified. Factorial analysis was done to reduce the data and find out the most significant factors with the help of SPSS software. The factors identified were used to develop the questionnaire for the survey.

The figure below depicts the research design (Figure 7). The research is directed at finding the human factors and user experience of people working in a remote environment. This exploratory research aims to highlight the significant factors that are responsible for the stress levels and user experience when working in a remote environment.

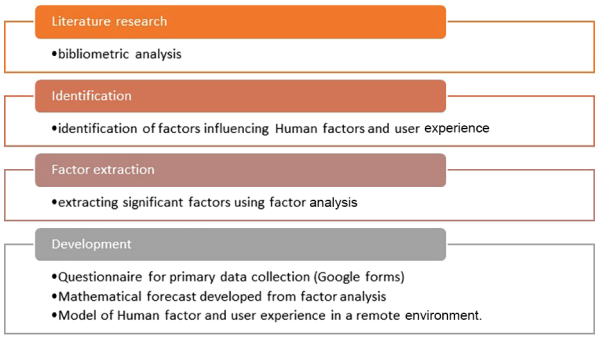

Figure 7. Research design (source: created by authors)

The questionnaire for the survey was formed using the help of factors that were identified using the bibliometric analysis. Primary data collection for this academic research was carried out with the help of online survey developed with the help of google forms in Kerala region of India. The questions for the survey are developed with the help of the factors obtained from the bibliometric analysis. The survey questionnaire mainly aims to understand the attitude and perspectives of the respondent group towards the remote work and digitalization factors during Pandemic period. The online survey is conducted through the online platforms like Facebook, Instagram, and WhatsApp in 2021 February.

The main methods of data analysis used in the research are descriptive analysis and factorial analysis.

2.1. Profiles of respondents and descriptive statistics

Descriptive statistics is an analysis used in summarizing a group of data. The data was collected using a questionnaire survey. The survey consisted of demographic questions and 36 questions, out of which 26 questions were about the factors that were acquired conducting bibliometric analysis and 10 about opinion on remote environment efficiency during Pandemic (Appendix 1). The total number of respondents were 159 of which 49.1% were in the age group of 18 to 25 years, 33.3% were in the age group of 26 to 40 years, 17% were 41 to 60 years and just 0.6% more than 60 years of age. The bibliometric analysis helped us identify the most significant and relevant factors for the research, a total of 26 factors are chosen and responses of 10 factors are analysed and explained the sections below.

User experience is an essential factor that determines the Human-machine interaction. It is how a person interacts and collaborates with the system, service, or a product. The question "On a scale from 1 to 5, how stressful was the user experience working remotely compared to that of a regular office environment? The Figure 8 illustrates the response from respondents who worked in a remote environment.

The analysis from the results comprehends that 8.8% of the respondents were very highly stressed and 24.5%

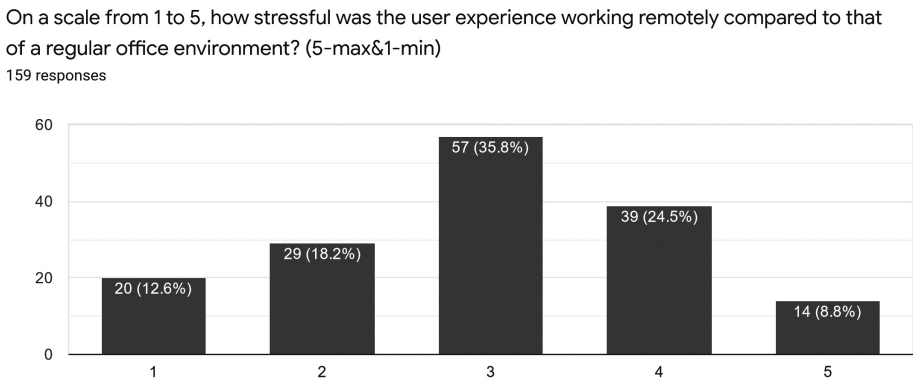

Figure 8. Response for User Experience (source: research)

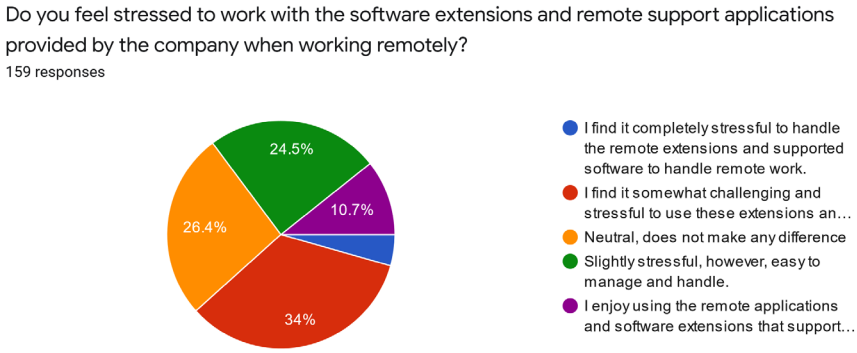

Figure 9. Response for User Interface (source: research results)

of them also experienced high stress levels, 35.8% were neutral and only a 12.6% of them did not feel any stress due to the user experience in a remote model.

A human interface provides the space for a human to interact with machine. Human interface is one of the most significant factors that should be analysed as remote environments does not facilitate the optimal and required interface. To assess the stress levels on human interface due to the remote set up question was asked "Do you feel stressed to work with the software extensions and remote support applications provided by the company when working remotely?" The result from the survey is illustrated in Figure 9.

The results indicate that almost 40% of the respondents agreed they were highly stressed due to the user interface and the office set up in a remote environment. 26.4% of them were neutral and only a 10.7% of them did not feel any stress rather enjoyed remote interface. Human interface by these remote apps and extensions failed to provide a good configuration and better usability unlike the resources in the office. Efficiency is a crucial a factor for any organization to be successful. The drift from the regular office environment to a remote set up would have unpredictable effects on the overall efficiency of employees or workers.

To identify the impact of this remote environment on efficiency question was asked "How do you feel when working from home regarding the overall efficiency compared to working from the office?" The respondents' results are illustrated in Figure 10. Other descriptive analysis could be found in Appendix 1.

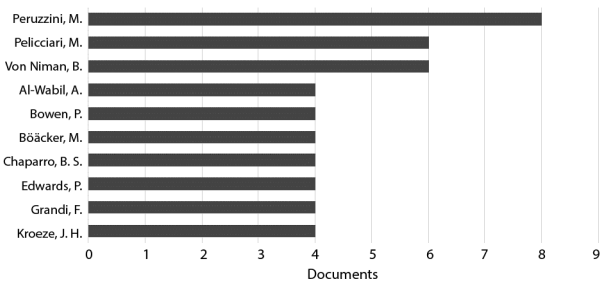

Figure 10. Response for Efficiency (source: research results)

2.2. Quantitative model for evaluation of human factors in remoter environment and correlations analysis

The next important phase of the research is the development of a model. The results from the factor analysis in SPSS are presented below.

Table 2. Respondent statistics (source: research results)

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.872
Bartlett's Test of Sphericity	Approx. Chi-Square	1878.273
	df	325
	Sig.	.000

The Table 2 displays that Kaiser-Meyer-Olkin measure of sampling adequacy achieved is 0.872 and it is higher than 0.50. This indicates that the generated data is suitable for factor analysis. The obtained value is of significance is less than 0.00 which is lower than 0.05 which implies the data can be subjected to reduction. From the Table 2 our obtained value 0.872 is in meritorious level.

The principal component analysis displayed the presence of 5 components with eigen values more than 1. The first 2 components explained the highest eigen values, 33.03% and 10.049% respectively (Appendix 3).

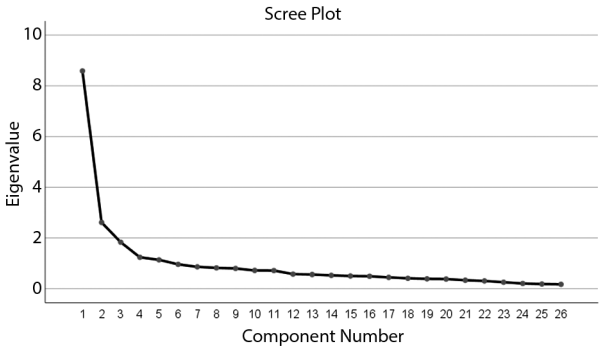

Figure 11. SPSS output for the scree plots generated (source: created by authors)

The scree plots are formulated using SPSS, the graphs indicate that the first 5 components are having eigenvalues more than 1. This scree plots shows us that eigenvalues start to form a straight line after component 5. This implies that the remaining components only account for a very small ratio of the variances and hence they are not that significant. This helped us to consider the first 5 components that had the highest eigenvalues more than 1 (see Figure 11).

In this step of principal component analysis, the factor loading matrix is displayed in Appendix 2. We acquire the variances of each principal component (Appendix 3). For factor reduction, we only extract first few principal components. The first component comprise of almost 34% of total cumulative contribution. Therefore, only the first 5 components are the most significant and rest of them are off lower significance. The Figure 12 below shows detailed correlation inside the most significant component 1 generated by SPSS software.

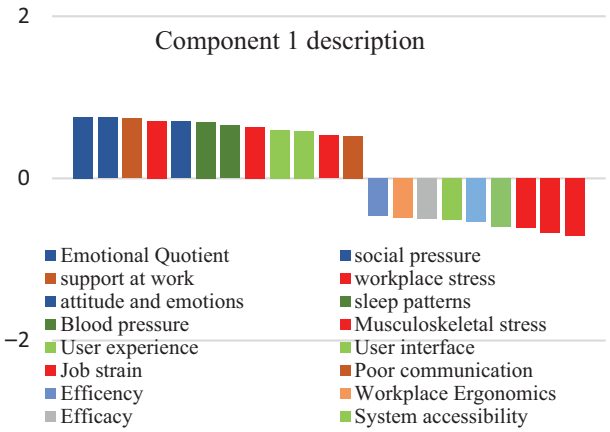

Figure 12. SPSS output for the scree plots generated (source: created by authors)

Factors with loading value more than 0.4 are considered for naming the components in the component matrix. From the first component chart the factor with most loading values in a positive magnitude are Emotional quotient (0.760) and Social Pressure (0.753). Similarly, on a negative magnitude, factors such as Decision latitude (–0.705) and Duration of work (–0.669).

With the help of factor analysis, the total number of factors were reduced to fewer factors. Moreover, it helped us to determine the 5 major components that are discussed above. Key results from the analysis on each component were made. Mathematically we can represent the model for human factors and user experience in remote environment can be given as:

$$Y = 0.33C_1 + 0.11C_2 + 0.07C_3 + 0.043C_4 + 0.04C_5 + 0.4C_n, \quad (1)$$

where: C_1 – Ergonomics factors of User Interface 1; C_2 – Work environment 2; C_3 – Efficiency 3; C_4 – Component 4; C_5 – Component 5; C_n – All other insignificant factors with less variances; Y –overall significance of human factors in remote environment.

The Figure 13 explains a conceptual model in a remote environment with major components explanation. From our hypothesis we have concluded that human interaction is not bringing the most dissatisfaction during remote environment, but User interface causes the most dissatisfaction.

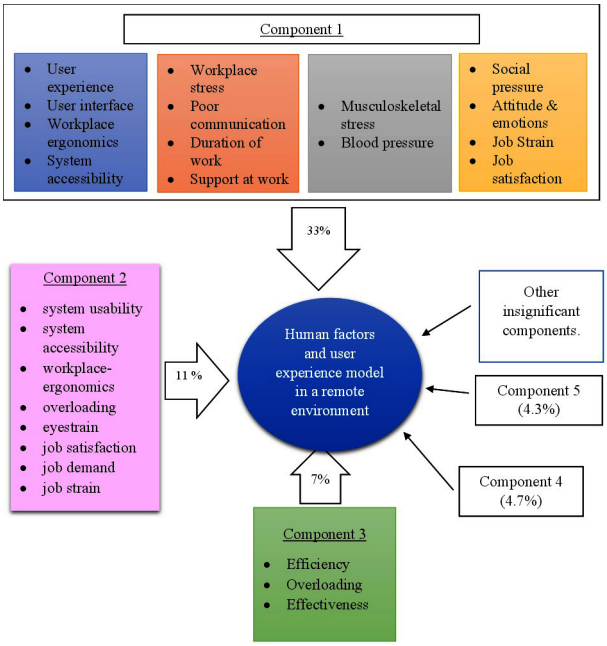

Figure 13. Conceptual model (source: created by authors)

The conceptual model indicates that human interface or user interface causes stressful experience. Other types of stress are also mentioned in the figure. All these factors influence the user experience while working remotely.

The gap identified from the literature review tells us that, the amount of similar studies is very limited and relatively new. Hence, a proper investigation on remote environments and their consequences are of great scope. Scientist (Marsh et al., 2022) are proposing their studies as "first integrative review conducted across the dark side of the digital workplace". And pointing that "greater use of a range of other theories in the dark side literature would also contribute to the theoretical diversity in this domain". Other authors (Thuillard et al., 2022) also naming their research as "our studies were one of the first that examined the influence of negative performance feedback".

Conclusions

The present paper has provided a detailed framework for prioritization of factors based on the empirical example for the specific situation in India. From our hypothesis we have concluded that human interaction is not bringing the most dissatisfaction during remote environment, but User Interface does. The Covid-19 had made unpredictable changes globally and ruled out the common

norms of office and opened a new remote realm where these factors also have a significant influence. Literature analysis identified six different categories, which influence on the human factors and user experience in terms of stress and its associated factors. The corresponding categories are Human machine interaction, indirect factors, organizational factors, occupational factors, cognitive factors, and physiological factors. The scientific literature highlighted the significance of each category, starting with human machine interaction. Human factors and human interaction both explains user experience and user interface. The terms User experience and Human experience are very related, logically they are simply directly proportional to each other due to digital transformation, a better user interface gives us a better user experience and human interaction since it is remote.

Empirical research helped us illustrate the perspective of workers who experienced the shift from a normal office to a remote environment. The following conclusions can be made to formulate a conceptual framework identifying the human factors and user experience in a remote environment model.

- People working in a remote interval are exposed to high stress levels.
- User interface brings the most dissatisfaction among the users in a remote environment.
- Human interaction is not bringing the most dissatisfaction among the users working in a remote environment.
- Stress can be explained in various levels, human-machine factors, indirect factors, physiological factors, cognitive factors, and occupational factors.

In general, the results displayed people were stressed overall. High level of User Interface contribution to stress is expressed by slow internet connection, inadequate system specification and task requirements being one of the major reasons for maximum stress. Factor analysis was carried out to reduce the data, there were a total of 26 factors correlation that should be analysed. The principal component analysis helped us to extract these 26 factors and were reduced to mainly 5 significant components. The first component showed the maximum variance of about 33% of the total weight (Ergonomics factors of User Interface). Taking the first component into consideration we analysed the most significant factors that were loaded both positively and negatively. The following conclusions were made from the research:

- Empirical research findings based on factor analysis proved that weak User Interface is bringing the most dissatisfaction.
- People who are working in remote environments are exposed to high stress levels.
- Human interaction and human interface are correlated to each other, in a remote environment due to the poor system set up and lack of resources, people had a stressful user experience compared to regular environment.
- Attitude and emotions affect the user's when working remotely compared to that of a regular set up. When user is exposed to high stress levels, they tend to be inefficient while making decisions in a remote environment. This implies cognitive stress and attitude, and emotions are negatively correlated.

When comparing with similar studies in (Marsh et al., 2022) it is also pointed to "technology-related stress, overload, anxiety, interruption and distraction, addiction and excessive use". Similar research (Thuillard et al., 2022) also supporting that "negative computer feedback was perceived as more unfair than human feedback". They stating that "perceived lack of fairness may possibly lead to counterproductive behavior in the workplace, ultimately impairing performance". Another newest study on stress (Taser et al., 2022) also underlining "technostress and loneliness" as major factors, also pointing "to the reduction of technology-induced employee stress" as major contribution to outcomes.

The following practical recommendations were made from the research results – promotion of social support is an important factor that helps employees to cope up with stress and reduce the effects of stress, pandemic making this social interaction difficult through digital communication, it is important the organization ensures a range of mechanisms that can help and assist, encourage, providing sufficient information, appreciation, emotional support etc. Most importantly by supporting a healthy environment where employees can seek for any support or assistance. The importance of assessing workloads and work assignments. Overloading can contribute greatly to feeling stressed thus it is at most priority to redistribute and regulate the work in context of remote environment. Studies shows people feel more overloaded when working in a remote set up thus reviewing the tasks and ensuring the employees only get appropriate amount of work will help to reduce the stress from overloading. An organization should ensure they provide and facilitate with sufficient resources to work remotely with proper software and tool extensions that are not hard to understand and use. Moreover, user interface and user experience were two significant factors which influenced stress. Thus, it is of prime importance to have an efficient tech support with frequent feedbacks from the users.

Additionally it is recommended that Human resource managers and supervisors, to provide awareness against the musculoskeletal disorders and postural stress. Due to the lack of appropriate workplace ergonomics, people experience these disorders. Hence, it is important to conduct awareness sessions, maintain a healthy lifestyle and on how to exercise at home to prevent these ill effects. Organizations should arrange psychological support initiatives by paying attention to the workers needs and problems. Implementing support services and educating the employees with self-calming techniques.

References

Akbar, F., Mark, G., Pavlidis, I., & Gutierrez-Osuna, R. (2019). An empirical study comparing unobtrusive physiological sensors for stress detection in computer work. *Sensors*, *19*(17), 3766. https://doi.org/10.3390/s19173766

Arthur, A. R. (2005). When stress is mental illness: A study of anxiety and depression in employees who use occupational stress counselling schemes. *Stress and Health*, *21*(4), 273–280. https://doi.org/10.1002/smi.1069

Briner, R. B. (1994). Stress management and counselling stress management at work: With whom, for whom and to what ends? *British Journal of Guidance & Counselling*, *22*(1), 75–89. https://doi.org/10.1080/03069889408253667

Cooper, C. L., & Cartwright, S. (1997). An intervention strategy for workplace stress. *Journal of Psychosomatic Research*, *43*(1), 7–16. https://doi.org/10.1016/S0022-3999(96)00392-3

Denny, M., Wells, J., & Cunningham, J. (2011). Assessing psychosocial work-related stress across five European countries: Implications for workforce development. *The Journal of Mental Health Training, Education and Practice*, *6*(2), 93–103. https://doi.org/10.1108/17556221111168940

Eisen, K. P., Allen, G. J., Bollash, M., & Pescatello, L. S. (2008). Stress management in the workplace: A comparison of a computer-based and an in-person stress-management intervention. *Computers in Human Behavior*, *24*(2), 486–496. https://doi.org/10.1016/j.chb.2007.02.003

Kaindl, H. (2020). *Human-machine interaction*. Springer. https://doi.org/10.1007/978-3-030-25629-6_66

Kalvelage, K., & Dorneich, M. (2014). A user-centered approach to user-building. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, *58*(1), 2008–2012. http://doi.org/10.1177/1541931214581419

Kinman, G., & Jones, F. (2005). Lay representations of workplace stress: What do people really mean when they say they are stressed? *Work and Stress*, *19*(2), 101–120. https://doi.org/10.1080/02678370500144831

Kortum, P., & Johnson, M. (2013). The relationship between levels of user experience with a product and perceived system usability. *Proceedings of the Human Factors and Ergonomics Society*, *57*(1), 197–201. https://doi.org/10.1177/1541931213571044

Law, E. L.-C., Roto, V., Hassenzahl, M., Vermeeren, A. P. O. S., & Kort, J. (2009). Understanding, scoping and defining user experience: A survey approach. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 719–728). https://doi.org/10.1145/1518701.1518813

Marsh, E., Vallejos, E. P., & Spence, A. (2022). The digital workplace and its dark side: An integrative review. *Computers in Human Behavior*, *128*, 107118. https://doi.org/10.1016/j.chb.2021.107118

Mensah, C., Azila-Gbettor, E. M., Appietu, M. E., & Agbodza, J. S. (2021). Internship work-related stress: A comparative study between hospitality and marketing students. *Journal of Hospitality and Tourism Education*, *33*(1), 29–42. https://doi.org/10.1080/10963758.2020.1726769

Mohammad Mosadeghrad, A. (2014). Occupational stress and its consequences: Implications for health policy and management. *Leadership in Health Services*, *27*(3), 224–239. https://doi.org/10.1108/LHS-07-2013-0032

Peruzzini, M., & Pellicciari, M. (2018). User experience evaluation model for sustainable manufacturing. *International Journal of Computer Integrated Manufacturing*, *31*(6), 494–512. https://doi.org/10.1080/0951192X.2017.1305502

Samara, A., Bond, R., Wang, H., & Galway, L. (2018). Adaptive user experience based on detecting user perplexity. In *Proceedings of the 32nd International BCS Human Computer Interaction Conference* (pp. 1–4). https://doi.org/10.14236/ewic/HCI2018.63

Sawyer, D. (1996). *An introduction to human factors in medical devices*. U.S. Department of Health and Human Services, FDA.

Solomon, J., & Wash, R. (2014). Human-what interaction ? Understanding user source orientation. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, *58*(1), 422–426. https://doi.org/10.1177/1541931214581088

Taser, D., Aydin, E., Torgaloz, A. O., & Rofcanin, Y. (2022). An examination of remote e-working and flow experience: The role of technostress and loneliness. *Computers in Human Behavior*, *127*, 107020. https://doi.org/10.1016/j.chb.2021.107020

Thuillard, S., Adams, M., Jelmini, G., Schmutz, S., Sonderegger, A., & Sauer, J. (2022). When humans and computers induce social stress through negative feedback: Effects on performance and subjective state. *Computers in Human Behavior*, *133*, 107270. https://doi.org/10.1016/j.chb.2022.107270

Vagg, P. R., Spielberger, C. D., & Wasala, C. F. (2002). Effects of organizational level and gender on stress in the workplace. *International Journal of Stress Management*, *9*(4), 243–261. https://doi.org/10.1023/A:1019964331348

Vakola, M., & Nikolaou, I. (2005). Attitudes towards organizational change: What is the role of employees' stress and commitment? *Employee Relations*, *27*(2), 160–174. https://doi.org/10.1108/01425450510572685

Valdez, A. C., Ziefle, M., & Verbert, K. (2016). HCI for recommender systems: The past, the present and the future. In *RecSys 2016 – Proceedings of the 10th ACM Conference on Recommender Systems* (pp. 123–126). https://doi.org/10.1145/2959100.2959158

Welbourne, J. L., Eggerth, D., Hartley, T. A., Andrew, M. E., & Sanchez, F. (2007). Coping strategies in the workplace: Relationships with attributional style and job satisfaction. *Journal of Vocational Behavior*, *70*(2), 312–325. https://doi.org/10.1016/j.jvb.2006.10.006

APPENDIX 1

1. Response on Efficiency		
"How do you feel when working from home regarding the overall efficiency compared to working from the office?"		
The respondents' results:		
Rating	Count	Percentage
Very efficient	28	17.6
Efficient	55	34.6
Neutral	41	25.8
Less efficient	19	11.9
Inefficient	15	9.4
Total	159	100%
Mean	3.39	
Standard deviation	1.18	

2. Response on Workplace Ergonomics		
On the scale from 1 to 5, How do you rate the workplace setting in a remote environment?		
The respondents' results:		
Rating	Count	Percentage
1	5	3.1
2	17	10.7
3	72	45.3
4	40	25.2
5	25	15.7
Total	159	100%
Mean	3.40	
Standard deviation	0.984	

3. Response for Poor Communication		
"Does poor communication and communication barriers while working remotely make you feel stressed?"		
The respondents' results:		
Rating	Count	Percentage
Very poor communication	29	18.2
Poor communication	53	33.3
Neutral	32	20.1
Good communication	32	20.1
Very good communication	13	8.2
Total	159	100%
Mean	3.32	
Standard deviation	1.217	

4. Response for Support at Work		
"Do you feel unsupported to work in a remote environment?"		
The respondents' results:		
Rating	Count	Percentage
Highly unsupported	16	10.1
Unsupported	40	25.2
Neutral	40	25.2
Supported	43	27.0
Highly supported	20	10.1
Total	159	100%
Mean	2.92	
Standard deviation	1.197	
Mean	2.92	
Standard deviation	1.197	

5. Response for Overload		
"On a scale from 1 to 5, How overly loaded do you feel when working from home?"		
The respondents' results:		
Rating	Count	Percentage
1	8	5
2	21	13.2
3	52	32.7
4	51	32.1
5	27	17
Total	159	100%
Mean	3.43	
Standard deviation	1.079	

6. Response for Musculoskeletal Disorders		
"Do you feel more exposed to Postural stress and musculoskeletal disorders?"		
The respondents' results:		
Rating	Count	Percentage
Highly stressed	20	12.6
Stressed	52	32.7
Neutral	38	23.9
Slightly stressed	25	15.7
No stress	24	15.1
Total	159	100%
Mean	3.11	
Standard deviation	1.262	

7. Response for Social Pressure		
"Do you feel any social pressure when working from remote when compared to office environment?"		
The respondents' results:		
Rating	Count	Percentage
Highly pressured	6	3.8
Pressured	51	32.1
Neutral	45	28.3
Lightly pressured	33	20.8
No social pressure	24	15.1
Total	159	
Mean	2.88	
Standard deviation	1.131	

8. Response for Attitude and Emotions
Does your attitude and emotions control the workflow when you work in a remote environment?".
The respondents' results:

Rating	Count	Percentage
Highly effects	19	11.9
Effects	56	35.2
Neutral	39	24.5
Slightly effects	26	16.4
No effect	19	11.9
9. Response for Job Strain		
"On a scale from 1 to 5, How do you rate the psychological job strain?"		
The respondents' results:		
Rating	Count	Percentage
1	8	5
2	17	10.7
3	64	40.3
4	55	34.6
5	15	9.4
Total	159	100%
Mean	3.32	
Standard deviation	0.966	
10. Response for Job Strain		
"On a scale from 1 to 5, How do you rate the psychological job strain?"		
The respondents' results:		
Rating	Count	Percentage
1	8	5
2	17	10.7
3	64	40.3
4	55	34.6
5	15	9.4
Total	159	100%
Mean	3.32	
Standard deviation	0.966	

APPENDIX 2

SPSS output for total variances – Principal component analysis (created by authors)

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	8.588	33.030	33.030
2	2.613	10.049	43.079
3	1.832	7.046	50.125
4	1.238	4.761	54.886
5	1.136	4.371	59.257
6	.960	3.693	62.950
7	.861	3.312	66.262
8	.820	3.154	69.415
9	.798	3.068	72.483
10	.720	2.769	75.252
11	.714	2.747	77.999
12	.575	2.210	80.209
13	.558	2.146	82.355
14	.524	2.015	84.370
15	.500	1.924	86.294
16	.490	1.884	88.178
17	.446	1.714	89.892
18	.409	1.572	91.464
19	.388	1.494	92.958
20	.379	1.459	94.417
21	.334	1.283	95.699
22	.305	1.172	96.872
23	.254	.977	97.849
24	.204	.786	98.634
25	.183	.704	99.339
26	.172	.661	100.000

APPENDIX 3

SPSS output for Principal component matrix (created by authors)

	Component				
	1	2	3	4	5
User experience	.593	.245	–.349	.168	.009
User interface	.584	–.025	–.181	.076	.238
System usability	–.383	.480	.137	.188	.016
System accessibility	–.510	.518	.202	–.025	–.040
Efficiency	–.464	.278	.513	–.008	–.022
Workplace ergonomics	–.482	.463	.246	–.034	.137
Workplace stress	.706	–.030	.101	.298	.106
Poor communication	.520	.178	.260	.408	–.049
Duration of the work	–.669	.015	–.286	–.142	–.395
Feeling unsupported at work	.738	–.143	.108	.164	.297
Overloading	.205	.528	–.442	.164	–.058
Smoking Habit	.233	–.194	.277	–.625	.017
Sleep patterns	.692	.179	.106	.065	–.243
Blood Pressure	.652	.096	.257	–.215	.139
Attitude and Emotions	.703	.274	.178	.084	–.259
Musculoskeletal stress	.635	.196	.223	.192	–.152
Eye strain	.387	.569	–.292	–.190	–.212
Stress management	–.534	.034	–.185	.160	.615
Job satisfaction	–.596	.445	.237	–.124	.007
Job demand	.194	.517	–.394	–.288	.183
Social pressure	.753	.073	.164	–.146	–.065
Job strain	.530	.495	–.244	–.281	.282
(Decision latitude)	–.705	–.101	–.246	.129	.004
Efficacy	–.505	.395	.422	.076	.219
Emotional Quotient	.760	.035	.041	–.038	–.002
Commitment	–.612	.173	–.184	.260	–.200