MAPPING POTENTIAL HUMAN VARIABLES IN USER-SMART TECHNOLOGIES ADAPTATION AT WORK

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Abstract. *The new and fast technology revolution inside organizations and work related tasks is no longer uncharted territory for years now. Keeping track with the constant evolution of machines, user-computer interactions, smart devices, assistive training stations and dynamic discoveries in the tech area require steady up to date adaptation of such gadgets to the human user. Recent studies have emphasized the need to reinforce the human centricity paradigm, in which the human being is placed in the center core of technology, adapting their aim, applications and functioning to the user needs and features and not the other way around. From this perspective, studies have started lately to focus more on adapting various technologies to the human user but the stage level concerning socio-psychological variables is still in pioneer time. Our article aims at reviewing some of the trends in exploring such human variables in association with the development of smart technologies at the workplace, following also our own research in this field and examples from other studies. Results underline a certain frame of human variables to be taken into consideration, when organizations want to introduce at work, the use of smart technologies, discussing implications for several such dimensions and potential outcomes for research. The study itself explores a certain map of individual features to be taken into consideration when assessing the introduction of smart technology at the workplace inside organizations.*

Key words: *smart technologies; work; human variables; adaptation; map.*

1. Introduction

The actual global world is obviously characterized by alert transformations in all domains. Organizations are forced to adapt to such new challenges, to implement new technologies. If the former technological revolutions impacted mostly the so-called "blue collars", mass production and manufacturing, the development of artificial intelligence (AI) contributes more to new patterns regarding „white collar" jobs (OECD, 2021). The progress undertaken facilitated the work domain, through safer labor conditions, increased productivity, easier ways of communication and travelling, but also changed personal lives in terms of leisure activities, house work, interacting with others and the list can continue.

Although the evolution of mankind has always been shaped by change, one must acknowledge that the spread of the coronavirus fostered new dynamics inside our interconnected modern world. Furthermore, the Covid-19 pandemic accelerated some of the existing trends in terms of digitalization, the usage of new technologies or ways of working (e.g. remote work, online meetings). Such new or improved existing technical possibilities make work from home feasible for many professionals, although new challenges like blurrier boundaries between work and non-work, difficulties in sharing the space with other family members, the necessity to take care or substitute the school of children are constantly mentioned (Allen et al., 2021; Schieman et al., 2021). In the case of other jobs, with regard to frontliners such as medical staff or other professionals, remote work was not possible, so the

confrontation with other challenges was imminent. Some of the changes which were implemented, forced by the pandemic context, were maintained even after the crisis, due to the fact that they proved to be effective. Nevertheless, not all organizations were able to adapt their functioning because of the nature of their activity in various cases or due to their financial costs, where in this view the International Labour Organization drew attention to the risks faced by companies, as not all can afford to invest in such new technologies (ILO, 2021).

Furthermore, besides the objective conditions, we should always consider the subjective, complex nature of human beings. Even if we can discuss about similar patterns inside a group, every individual has specific needs and requirements, different experience and education backgrounds, emotions, expectations, abilities, desires and so on. The introduction of new technologies in the organizational domain should take into account two major aspects - the hard dimension, referring to the technological, financial and legal issues and the soft dimension, addressing the human factors, the socio-psychological characteristics of the employees, placing human dimension at the core of the technology.

2. Smart technologies - user interactions

Technology and its rapid development in the last decades have raised the demand for usage in various activity areas, changing the way people work, travel, entertain and benefit from numerous services in a day to day life. Currently, the debate over AI and automated decision making (ADM) is well known and in process of constant evaluation, development and implementation. Aside from AI or ADM, people's daily lives have been impacted by the use of smart devices, paving the way for future developments and study trends in this direction.

Smart technologies may be seen as a broader concept which contain the use of AI, machine learning, big data analysis, adaptable gadgets that collect and develop data, instruments that possess cognitive awareness. Moreover, every little device that today is used on a normal basis, from a smart watch, telephone, tablet, tv, house administration platforms, search engines all the way to more complex systems such as virtual machines, training assistive systems, simulation pods, automated robot builders, with regard to specific areas, can be also seen as part of the smart technologies rapid development process, being very tangible products and in a close proximity of the normal everyday human user.

As a specific common example, many people already use a smart telephone, which can recognize vocal command, can analyze a voice or a face for identification, may provide personalized walking programs for the user based on his past habits (speed movement, pace, burned calories, elevation etc.), may record physical indicators such as heart rate, respiratory data, blood oxygen saturation, sleep and stress monitoring in combination with a smart wrist watch. The same gadget may offer a new perspective over communication between parts, by adding localization tracking and guidance systems, alert systems, monitoring step by step the human movement and interaction with the environment, offering suggestions to various problem based situations. Supplementary to this, the Internet of Things (IoT) gave the opportunity to relate such devices, synchronize and exchange data in a wider virtual world, creating the premises for unimaginable possibilities.

Martin, Lilic and Martinez (2022) presented an innovation ecosystem that highlights the interaction between smart technologies, AI and various sectors of activity. The authors explored in their work technologies such as machine learning, IoT, big data, business analytics, blockchain, robotics, cybersecurity, augmented/virtual reality (AR/VR), building information modeling (BIM), geographic information system (GIS) which can be implemented in activity sectors like mobility and logistics, transportation industry, tourism, culture, leisure, health services, social welfare, energy industry, constructions, digital economy, territorial based endogenous resources, the latter benefiting from their use (Martin, Lilic & Martinez, 2022). So far, all the technologies at hand have addressed technical matters and the big sectors of activity, trying to improve the life of people but at the same time creating new needs and trends.

An interesting question arises though - is the development of smart technology part of a natural, unstoppable process of evolution and development, creating trends for the people to adapt to it or should it be seen as a normal step in the tech revolution, solicited by the people and for the people, adapting the tools to the user and not the other way around? This question offers a homework for thought in the coming years, the answer being unclear at the moment.

A wide collection of research literature and studies have highlighted the importance of the human centricity paradigm, as a primary condition for the optimal and normal development of future technologies (Kim & Gatling, 2018; Cambon, 2017; Pogan & Popa, 2020). Of course the smart category component will make no exception in this view.

Pink et al. (2022) suggested that the key answer for adaptive technologies and user oriented development smart systems resides in the research developed between various discipline areas such as anthropology, sociology, media and communication studies and ethnology, which could enhance the so-called "rehumanizing automation", placing human users at the center of the entire process. The same authors expressed the need for an individual focused approach, in which humanities and social sciences theory and methodology are used and given priority, supporting the idea that the human component is present in every step of the way, concerning innovation, design, development, implementation, evaluation of smart systems, including AI and ADM and any other technological discovery.

Other authors also underlined the importance of future human - computer interaction and AI unification, bringing together the two trends, in an attempt to develop systems and tools relevant to the end user, while taking into account individual and social contexts, while maintaining a high motivation for the developers and a practical perspective (De Choudhury et al., 2020; Lee et al., 2019; Zhu et al., 2018; Pogan & Popa, 2020). Liao, Hansen and Chai (2020) specifically described a design frame for AI clear instances such as: representation creation, empathy triggers and engagement. Pink et al. (2022) also stressed out the importance of reconciling digital technologies with the human approach, avoiding such the risk of failure in admitting that humans are part of the technology process and products every step of the way and also the other way around.

At present, from the individual user perspective, the smart technology user interactions wave between enthusiasm and open engagement, curiosity and perceived utility, all the way to resilience, fear (e.g. fear of the unknown operating system, fear of task failure, fear of replacing, fear of result quality etc.), and anxiety in a new fast growing environment that does not follow a clear path, objectives and results. Bower and Steyvers (2021), in a recent study, found out that there is an increased level of sensitivity of users when it comes to AI mistakes, leading towards aversion. In this way, the human user will be more likely to adopt a resilient behavior towards a smart system which failed to be understood, efficient and used at full capacity and in the correct manner. Moreover, the level of experience and usage frequency constitute premises for understanding and adopting a better approach to smart technology and devices (Pogan & Popa, 2020).

3. Smart technologies and users at work

The new century tech revolution took the development of new devices, systems and discoveries to a whole new level in the work domain. Organizations started to use smart technologies in their practice field, investing both in research and implementation of numerous applications that can ease and support, change and develop the work tasks, work procedures and work outcomes. From simple smart gadgets, automated decision making machines, augmented reality to artificial intelligence, there is a wide collection of outputs for the organizational field and work which the present paper underlines with regard to several dimensions and examples. Lomborg (2022: 127) exemplified the everyday presence of AI in work assignments such as recommender systems, customer service chatbots, search engine algorithms, smart assistants, digital self tracking services and others. Bergquist and Rolandsson

(2022: 142) pointed out the importance of making the healthcare work digital, shifting data in real time, operating through smart devices and taking medical decisions while respecting discretion.

Reverberi et al. (2022) explored in a recent study the decision making support through AI in the medical field at work, concluding that human-AI interaction and advising can improve the medical act when correct and a better diagnosis. Other studies associated the implementation of smart technologies at work with a true ergonomics science and beyond, trying to adapt for example robotic modules to the human users (Ahmad, Mubin & Orlando, 2017; Liao, Hansen & Chai, 2020; Tanevska et al., 2020). Zolfagharian et al. (2022) explored new models and concepts for safe tactile interaction between a human operator and a smart operating machine, analyzing information types, physical data translating and gesture recognition, for a better cognitive and communication pattern in safe work sequence tasks. The same authors emphasized the importance of such research endeavors for future discoveries in the use of smart robotics for therapeutic and educational fields (Zolfagharian et al., 2022: 1).

The user-smart device adaptation and integration are yet in their pioneer times but with some huge potential for the work industry. Wang et al. (2013) underlined the role of e-skin in a variety of applications from interactive input or control machines, smart wallpapers, medical and health monitoring or intervention platforms. Valadão et al. (2016) presented the development of a smart walker, an application with regard to the medical sector, which uses various encoders to gather information on the user and support or protect him in various situations. Montes and Garcia (2022: 39) presented a road map for future IT governance platforms in which public administration stakeholders and workers may carry on numerous tasks, using shared data and integration services.

From another perspective, Bertram et al. (2018) stressed the importance and utility of assistive systems at work, especially for manual working modules or stations, which can improve the work performance outcomes, task steps efficiency and employee training. The human user may understand, visualize and supervise job tasks more efficiently (Bertram et al., 2018).

4. Mapping human variables inside smart technologies - adaptation

On the basis of our previous research and analyzing multiple research trends up to date, the present paper tries also to underline several human variables that can be taken into account when developing and adapting smart technologies to the human user and workforce, useful both for experimental designs or pilot testing and implementation.

Studying the role of individual characteristics in technophobia, previous research considered personality variables, cognitive orientation, mathematics and logic skills (Korukunda, 2005). The same author correlates technophobia with computer experience, academic achievement, gender and math anxiety (Korukunda, 2005). In another study, Bozionelos (1997) addressed fear, skill level and cognitive spontaneity as variables that impact human-computer interaction.

Healthcare is among the domains that highly benefits from the advances made by smart technologies**.** Such improvements may help professionals use new ways for studying or practicing, through augmented or virtual reality, from research to real-time applied interventions. Moreover, patients already can monitor different personal health parameters easily, using AI devices like watches or bracelets. Bettiga, Lamberti and Lettieri (2020) showed that the usefulness and accessibility of healthcare applications influence patients` intention to adhere to them. They also mentioned social influence, technology promptness and innovativeness as triggers (Bettiga, Lamberti & Lettieri, 2020).

Spatola and Normand (2021) explored the psychological implications of motivation and threat in relation with artificial agents when human users interacted with this type of technology.

In another article, exploring the human-machine interaction, the authors proposed looking into several dimensions that raise numerous challenges for the future when it comes to social and psychological interaction between user and smart technology, drawing attention to variables such as: morphology, locomotion, speech, facial emotion recognition, computer vision, natural language processing, AI architecture, and free will (Roese & Amir, 2009). Roese and Amir (2009: 431) also underlined the importance of addressing the design solicitations through a psychology approach with regard towards eye gaze, body language, personal space and theory of mind. Pogan and Popa (2020: 124) also explored the impact of user experience and time of usage on working with smart devices, as dimensions to be taken into consideration for future research.

In Table 1, we synthesized some of the human variables that might be considered as key starting points for exploring the human-smart technology interactions at work and adaptation of these devices to the user and not the other way around.

Table 1. Potential human variables - smart technology research exploration at work

Crt.	Categories	Dimensions	Application domain	Example
1	Physical	- physical traits - physical skills - sensation and perception levels - learning abilities	Industry Medicine Services Transportation Education Leisure	Remote operation surgery Remote diagnosis and health monitoring
2	Psychology	- personality traits - cognitive features - motivation - individual differences - communication skills - learning styles - performance	Industry Medicine Services Transportation Education Leisure	Smart testing Mental illness interventions
3	Social	- perception - interaction experience - level of experience - communication - education	Industry Medicine Services Transportation Education Leisure	Educational smart platforms Smart assistive automated operator
4	Work	- task requirements - complexity - automation degree - level of experience - time of usage	Industry Medicine Services Transportation Education	Augmented reality devices Assistive training

			Leisure	systems

5. Conclusions

The so-called intelligent workplace is already an existing reality for many organizations and a not so distant plan for others. Besides the work domain, everyday life of individuals, groups, communities and societies is shaped by the increasing use of innovative technologies, smart devices and interconnected intelligent systems, with regard to leisure activities, medical services, transportation, education, communication, shopping and many other, as emphasized in previous sections of the present paper.

It is already acknowledged that the actual world is an interconnected, intelligent environment where smart technologies, implemented in various areas, ease work and specific activities, but will require other types of resources, where new jobs emerge and others will no longer be necessary. Such transformations raise, inevitably, opposite attitudes, with some of them orbiting around concepts like technophobia or anxiety, as previously described, while others taking on more optimistic positions, of acceptance, technological readiness and adherence to these new technologies.

When analyzing the adherence to new ways of living and working, one should understand and realize that the process is influenced by both objective aspects, like infrastructure, costs, availability and accessibility, and subjective ones, such as physical traits and skills, learning abilities, personality characteristics, perceptions and attitudes, education, previous experience and so on.

In this regard, the human centricity paradigm should represent the dominant perspective when it comes to addressing the projection and implementation of smart technologies in all contexts, both for work and for day by day usage. Thus, such prototypes, devices, equipment and innovative means of carrying activities will be always expected to answer the existing needs of the human user and to contribute to a better living of people for years to come.

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