

Article

Techno-Stress: Damage Caused by New Emerging Risks

Rubén Rodríguez Elizalde

Centro de Educación Superior de Negocios, Innovación y Tecnología, Universidad Rey Juan Carlos,
28002 Madrid, Spain; elizalde@citop.es

Abstract: The world moves and advances very quickly. Production systems and jobs evolve with the world. Occupational risks change as jobs change: The occupational risks of jobs we found two hundred years ago are different from the risks inherent to today's jobs. The influence of technology is evident in many of today's companies and, as a consequence, in the work that takes place in them. The recent COVID-19 pandemic, which has so upset the world, has made possible the acceleration in the massive use of certain communication tools that has been linked to the home confinement of a significant part of the population. Lots of workers and companies have been forced to telecommute. In a lot of countries, legislation and regulations were not prepared for these new ways of working: the laws have had to adapt to this new operation. In this area techno-stress has emerged, a new variety of stress derived from the use of new technologies at work, with the consequent negative psychosocial effects for the worker and the people around him, which can, at the same time, be the prelude to many others pathological processes of various nature.

Keywords: techno-stress; COVID-19; health; workplace risk prevention; telecommuting



Citation: Elizalde, Rubén Rodríguez. 2021. Techno-Stress: Damage Caused by New Emerging Risks. *Laws* 10: 67. <https://doi.org/10.3390/laws10030067>

Received: 20 June 2021

Accepted: 10 August 2021

Published: 19 August 2021

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Copyright: © 2021 by the author. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction: New Emerging Risks

There has always been a high interest in analyzing the relationship between work and health. Since its constitution, the World Health Organization (WHO) has defined health as a state of complete physical, mental, and social well-being; not only the absence of disease or infirmity. In this sense, WHO has also defended the close relationship that exists between health and working conditions: healthy work has always been one of its greatest ambitions for everybody.

Over the years, the attention paid to occupational risk factors has made possible great advances in knowledge. This advance ranges from the etiology of physical and mechanical factors to those of a psychosocial nature. So much so, that risk prevention in the workplace has become a priority prevention and intervention objective for governments, employers, and employees today. Advances and discoveries make this interest grow more and more every day. Therefore, a fundamental event was the demonstration of the relationship between certain aspects of work and stress and the prevalence of other disorders, such as nervous disorders, musculoskeletal disorders, digestive disorders, or some heart diseases.

However, in the same way that we have advanced in the knowledge of these factors, the working ways have also evolved: they have not stopped.

This evolution has promoted a response to emerging risks secondary to the new work models that are expanding thanks to the advance of digitization and the use of mobile information technologies (Mobile IT). When we say Mobile IT, we are talking about the ability of the information technology (IT) department to deliver IT services to employees working on mobile devices (Ninaus et al. 2015).

The new production models, characterized by the massive use of information and communications technology (ICT), question the traditional systems of occupational risk prevention. In the same way, these new production models impose the need to address the risks of those jobs, that are considered non-standard (Ayyagari et al. 2011).

Work and workplaces are subject to continuous change due to the introduction of new technologies, the incorporation of new substances, or the modification of work processes, as well as the various changes in the structure of the workforce and the workforce, Labor market, and also by new forms of employment and work organization. All of the above can produce (in most cases it produces) new risks and difficulties for the safety and health of workers that must be anticipated and addressed to guarantee safety and health in the future.

The introduction of new information and communication technologies in all areas has generated different forms of communication, relationships, information, learning, and, of course, work. All these seem to be advantages, however, there are also drawbacks that are now beginning to become apparent (Blacker and Brown 1986).

The adaptive changes that they entail bring with them serious and important risks and consequences for both workers and organizations.

Our society evolves at the pace of new technologies and changing economic and social conditions. As a result, our workplaces and work procedures are constantly subject to constant change. Every new employment situation brings with it new and emerging problems and risks, before which protection measures are necessary to guarantee high levels of safety and health at work.

Computer, mobile phone, internet, email, apps, instant messaging service, social media, all of these are entities that we have very internalized already. The rest of society too, of course. Information and communication technologies (ICTs) are part of every areas of our life: public or private, work or personal.

When we talk about new technologies, the first thing we have to do is take into account that new technologies are not exactly the same as computing; New technologies refer to all technological advances, all programs and all applications that have communication as a central pillar.

In recent years, there have been significant technological advances in the workplace. These advancements have transformed the way many people go about their jobs.

The effects of these changes on occupational safety and health have also been notable: in some cases more traditional hazards and risks have been reduced or eliminated, for example through industrial automation, but new technologies have also created new risks or emerging risks.

All these technological changes have revealed technical problems, without a doubt. However, without a doubt, the most worrying thing is that alongside these technical problems there have also been human and social problems. The consequences of these problems are the subject of deep debate due to their consequences, both for workers and for companies and businesses.

The changes generated by the new technologies require prevention in order to avoid all kinds of damage and negative, unwanted effects on companies and workers.

To know if an occupational risk is emerging, it is necessary to attend to the definition given by the European Risk Observatory (ERO), of the European Agency for Safety and Health at Work (EU-OSHA 2014), an organization in charge of detecting new and emerging risks in the work environment, to increase the effectiveness and advance of preventive measures. According to this community organization, an emerging occupational health and safety risk is any new risk that is increasing.

When we say that a risk is new, we mean that the risk did not exist before; therefore, we mean that it is caused by new processes, new technologies, or new social or organizational changes, different from those that existed before. In other words, it was previously a known factor, but is now considered risk due to new scientific discoveries or new social perceptions.

Techno-stress is one of the newest risks due to the use and use of new technologies, manifested in two ways, either by a maladjustment or rejection, or by a total dependence. It can be said that techno-stress is a specific form of work stress related to the use of ICTs (Ayyagari et al. 2011).

2. Objective

The objective of this article is to analyze the new functioning of many of the labor sectors that have functioned through teleworking and confinement, and still continue to do so, to discover, among the new emerging risks, techno-stress, understood as a psychosocial damage that it can be prevented in companies, so that its harmful consequences are avoided.

A valid and reliable instrument for the detection and measurement of techno-stress will be presented, to finally introduce psychosocial intervention strategies for its prevention. With all this, the article tries to raise awareness of the risks that the new reality has brought, and very particularly one of them: techno-stress. These risks have not been sufficiently known and prevented due to the rapid events have occurred in recent months, in which saving from the virus has been an absolute priority (and almost the only one).

3. Occupational Risk Prevention and Psychosociology

When we talk about prevention of occupational risks, we are talking about the set of activities or measures adopted or planned in all phases of the company's activity, in order to avoid or reduce the risks derived from work in order to guarantee safety and health of workers the possibility that a worker suffers a certain damage derived from work. To classify a risk from the point of view of its seriousness, the probability of the damage occurring and its severity will be jointly assessed.

This is important: preventive legislation establishes the obligation to act on risk. This obligation is perfectly fulfilled with active prevention techniques. These act on the probability and frequency of the risk. Complementarily and to a lesser extent, they also do so on the consequences of it.

Risk increases when the number or probability of exposure to risk increases; or the effects on workers' health worsen.

Preventive actions within a company may be of a material nature or may be related to the training and information of workers.

Among the preventive techniques to improve working conditions, due to its importance for this article, it is worth highlighting occupational psychosociology. It is the discipline that is responsible for the study of such important aspects as: work time, hours, breaks, work rhythm, work organization itself, mental load, and labor relations, among others (Cox and Griffiths 1996).

In short, it is a preventive, non-medical discipline in charge of controlling the work-related aspects that cause job dissatisfaction. For this, important issues such as: the organization of work, its content, the schedule, breaks, the pace of work, as well as issues related to mental load, labor, and interpersonal relationships, etc., are studied (Perez-Iñigo and Ortiz Chaparro 1995).

It is a discipline closely related to Ergonomics and its methods are largely based on principles from psychology and sociology.

Occupational psychosociology is responsible for adjusting the imbalances produced between the work demands and the worker's ability to respond to them, in order to assess and control risks of work origin such as stress (Cox and Griffiths 1996).

Its objective is to know, through a series of techniques, the psychosocial risks in the workplace, as one more part of the environment and the work environment. All psychosocial research should focus on the evaluation and diagnosis of the situation of the working conditions with respect to the worker. Once this knowledge is reached, the appropriate preventive and corrective measures can be proposed to eliminate or at least minimize risk situations.

In psychosociology, the study of stress is fundamental: stress is a harmful process that is too frequent, unfortunately, in the world of work; its consequences on the health of the person who suffers it can be very serious.

Stress is a substantial imbalance (perceived) between the demand and the response capacity (of the individual) under conditions in which failure in the face of this demand has important (perceived) consequences (McGrath 1970). It is a disease that is on the rise due to

the great changes that the labor, social, and economic world is experiencing. Workers have to assume all the changes that the world is experiencing, and these may be increasingly difficult to overcome: that is precisely what can end up leading to stress.

“Psychosocial risks and work-related stress are among the most challenging issues in occupational safety and health. They impact significantly on the health of individuals, organisations and national economies.

Around half of European workers consider stress to be common in their workplace, and it contributes to around half of all lost working days. Like many other issues surrounding mental health, stress is often misunderstood or stigmatised. However, when viewed as an organisational issue rather than an individual fault, psychosocial risks and stress can be just as manageable as any other workplace safety and health risk”. (EU-OSHA n.d.)

4. COVID-19 and Telecommuting

When we speak of distance work we are referring to a job in which the work activity is provided predominantly at the worker's home or in a place freely chosen by the worker, as an alternative to its on-site development. The company's facilities (Salinas 1995).

Remote work, understood as work that is carried out outside the usual establishments and centers of the company, and of which teleworking is a subspecies that implies the provision of services with new technologies (Di Martino and Wirth 1990).

Thus, when we talk about teleworking we are talking about the form of organization and performance of work, using information technologies within the framework of a contract or work relationship, in which a work that could also be carried out in the company premises are carried out outside these premises on a regular basis (European Framework Agreement on Teleworking).

We must not fool ourselves with this: the health crisis caused by COVID-19 moved or forced many companies to opt for teleworking to keep all or part of their activity and workers to accept it in order to keep their jobs. That is, a large part of society had to adapt quickly and unexpectedly to remote work, as it was a relatively minority practice in many before the COVID-19 pandemic.

According to the spread of COVID-19, the confinement measures were tightening. At the same time, companies were opting to use telecommuting on a massive scale to maintain jobs and ensure the continuity of their activity.

Indeed, analyzed a year later, it can be affirmed that teleworking is an effective mechanism to maintain jobs and ensure the continuity of economic activity in the context of COVID-19.

In this sense, the map we have on the previous graph (Figure 1) is significant, and it represents the percentage of teleworkers in Europe in 2018, before the pandemic. The difference is striking: the high rate in Finland or the Netherlands compared to the rest, and the low rate in some Eastern European countries. Netherlands was the EU country with the most teleworkers at the end of 2019: on this way, it was a country that did not register a notable rise in its teleworker ratio when the pandemic came (Figure 2). The difference between pre-pandemic and post-pandemic numbers is considerable in most countries.

Due to the large increase in the number of teleworkers, there has also been a response in legal matters. Until now, in a lot of countries teleworking was regulated in a scattered and lax way. In fact, it was necessary, in many places, for legislation to address controversial teleworking issues: compensation of employee expenses, control of working hours or prevention of occupational hazards outside the office, to name just a few examples.

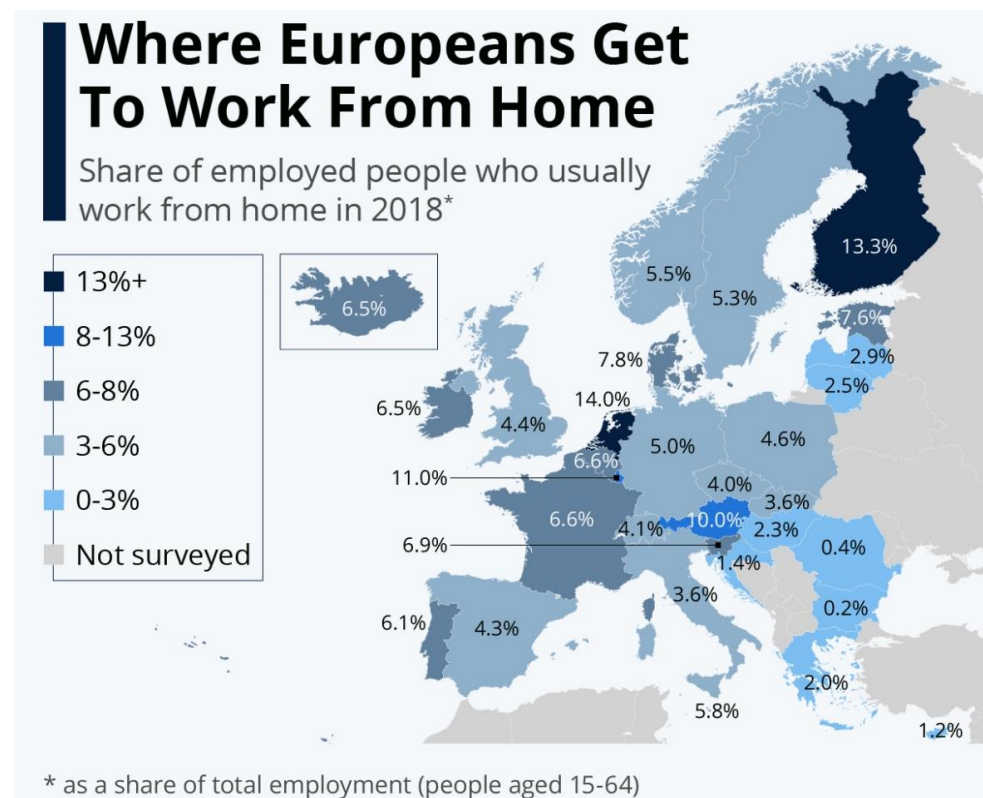


Figure 1. The map of teleworking in Europe, in 2018, before the COVID-19 pandemic. The percentages reflected on the map are applied to the total active population, 15–64 years old (Eurostat).

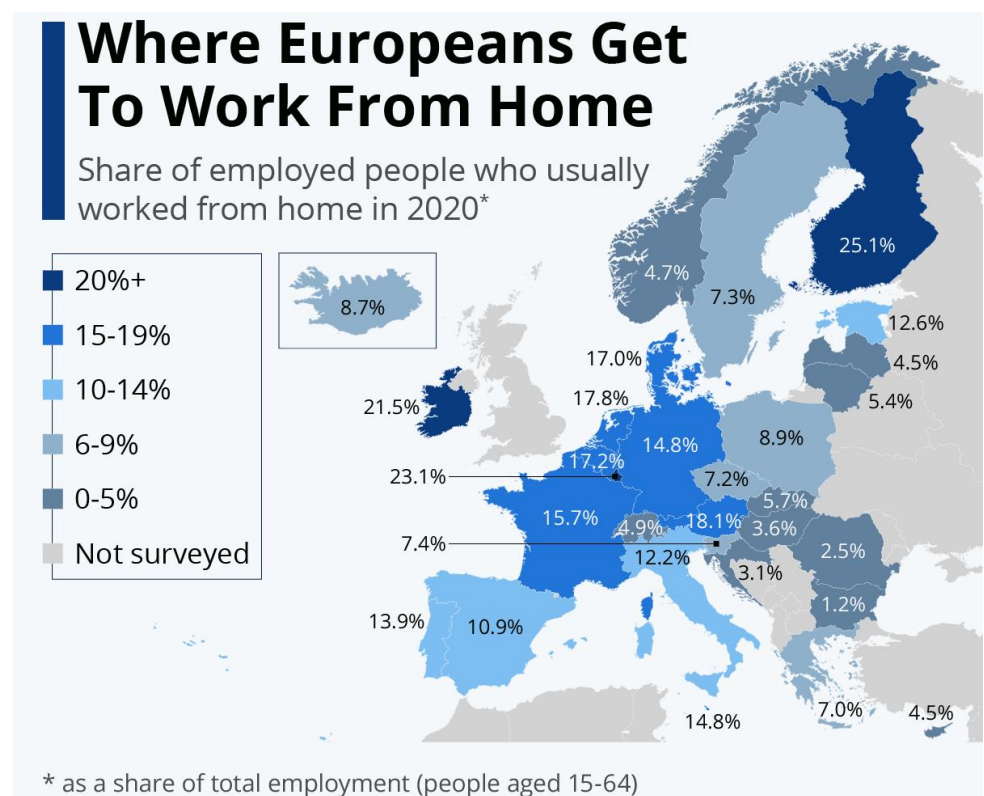


Figure 2. The map of teleworking in Europe, in 2020, during the COVID-19 pandemic. The percentages reflected on the map are applied to the total active population, 15–64 years old (Eurostat).

Now, we have an agreement within the framework of the public function that normalizes teleworking in this area.

Generally speaking, most national telework laws establish some key commonalities:

- The rule does not apply to those who telework sporadically, but to those who do it regularly. For example, in Spanish legislation, these are those people who telework for at least 30% of their working day, in a 3-month calculation period;
- Teleworking is always voluntary for the worker and the employer, so that it cannot be chosen by the former or imposed by the latter, but must be the result of an agreement that must also be formulated in writing;
- Teleworking is also reversible, so that at any time the employer and worker can agree to return to work entirely from the company's premises.

There are three types of teleworking:

- Teleworking at home;
- Teleworking in telecentres;
- Mobile teleworking.

From all of them, without a doubt, the most widespread and the one that has had all the leading role during the COVID-19 pandemic is home teleworking: the worker carries out his work in his own home. In fact, most of the time, when talking about teleworking, this modality is spoken by default ([Blanco-Donoso et al. 2020](#)).

The experiences of teleworking in different companies and countries lead to the identification of a series of aspects that are constituted as advantages of teleworking and others as inconveniences or problems that derive from this new organization of work and that require them to be considered in order to alleviate them to the extent as possible. The main risks related to teleworking are:

- Musculoskeletal disorders;
- Visual fatigue;
- Risks derived from the transformation of part of the home into a workplace;
- Organizational risk, namely, stress.

The fact that teleworkers normally work at home, alone, or at least isolated from the rest of the company's workforce, maintaining almost exclusively telematic or telephone contact, implies a series of possible psychosocial occupational risks, which they can give rise to various pathologies.

Portugal has one of the most comprehensive regulations on teleworking in Europe. Its “*Código de Trabalho*” is very interesting according to what we analyze here: it places the emphasis precisely on the prevention of occupational risks: it establishes a mandatory control of the conditions of the position, extendable to when operating remotely. In other words, a prevention technician from the company must visit the worker's home to check that he meets all safety regulations ([Moorcroft and Bennett 1995](#)).

On 16 July 2002, the European Framework Agreement on Teleworking was signed. Its last modification was registered on 17 May 2005. In other words, almost ten years have passed since its drafting and more than fifteen since its last modification. Regarding health and safety, this document already pointed out something important:

“the employer is responsible for the protection of the occupational health and safety of the teleworker in accordance with Directive 89/391 [Health and safety at work—general rules] and relevant daughter directives, national legislation and collective agreements. In order to verify that the applicable health and safety provisions are correctly employed, the employer, workers' representatives and/or relevant authorities have access to the telework place, within the limits of national legislation and collective agreements. If the teleworker is working at home, such access is subject to prior notification and his/her agreement. The teleworker is entitled to request inspection visits”. ([EUR-Lex 2005](#))

Not every worker is suitable for teleworking, nor is every command to direct and manage teleworkers nor any type of work lends itself to being carried out effectively through teleworking.

5. Risks Associated with the Use of ICTs

The concept of teleworking is closely related to aspects such as the possibilities of information technologies, new conceptions of social and labor organization, new management guidelines, etc. Teleworking has been the object of very different considerations, being able to find radical defenders of it (for whom teleworking would be a source of important economic and personal benefits) and critical positions that consider teleworking an important way to exploit workers (Figure 3).



Figure 3. Information and communication technologies are very useful and beneficial, but they should be used in moderation: their massive use can be dangerous and harmful (author's photograph).

New technologies have brought about a revolution in the world of prevention, since, at present, most of the non-traumatic pathologies suffered by workers are related to technostress that causes the excessive use that is made of them, both outside as within the working day.

Through mobile devices, many workers are “connected” 24 h a day and are not aware of the health risks that these types of customs entail. Faced with this situation, it is very difficult to discern which pathologies derive from professional activity, and which from personal life.

Given this reality, the need to address the risks of technological innovations in organizations is generated in order to prevent their impact.

In all preventive legislation, no matter the country, it is stated that the risk assessment will be carried out when working conditions change, for example, due to the introduction of new technologies. Likewise, the risk assessment must be repeated when working conditions may be affected by the introduction of new technologies.

The changes generated by new technologies demand their prevention to avoid the risks and negative effects of their impact on companies and workers. In this sense, the preventive legislation of all countries always specifies that risk assessment must be repeated when working conditions may be affected by the introduction of new technologies.

It is necessary to analyze the antecedents of technological innovations in companies in order to prevent their impact at both an individual and organizational level (Demerouti et al. 2001). At this point, psychosocial research has studied the problem of the consequences of

the introduction of Information and communication technologies on the health of people at work, such as muscle problems, headaches, mental and physical fatigue, anxiety, fear, and boredom. It is within this framework that the term “techno-stress” becomes important, referring to the specific stress derived from the introduction and use of new technologies at work. The next section focuses on the analysis of techno-stress as damage caused by new technologies ([EU-OSHA 2019](#)).

6. Techno-Stress

Work-related stress, as was already mentioned in Section 3 of this article, manifests when the worker feels that his work environment demands more than he can bear (or more than the worker can control).

If work-related stress is intense and lasts a long time, it can lead to physical and emotional disturbances. Work-related stress can be caused by psychosocial risks, such as the design, organization, and management of work (this would be the case, for example, high demands of work with little control over it), as well as for problems such as harassment and violence at work. Physical hazards, such as noise and temperature, can also cause stress.

Risk factors for work-related stress include:

- Work at high speed and with very tight deadlines;
- The pace of work determined by external demand or by the speed of the machinery;
- Unforeseen interruptions in work;
- The lack of correspondence between training and job demands;
- Bullying and sexual harassment.

Most cases are related to the way work is designed and the way organizations are managed. Other causes of stress can be career development, status and salary, the role of the person in the organization, interpersonal relationships, and the relationship between personal and work life. There are no significant gender differences in the prevalence of psychosocial health risks ([Perez-Iñigo and Ortiz Chaparro 1995](#)).

Regarding age as a stressor, workers between 40 and 54 years old experience work-related stress more often than workers of other ages. Thus, workers between 15 and 24 years old are those who report suffering the least stress.

With regard to the economic sector, the prevalence of psychosocial health problems is highest in the education, health and social services, transport, and communications sectors. Some research indicates that the professional group most affected by stress is that of members of the executive branch and of the legislative and managerial bodies of the public administration and companies, followed by scientific and intellectual professionals. A different classification of professions suggested that the more skilled manual workers, such as skilled agricultural workers, are the most affected by psychosocial risks ([McGrath 1970](#); [Peiró and Salvador 1993](#)).

WHO predicts that levels of depression and stress will rise dramatically with the rapid incorporation and globalization of new technologies. WHO believes that the aging of the population in the European Union, which will change the proportional relationship between employed and retired people, will not only increase the average age of the workforce, but will also lead to an increase in the workload of workers, whose number will be progressively reduced, thus contributing to the development of stress ([EU-OSHA 2014](#)).

As we have seen, techno-stress is an emerging psychosocial risk closely related to the widespread use of ICTs in a society in which their use is widespread and jobs with teleworking and new technologies proliferate. It should be noted, however, that the advance in the use of technologies in the world of work has made it possible to enhance flexibility, work from remote locations, find the best specialists, and allow certain people to access jobs that otherwise could not be found. Therefore, it should improve efficiency and work-life balance. The problem arises when it is not possible to respond to the requirement in the continued use of ICTs or when the demands of flexibility exceed the ability to adapt to the person and superimposes work on personal and family life.

Craig Brod defined techno-stress as a “modern adaptive disease caused by the inability to cope with new information technologies in a healthy way” (Brod 1984, p. 16). The negative impact of techno-stress is assumed, describing it as a disease.

A first approach to this phenomenon, associated with the use of technology and its impact on a psychological level, which describes the inability to cope with new technological demands and which was later expanded by other scientists. Rosen and Weil, after 16 years of research, pointed to techno-stress as “any negative impact on attitudes, thoughts, behaviors or psychology caused directly or indirectly by technology” (Weil and Rosen 1997).

Techno-stress is, therefore, the result of a perceptual process of mismatch between demands and available resources, and is characterized by two central dimensions: (1) affective symptoms or anxiety related to the high level of psychophysiological activation of the organism, and (2) the development of negative attitudes towards ICT. Now, this definition is restricted to the best known type of techno-stress

The theoretical framework proposed by them, as Chiappetta pointed out twenty years later (Chiappetta 2017), has evolved over time to also include the risks of permanent exposure to information. Information that is provided by digital technology and that causes an information overload (Figure 4). Thus, the inability to manage this amount of information will cause “a state of anxiety characterized by a general fear of being overwhelmed by an immense amount of information” (Chiappetta 2017). The techno-stress of the worker who uses ICT, not only in a standard job but at any time and in any place (such as his private or personal life). Thus, techno-stress is characterized by breaking the space/work time binomial: it presupposes people who can work twenty-four hours (24 h), seven days a week (24/7 worker). In other words, techno-stress is victimized by workers who have to be permanently located, under continuous supervision and aware of the platform used, so as not to lose any information, regardless of its relevance.

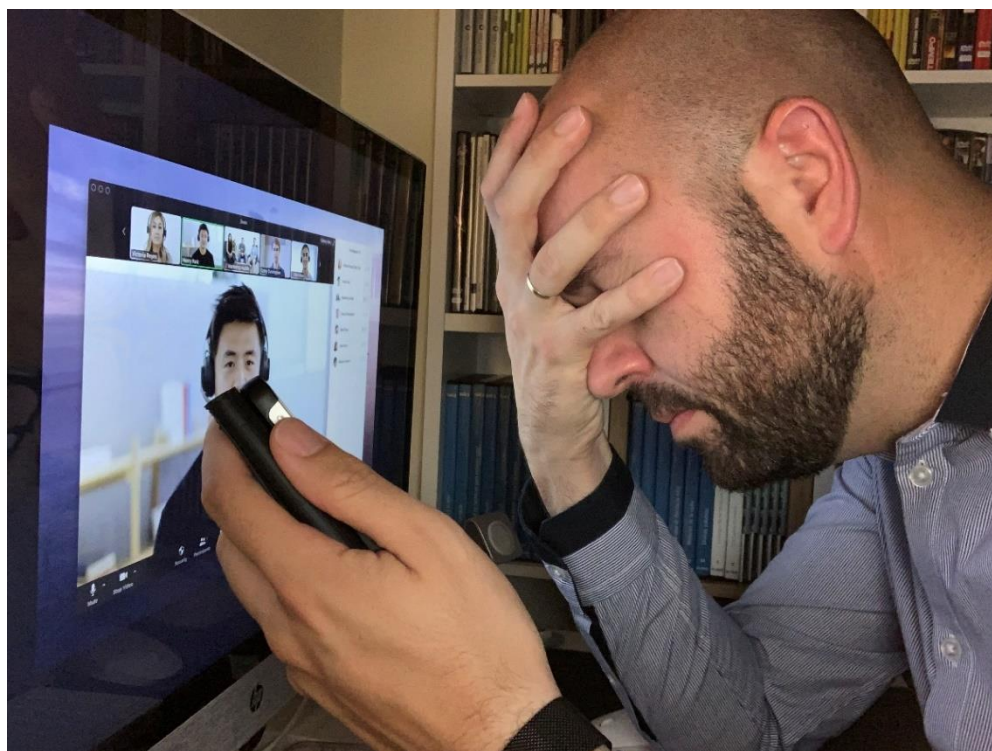


Figure 4. The uncontrolled and massive use of information and communication technologies is an obvious cause of techno-stress, with serious damage to the health of the individual. (author’s photograph).

However, it should be noted that technology per se is “neutral” and constitutes a psychosocial risk when it poses a threat, depending on the type of exposure and the effect caused (Salanova Soria 2007). To this, we should add other psychosocial variables, whose intervention has been identified. Among them, it is worth highlighting the self-efficacy towards technology (Bandura 1997).

For this reason, many experts point out that it is more accurate to talk about changes and not so much about positive or negative effects of ICTs. In this way, it is assumed that its effect is indirect and is conditioned by individual variables of the worker himself, variables dependent on the job position, and variables dependent on the organization of the company (Salanova et al. 1999).

Therefore, the deterioration of health will depend on the perception that the worker himself has of the use of ICT, namely, if he perceives them more as an opportunity to better balance work and personal life, or as a cause of conflict between the two (Ninaus et al. 2015) becoming a “double-edged sword” (Diaz et al. 2012).

The Spanish National Institute for Safety and Health at Work dedicated one of its technical notes on prevention (NTP 730) to techno-stress. In it, he collects an updated definition of this phenomenon and describes it as “a negative psychological state related to the use of ICT or the threat of its use in the future, an experience related to feelings of anxiety, mental fatigue, skepticism and beliefs of ineffectiveness”. Conditioned by the perception of a mismatch between demands and resources related to the use of ICT (Salanova et al. n.d.). From here, the authors establish a classification that makes it possible to distinguish between different types of techno-stress such as: techno-anxiety, techno-addiction, and technoadddiction. We discuss each one below:

- Techno-anxiety is characterized by high levels of unpleasant or unpleasant physiological activation. The present or future use of some type of ICT causes tension and discomfort in the worker; a very specific example of techno-anxiety is technophobia. Technophobia is fear and anxiety towards ICTs, which is why it attacks the affective dimension (Jay 1981);
- Techno-fatigue is, in essence, fatigue and exhaustion, mental and cognitive, produced by the continuous use of ICT. This fatigue caused by new technologies is complemented by skeptical attitudes of the worker and beliefs of ineffectiveness in the use of technologies. A very clear example of techno-fatigue is known as “information fatigue” syndrome;
- Technoadddiction is a case of specific techno-stress. Technoadddiction is caused by the inability to control the use of ICT; In other words, technoadddiction is caused by the compulsive desire to use ICT always, anytime, anywhere. The use of ICT for long periods of time is a sign of tech addiction: a tech addicted person is someone who wants or needs to be up-to-date with the latest technological advances, to the point of being dependent on technology or making it the axis on the one that spins all his life.

It could be said that the first two, techno-anxiety and techno- fatigue, are due to maladjustment or mistrust of new technologies, and the third one, technoadddiction, is due to a compulsive and uncontrollable need.

Along with them appear other phenomena, such as the FOMO syndrome or nomophobia.

- The FOMO syndrome, which corresponds to the acronym “fear of missing out”: it is the feeling of missing something. It is a disorder produced by the advancement of technology and the number of options that are presented, the need to be constantly connected and aware of everything that happens on the networks;
- On the other hand, nomophobia is the irrational fear of leaving home without a mobile phone.

Apart from them, there are other known techno-stressors, such as windows or apple syndrome, digital amnesia, email apnea or infoxication, to name just a few.

Personal characteristics and skills are essential when facing the requirements that new technologies pose. Indeed, it does not affect all groups equally. Certain people perceive the work demands posed by ICTs as a stimulating and motivating challenge; Others, on the other hand, for reasons of character or lack of knowledge, are not (or do not believe) capable of facing these demands. This makes them more vulnerable to techno-stress.

In this sense, overload, routine, role conflicts, and conflicts between work and family are the main psychosocial risks linked to the use of ICTs (Bird et al. 1983). Certain recent studies have pointed out that the aforementioned stressors (work overload, role ambiguity, invasion of privacy, conflict between work and home, and job insecurity) are those that are related to certain characteristics of the new technologies (Ayyagari et al. 2011). Among these characteristics, the ease of use, dynamism and intrusiveness stand out.

In other research, there have been authors who have explained that workers, ICT users, experience techno-stress due to information overload, invasion of personal life, inability to deal with uncertainty, and the complexity generated by information systems and the feeling of insecurity due to their rapid advance (Tarafdar et al. 2007). All of this ends up causing effects on personal health and on organizational well-being, significantly reducing job satisfaction, commitment, innovation, and productivity (Tarafdar et al. 2011).

Therefore, these changes that have occurred in the world of work, after the implementation of innovative technologies have modified labor relations and have transformed the world of work in its organization and content, altering the health and well-being of people. Some of the moderating variables have been exposed at the individual level, however, there are also moderating variables at the organizational level that allow counteracting the conditions of techno-stress and its results: it is necessary to promote training for the use of information systems, technical support, participation and involvement in its adoption and fostering support for innovation.

In fact, user participation is both a predictor and a valid moderator of techno-stress since it dampens the incidence of technological innovations in the users' position during the change (Salanova et al. n.d.).

7. Techno-Stress Measurement

In order to make a techno-stress measurement, we have different instruments. Most of them have been generated in the United States (Rosen et al. 1987; Rosen and Weil 1992; Sears et al. 2000; Weil and Rosen 1997).

Among the instruments to measure techno-stress, a battery that evaluates technophobia stands out. This battery comprises three instruments:

1. Computer anxiety rating scale (CARS-C): it measures anxiety towards technology;
2. Computer thoughts survey (CTS-C): it measures the concrete thoughts that people have when they are working with technology;
3. General attitudes toward computers Scale (GATCS-C): it assesses a series of attitudes towards computers and technology.

Each of the instruments consists of twenty (20) items, which contains a response scale from one (1) to five (5).

Two scales stand out to assess the damage produced by the use of technologies as well (Hudiburg 1989a, 1989b):

- Computer technology hassles scale;
- Computer hassles scale.

It should be noted that the second scale (Computer hassles) is a shortened version of the first one (Computer technology hassles). This second scale focuses only on the damage caused by the current use of computers. In both cases, the severity of the damage, problems with execution (for example, a program speed that is too slow or crashes frequently) and problems with the information that the computer offers (for example, incomprehensible instructions) are evaluated.

There are more tools to measure techno-stress. There are instruments that allow evaluating other phenomena related to technology, such as the psychological dependence of some people. For this case, there is a simple and brief instrument, which is made up of seven (7) dichotomous scoring units that must be answered (Weil and Rosen 1997).

In Spain, we have a valid instrument for the diagnosis of techno-stress. Its name is RED -TIC: it has been developed by WANT Research team, Prevenció Psicosocial de la Universitat Jaume I de Castellón (<http://www.want.uji.es> (accessed on 30 May 2021)).

This instrument is made up of four blocks of variables:

1. Administrative data;
2. Use of ICT;
3. Psychosocial risks; and
4. Psychosocial consequences.

As can be seen, the blocks directly refer to working with technologies (Salanova Soria 2005).

It is worth highlighting, within this tool, its ability to diagnose techno-stress and much more, since it allows to know its antecedents, among which it is convenient to highlight the demands and the lack of work resources and personal resources. It also assesses the consequences caused on an emotional level and includes an assessment of psychosocial damage and psychosocial well-being (Salanova Soria 2003).

8. Policy Implications of the Stresses Associated with Telecommuting

According to the previous sections of this article, ICTs have been a great way to reconcile work and personal life in recent times and a way to save jobs and companies from the COVID-19 pandemic in recent months (Diaz et al. 2012). However, they have become a personal risk to the worker: there have been no limits on job obligations in many cases. Thus, leisure and family and social life have been altered and invaded. In addition, this has prevented the disconnection of obligations, producing physical, psychological, and social risks for workers who used ICTs (Di Martino and Wirth 1990). For this reason, all the occupational diseases derived from the continuous and non-rationalized use of the new technologies that have been listed in Section 6 of this article have been shown.

Techno-stress has become normal today, especially since the arrival of the pandemic. To the massive labor use of ICTs, confinement and information fatigue are added, meaning techno-stress is a risk. The large amount of news and information that is available to workers with just a click of the mouse, both in the media and on social networks, is a significant risk (Salanova Soria 2003).

The pandemic has brought a lot of uncertainty. Due to this uncertainty, every individual brain seeks all the possible information to adapt to the environment and try to survive. Meanwhile, the media have published as much information as possible. The need for information with a lot of people confined at home, and with ICTs allowing easy access to the information, made these people have their only window to the world on their devices (Blanco-Donoso et al. 2020).

Therefore, techno-stress brings disorders associated with anxiety symptoms: it can lead the worker to burnout syndrome (Salanova et al. 2002). Work activity, as a consequence of a continuous exposure to situations of chronic stress, related to the use of new technologies (Demerouti et al. 2001).

The adaptive changes characteristic of technology mean serious and important risks and consequences for workers, but also for organizations. Therefore, techno-stress not only has harmful effects on workers' health: it also has perverse effects on companies.

There are a lot of consequences of techno-stress. Many of them have already been mentioned before and characterize work stress: sleeping problems, headaches, muscle aches, gastrointestinal disorders, feeling overwhelmed, chronic fatigue. All of them frequently cause sick leave. It increases the levels of absenteeism in the company and reduces the workers performance and decreases the workers productivity.

Work absences, absenteeism or reduced work performance, all due to insufficient or inappropriate use of new technologies, hurt companies.

The company has to guarantee the effective protection of the safety and health of all its workers; this cannot be forgotten. Most of the countries preventive legislation works to support this goal. Therefore, the company must work to avoid the risk factors mentioned above. Companies must implement strategies to reduce the chances that their employees suffer any of the ills mentioned in the previous section (Salanova et al. n.d.).

In this sense, active strategies are especially effective: strategies in which the worker performs an action. In them, the company must encourage workers and provide them with the necessary resources so that they can develop the necessary actions to avoid techno-stress (Salanova et al. 1999). Mechanisms must also be included to facilitate the adaptation of workers to new technologies: training, information, and communication are key pieces in this regard: the workers have to know the changes and prepare for those changes, having communication tools that promotes their participation.

Every measure has to be accompanied by strategies focused on the design of the job: strategies that try to design (or redesign) the jobs in which new technology is going to be implemented. “Healthy” jobs are generated like this. It is interesting that employees perceive technology as a very useful tool.

A good policy of prevention and risk management, promotion of health in companies framework and promotion of healthy lifestyles, contribute to the improvement of business competitiveness. The next section of this article, below, lists ways to avoid techno-stress.

9. Ways to Deal with Techno-Stress

As in the rest of the preventive activity, the level of risk to which workers are exposed must be evaluated, as we have seen in the previous section (Salanova et al. 1999).

Based on this information, then a series of preventive measures must be planned and implemented to eliminate or reduce the risk, adapting ICTs to the requirements and skills of each worker. It is necessary to try to grant the worker sufficient autonomy and control over the tasks that he has to carry out; in other words, you have to try to put technology at the service of the worker.

Adequate training and information are decisive for workers to strengthen their skills and competencies in the use of ICTs, while developing proactive attitudes and abandoning initial misgivings. Attendance to specific training courses on the use of technologies constitutes one of the prevention strategies par excellence, since it allows us to face technological change.

A good job design, in which this technology is to be implemented or innovated, generates a healthy position, turning technology into a powerful instrument to enrich personal interaction and promoting the feeling of belonging, at the same time that the culture of the organization is reinforced (Lazarus 1981).

Today, ICTs are a practically essential means in the work environment and a profitable use of them is a priority factor for the competitiveness of companies, provided that these tools are achieved in an ideal way, and thus they will allow to optimize performance of the tasks.

To do this, the following preventive action objectives must be met (order is important):

- Avoid risks;
- Evaluate the risks that cannot be avoided;
- Combat the risks at source;
- Replace what is dangerous with what is less dangerous;
- Adapt the job to the person;
- Take into account the evolution of technology;
- Plan prevention looking for a coherent and integrated set with the rest of the activities and circumstances of the company;
- Adopt measures that put collective protection before individual protection.

However, it is essential to identify the needs and priorities in the field of ICTs, to draw up an adequate development and implementation plan. Fluent communication, both oral and written, is essential to facilitate access to information ([Molina 1995](#)).

All this must be accompanied by an empowerment of work teams, increasing the use of interdepartmental groups to solve problems related to ICTs, providing easy-to-use software and providing support in its initial phases.

ICTs have brought many advantages to business development, being a key factor not only in that economic development, but also in work-life balance (family, flexibility, mobility when working, saving time, etc.).

Currently, ICTs are seen as an occupational risk factor and not so much as another means of educating workers to take preventive measures to avoid health problems or accidents in their daily performance. We must seek a balance between benefits and contraindications of ICTs.

The prevention and protection measures in the face of new technologies, in general, must coincide with the principles that must be applied in all preventive policies, which are:

- Avoid risks;
- Evaluate the risks that cannot be avoided;
- Combat the risks at source;
- Replace what is dangerous with what is less dangerous;
- Adapt the job to the person;
- Take into account the evolution of technology;
- Plan prevention looking for a coherent and integrated set with the rest of the activities and circumstances of the company;
- Adopt measures that put collective protection before individual protection.

If an eminently practical training is given, the possibility of success increases, the fear of error can be reduced and the worker's anxiety can be reduced.

At first, the training should be simple and understandable. This generates confidence in the worker: the operator is prepared to face riskier situations in the future, where he will have the opportunity to test his knowledge.

The Internet can be a conducive medium for a worker to obtain the training, both general and specific, that his position requires for those cases in which this training modality is used.

Online learning offers the possibility of organizing schedules tailored to workers. To this it must be added that they do not need to make any travel: learning can be done from home, from the workplace or from anywhere, as long as they have an Internet connection.

Social media, as a support instrument, can greatly facilitate the employee education process. With them, the relevant information is made available to the worker to facilitate self-learning, which means that the worker feels more involved in the company.

It cannot be forgotten that, just as stress is a phenomenon of social dimensions, techno-stress, as a variant of the previous one, is also so. Much has been said here about interpersonal relationships in the workplace: they can be a cause of stress but, as with any social relationship, they can act as an important factor reducing stress levels, although it is ignored by means of which mechanism this Social support exerts its cushioning effect.

We can think that social support acts on at least four fronts ([French and Caplan 1972](#)):

- It can promote awareness that facilitates the adaptation of work demands to individual capacities;
- The affected worker has a more real and objective perception of the reality that he is living: this reduces the possible distortions to which the particular form of perception of each person can lead;
- The consequences experienced by stress can be reduced. Personal contact, as an expression of affection and understanding, can be a factor that facilitates emotional discharge and slows the spiral of repetitive negative thoughts that unleash a cumulative process of tension;

- The subject's adaptive resources may increase. Social support can provide the individual with a feeling of support and security, which is an element that increases her ability to react and favors a feeling of control of the situation.

Using new technologies and a transmission of information and complete training, professions that could be considered high risk in occupational accidents have seen a reduction in the number of accidents.

A good risk prevention and management policy, together with the promotion of health within the framework of companies and the promotion of healthy lifestyles, contribute to the improvement of business competitiveness.

Steps must be taken to combat this anticipated increase in stress. Work-related stress can be prevented or counteracted by redesigning the job, improving social support, and offering reasonable compensation for effort.

10. Conclusions

Telecommuting is not new: COVID-19 forced a lot of companies to implement telecommuting to survive. For this reason, telecommuting and its occupational risks are new for a lot of people: employers and workers. The application of innovative technologies is making it easier for companies and workers to have a greater volume of information. It is also allowing much faster and more efficient business decisions.

Technical, human, and social problems are revealed by technological changes and communication development, in a particularly significant way in companies and organizations, and also in workers, of course. The negative psychosocial effects of the use of information and communications technology are directly related to techno-stress, which is directly reference to problems of adaptation to new technological tools and systems. In this article, techno-stress has been defined as a negative psychological state, directly related to the use of ICT or the threat of its use in the immediate future. This state is conditioned by the perception of a mismatch between the demands and resources related to the use of ICT. This leads to a high level of unpleasant psychological and physiological activation and the development of negative attitudes towards ICT.

However, it is reflected that techno-stress is the result of a perceptual process of mismatch between demands and available resources, and is characterized by two central dimensions, affective symptoms or anxiety related to the high level of psychophysiological activation of the organism and development negative attitudes towards ICT.

Despite what we have said so far, we must have a global vision: The use of new technologies alone cannot be considered as a source of risk. Quite the opposite: these new technologies are a great help in the preventive management of the company and a contribution to the reduction in accidents and the improvement of the conditions of workers and jobs.

In fact, new technologies are of paramount importance in the field of occupational risk prevention, insofar as they allow the planning of control inspections in an agile and efficient way and allow better control of preventive measures and working conditions, proposed during visits and inspections.

At the same time, ICT facilitate the recording data taken during the observation of the works and allows them to be always available to update or analyze them at any time they are needed.

The high speed and information exchange capacity makes it possible to speed up the exchange of documentation, which can be done automatically, saving time and guaranteeing better control of the contracting companies.

A good use of the appropriate technologies makes the company have higher levels of security and better productivity and be more competitive, helping to comply with current legislation in a much simpler way and through tools specially designed for this. In this way, the integration of the company is promoted at all its levels, also simplifying the management processes.

Finally, we cannot forget that the human being is a sociable being; we cannot forget the psychological benefits of face-to-face work. It seems that the COVID-19 pandemic is coming to an end, thankfully. Vaccines are allowing herd immunity to be closer and closer and that, with it, the borders can be reopened, allow free movement and return to pre-pandemic normality. In this situation, many companies are considering whether to recover face-to-face work or keep teleworking. Compared to teleworking, the recovery of face-to-face working brings a lot of benefits from a psychological and emotional point of view: being and feeling belonging to part of a group or a community are indicators of mental health. Therefore, recovering human contact and social relationships in a job is a key variable for the well-being of worker. Telework means loneliness. Face-to-face work reduces the feeling of loneliness that remote teleworkers can sometimes feel with little support network: communication between teams and departments is improved, which can have benefits at the level of family and work conciliation, and even increase productivity.

However, the return will not be easy. Returning to work in person can have a very significant psychological impact. Ideally, the company was already communicating the intention to return to normality pre-pandemic, so that the worker becomes more mental and carry out a psychosocial evaluation according to the situation.

There will be cases in which very high levels of anxiety are detected: the return must be as slow and flexible as possible. The new normal requires adaptation, especially after the intensity that many workers have experienced on last months.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The author declares no conflict of interest.

References

- Ayyagari, Ramakrishna, Varun Grover, and Russell L. Purvis. 2011. Technostress: Technological Antecedents and Implications 1. Available online: <http://www.misq.org> (accessed on 27 May 2021).
- Bandura, Albert. 1997. *Self-Efficacy: The Exercise of Control*. New York: Freeman.
- Bird, Gerald. A., Gloria W. Bird, and Marguerite Scruggs. 1983. Role-Management Strategies Used By Husbands and Wives in Two-Earners Families. *Home Economics Research Journal* 12: 63–70. [CrossRef]
- Blacker, Frank, and Colin Brown. 1986. Alternative models to guide the design and introduction on the new information technology into work organizations. *Journal of Occupational Psychology* 59: 287–313. [CrossRef]
- Blanco-Donoso, Luis Manuel, Eva Garrosa Hernández, Jennifer Elena Moreno-Jiménez, and Bernardo Moreno-Jiménez. 2020. Occupational psychosocial risks of health professionals in the face of the crisis produced by the COVID-19: From the identification of these risks to immediate action. *International Journal of Nursing Studies Advances* 2: 100003. [CrossRef]
- Brod, Craig. 1984. *Techno Stress: The Human Cost of the Computer Revolution*. Iowa: Longman Higher Education.
- Chiappetta, Marta. 2017. The Technostress: Definition, Symptoms and Risk Prevention, 4. Available online: https://www.researchgate.net/publication/325031719_The_Technostress_definition_symptoms_and_risk_prevention (accessed on 11 June 2021).
- Cox, Tom, and Amanda Griffiths. 1996. The assessment of psychosocial hazards at work. In *Handbook of Work and Health Psychology*. Edited by Schabracq M. J., J. A. M. Winnubst and C. L. Cooper. Chichester: Wiley and Sons, pp. 127–46.
- Demerouti, Evangelia, Arnold B. Bakker, Friedhelm Nachreiner, and Wilmar B. Schaufeli. 2001. The Job Demands-Resources Model of Burnout. *Journal of Applied Psychology* 86: 499–512. [CrossRef]
- Di Martino, Vittorio, and Linda Wirth. 1990. Teletrabajo; un Nuevo Modo de Trabajo y de Vida. *Revista Internacional del Trabajo* 109: 469–98.
- Diaz, Ismael, Dan. S. Chiaburu, Ryan D. Zimmerman, and Wendy R. Boswell. 2012. Communication Technology: Pros and Cons of Constant Connection to Work. *Journal of Vocational Behavior* 80: 500–8. [CrossRef]
- EU-OSHA. 2014. La Estimación del Coste del Estrés y los Riesgos Psicosociales Relacionados con el Trabajo. OSHwiki. Retrieved 18 March 2019. Available online: https://oshwiki.eu/wiki/A_review_on_the_future_of_work:online_labour_exchanges_or_crowdsourcing (accessed on 12 June 2021).
- EU-OSHA. 2019. A Review on The Future of Work: Online Labour Exchanges or Crowdsourcing: OSHwiki. Retrieved 18 March 2019. Available online: https://oshwiki.eu/wiki/A_review_on_the_future_of_work:online_labour_exchanges_or_crowdsourcing (accessed on 7 June 2021).

- EU-OSHA. n.d. *Psychosocial Risks and Stress at Work*. Available online: <https://osha.europa.eu/en/themes/psychosocial-risks-and-stress> (accessed on 11 June 2021).
- EUR-Lex. 2005. Teleworking. Last Updated on 17 May 2005. Available online: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=LEGISSUM%3Ac10131> (accessed on 7 June 2021).
- French, John R. P., and Robert D. Caplan. 1972. Organization Stress and Strain. In *The Failure of Success*. Edited by A. J. Marrow. New York: Amacom, pp. 30–66.
- Hudiburg, Richard A. 1989a. Psychology of Computer Use: VII. Measuring Technostress: Computer-related stress. *Psychological Reports* 64: 767–72. [CrossRef]
- Hudiburg, Richard A. 1989b. Psychology of Computer Use: XVII. The Computer Technology Hassles Scale: Revision, reliability, and some correlates. *Psychological Reports* 65: 1387–94. [CrossRef]
- Jay, T. 1981. Computerphobia: What to Do About It? *Educational Technology* 21: 47–48.
- Lazarus, Arnold. A. 1981. *The Practice of Multimodal Therapy*. New York: McGraw-Hill.
- McGrath, Joseph E. 1970. *Social and Psychological Factors in Stress*. Holt McDougal: Rinehart, & Winston of Canada.
- Molina, Jose Luis. 1995. Implantar con Éxito el Teletrabajo en la Empresa. *Alta Dirección* 30: 81–94.
- Moorcroft, Sheila, and Valerie Bennett. 1995. *European Guide to Teleworking*. Dublin: European Foundation for the Improvement of Living Working Conditions.
- Ninaus, Katharina, Sandra Diehl, Ralf Terlutter, Kara Chan, and Anqi Huang. 2015. Benefits and Stressors—Perceived Effects of ICT Use on Employee Health and Work Stress: An Exploratory Study from Austria and Hong Kong. *International Journal of Qualitative Studies on Health and Well-being*. [CrossRef] [PubMed]
- Peiró, José M^a, and Alicia Salvador. 1993. *Control del Estrés Laboral*. Madrid: Eudema Psicología.
- Perez-Iñigo, Carlos, and Francisco Ortiz Chaparro. 1995. Teletrabajo y Organización Empresarial. BIT (La Revista de las Tecnologías de la Información) 92, Abril – Mayo 1995. Available online: https://docs.google.com/viewerng/viewer?url=https://www.coit.es/sites/default/files/archivobit/pdf/bit092_15.pdf (accessed on 5 June 2021).
- Rosen, Larry D., and Michelle M. Weil. 1992. Measuring Technophobia. A Manual for the Administration and Scoring of the Computer Anxiety Rating Scale, the Computer Thoughts Survey and the General Attitude toward Computer Scale. Available online: https://www.shs-conferences.org/articles/shsconf/pdf/2018/12/shsconf_shw2016_02003.pdf (accessed on 12 June 2021).
- Rosen, Larry D., Deborah C. Sears, and Michelle M. Weil. 1987. Computerphobia. *Behavior Research Methods, Instruments, and Computers* 19: 167–79. [CrossRef]
- Salanova Soria, Marisa. 2003. Trabajando con tecnologías y afrontando el tecnoestrés: El rol de las creencias de eficacia. *Revista de Psicología del Trabajo y de las Organizaciones* 19: 225–47. Available online: <http://www.redalyc.org/articulo.oa?id=231318057001> (accessed on 12 June 2021).
- Salanova Soria, Marisa. 2005. Metodología WONT para la Evaluación y Prevención de Riesgos Psicosociales. *Gestión Práctica de Riesgos Laborales* 14: 22–32.
- Salanova Soria, Marisa. 2007. Nuevas Tecnologías y Nuevos Riesgos Psicosociales en el Trabajo. Available online: <http://rabida.uhu.es/dspace/handle/10272/3411> (accessed on 12 June 2021).
- Salanova, Marisa, Eva Cifre, and Pilar Martín. 1999. El Proceso de “Tecnoestrés” y Estrategias para su Prevención. *Prevención, Trabajo y Salud* 1: 18–28.
- Salanova, Marisa, José María Peiró, and Wilmar. B. Schaufeli. 2002. Self-efficacy Specificity and Burnout among Information Technology Workers: An extension of the Job Demands-Control Model. *European Journal on Work and Organizational Psychology* 11: 1–25. [CrossRef]
- Salanova, Marisa, Susana Llorens, Eva Cifre, and Clotilde Nogareda. n.d. NTP 730: Tecnoestrés: Concepto, Medida e Intervención Psicosocial. Available online: <http://www.want.uji.es/download/el-tecnoestres-concepto-medida-e-intervencion-psicosocial/> (accessed on 12 June 2021).
- Salinas, José María. 1995. El teletrabajo en la nueva sociedad global de la información. *Boletín Fundesco* 164: 5.
- Sears, Deborah C., Larry D. Rosen, and Michelle M. Weil. 2000. General Attitudes toward Computers Scale (GATCForm C). In *Measuring Technophobia: A Manual for the Administration and Scoring of the Computer Anxiety Rating Scale, the Computer Thoughts Survey and the General Attitude Toward Computer Scale*. Edited by Larry D. Rosen and Michelle M. Weil. Orange: Chapman University.
- Tarafdar, Monideepa, Qiang Tu, T. S. Ragu-Nathan, and Bhanu S. Ragu-Nathan. 2007. The Impact of Technostress on Role Stress and Productivity. *Journal of Management Information Systems* 24: 301–28. [CrossRef]
- Tarafdar, Monideepa, Qiang Tu, T.S. Ragu-Nathan, and Bhanu S. Ragu-Nathan. 2011. Crossing to the Dark Side: Examining Creators, Outcomes, and Inhibitors of Technostress. *Communications of The ACM—CACM* 54: 113–20. [CrossRef]
- Weil, Michelle M., and Larry D. Rosen. 1997. *Technostress: Coping with Technology Work*. New York: John Wiley and Sons.