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Smart Working: measurement of the Sustainability impact

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Abstract English version

This paper aims to develop a set of indicators to quantitatively measure the impact of Smart Working on environmental, social and economic sustainability.

Smart Working can be described as a real revolution in the way employees work today.

The concept of Sustainability was born in the 1970s when humanity began to realize that the planet's resources are not infinite and that the ideals of absolute exploitation of resources and people of the time would lead the planet to ruin.

Therefore, the goal of this work is to create awareness of the current and future importance of Smart Working in the work organization and in the people's lives, and to understand the importance of the concept of Sustainability and sustainable development. Studies in the literature qualitatively address the impact of Smart Working on social and economic environmental sustainability, such as: air and noise pollution, energy consumption and associated costs, work-life balance, psychological stress, physical health, commuting, etc.

The innovation of this study is to create a set of indicators to quantify these impacts in order to raise awareness for companies implementing Smart Working activities.

Abstract versione Italiana

Questo lavoro riguarda lo sviluppo di una serie di indicatori per misurare quantitativamente l'impatto dello Smart Working sulla Sostenibilità ambientale, sociale ed economica.

Lo Smart Working può essere descritto come una vera e propria rivoluzione nel modo in cui lavoriamo oggi.

Il concetto di Sostenibilità nasce negli anni '70 quando l'umanità ha iniziato a rendersi conto che le risorse del pianeta non sono infinite e che gli ideali di sfruttamento assoluto delle risorse e delle persone di allora avrebbero portato il pianeta al collasso.

Pertanto, lo scopo di questo articolo è quello di creare consapevolezza dell'importanza attuale e futura dello Smart Working nell'organizzazione del lavoro e nella vita di tutte le persone, e di comprendere l'importanza del concetto di Sostenibilità e di sviluppo sostenibile. Gli studi presenti in letteratura trattano in maniera qualitativa gli impatti dello smart working sulla Sostenibilità ambientale sociale ed economica, quali: inquinamento dell’aria ed acustico, consumi energetici e relativi costi, work-life balance, stress psicologico, salute fisica, pendolarismo, ecc...

L'innovazione di questo studio consiste nel creare una serie di indicatori in grado di quantificare questi impatti, aumentando così la consapevolezza per le aziende che implementano attività di Smart Working.

Introduction

This work is aims to develop a set of indicators to measure the impact of Smart Working on environmental, social and economic Sustainability.

The need arises from the ever-increasing importance and prevalence of these two phenomena. On the one hand, Smart Working can be described as a real and proven revolution in the way of working. On the other hand, since the 1970s, humanity has begun to realize that the planet's resources are not unlimited and that the ideals of absolute exploitation of resources and people at that time would lead the planet to collapse.

Smart Working means "*rethinking work from a smarter perspective, challenging traditional constraints of place and time, and giving people more autonomy to design their work while taking more responsibility for outcomes. Autonomy, as well as flexibility, empowerment, talent development and trust, are key principles of this new approach.*" (Smart Working Observatory, 2016).

Smart Working is thus a process of profound change that affects organizations as a whole, the way they design their work and manage their relationships. Smart Working should not be reduced, as is unfortunately often the case, to a form of corporate welfare or a more flexible form of telecommuting that allows employees to work from home once a week. Smart Working is much more than that; it is a new management philosophy based on giving people back more flexibility and autonomy in choosing their working conditions, e.g., in terms of the premises, the working hours, and the work tools to be used, and in return holding them accountable for the results (Smart Working Observatory, 2016).

On the other hand, the concept of environmental Sustainability has attracted growing interest in society in recent years. It is the result of an increased awareness of the depletion of our planet's resources and the constant need to preserve the quality of our natural heritage, with the aim of promoting more balanced economic-social development models than those adopted in the past. Sustainable development is a multifaceted and

multidisciplinary concept proposed as an objective value, sometimes as a reference model to aspire to, in order to overcome the "unsustainable" logic of profit and growth that has been pursued until now. In the last 50 years, as a result of the incessant process of globalization, the Western world has understood development as synonymous with material and quantitative growth, ensuring that the successes achieved in the economic field have entailed enormous human, social and environmental costs, showing that development in the form pursued so far must be considered unsustainable. Faced with the crisis of recent years, the need then arose to promote development that could be described as sustainable, and in 2002 the Johannesburg Declaration on Sustainable Development established the three pillars of Sustainability: social development, economic development and environmental protection.

Thus, the purpose of this paper is to create awareness of the current and future importance of Smart Working in the organization of work and in people's lives, and to understand the importance of the concept of Sustainability and sustainable development. However, unlike the studies in the literature, the innovation lies in creating a set of indicators that can quantify how Smart Working impacts environmental, social and economic Sustainability, thus creating awareness for companies that implement Smart Working activities. By having data that shows the impact of Smart Working on Sustainability, it is also possible through the study to understand any limitations or shortcomings in the implementation in the company.

The thesis begins with a literature review of both phenomena, Smart Working and Sustainability, analyzing them first as separate entities and then as interconnected entities, demonstrating the impact of Smart Working on Sustainability.

The second chapter explains the methodology of the literature review, the lessons learned, and the process of creating the indicators presented in the last chapter.

Following the methodology, the indicators that measure the impact of Smart Working on environmental, social, and economic Sustainability are presented, and finally, the conclusions and limitations of the work.

1 Literature review

After an in-depth literature review, this chapter analyses two different phenomena that are interrelated and increasingly important in our lives: Smart Working, which in Italy is now present in 91% of large companies, 48% of SMEs and 57% of Pas (Smart Working Observatory, 2022), and Sustainability, considering that 84.3% of companies have implemented at least one social Sustainability measure and 75.8% at least one environmental Sustainability measure (Istat, 2020).

Of the two, the facets of the different definitions in the literature, the principles on which they are based, and their main characteristics are examined.

Both Smart Working and Sustainability can have a strong impact, albeit in different ways, on citizens' current and future quality of life. This chapter therefore discusses their potential, the optimal ways to implement them, and how they relate to each other.

1.1 Smart Working

This first part of the literature review refers to Smart Working.

The section begins with the definitions, which are analysed in chronological order to understand their evolution over time, from the beginning to the present. Following on from the current definition, the main principles and design levers are analysed. Then, the different implementation models and their specificities will be explained. Finally, the benefits and limitations are briefly presented, which will be explored in greater depth in the next section in relation to Sustainability from three different perspectives: that of the company, that of the employees and that of society. Finally, the current state of diffusion of the phenomenon in Italy and its normative aspect are examined.

1.1.1 Definition

In the first years of the 2000s, Smart Working (SW) has emerged in international literature as a new way to define what is considered as an innovative approach to work organization (Boorsma et al., 2011), challenging the conventional models of work design and redesign, the traditional organizational hierarchy, and the classic managerial style mainly focused on control (Brewer, 2000).

The phenomenon known in Italy as Smart Working can also be defined in academic literature as Flexible Working and Agile Working.

Starting from the different definitions of Smart Working, analysed in chronological order, it is possible to understand the essence of this phenomenon, on what it is based on and how it has evolved over time and, finally, how it is considered nowadays and what principles, levers and models need to be analysed in order to get a proper knowledge of this topic.

"Smart Working is the newly coined term that embraces the entirety of new ways of working opportunities in an integrated manner – be that spatial and temporal autonomy, the required cultural and trust transitions, technological advances, wider intellectual connections and stimuli, social, ethical and environmental sensitivities – all harmonized to suit the individual working style" (Blackwell, 2008).

The above definition is one of the earliest definitions of Smart Working. It is important to note that even the earliest definitions, when the phenomenon was in its beginnings, emphasized the foundation on which it is still based today: mutual trust, flexibility, and technology.

"*Smart Working involves developing a new work culture. It is not about doing things in the old way with some new technologies and redesigned offices – it is about new ways of working using new tools, new processes, and new approaches to management and teamwork. This requires different types of behaviours and different expectations about how work is done*." (Flexibility, 2011).

The centre of this definition is related of a "*new work culture*". Indeed, Smart Working is not only an increase flexibility and a change in the used technologies, here it is highlighted that also a culture switch is needed. From a task-based culture to a goal oriented one.

"The term "Smart Working" has arisen worldwide to describe a new, more enlightened work environment that literally breaks down the physical barriers of "the office" as we know it. More and more, workplaces are being thoughtfully optimized to help employees 12 *do their best work-anywhere and anytime. While Smart Working is certainly helping organizations to increase efficiency and reduce costs, it is also enabling them to provide a workspace that better reflects how we work, and to fully leverage employees' dynamic creativity and emotional connection to work."* (Plantronics, 2012).

The centrality of the reorganization of physical spaces is highlighted here. Compared to previous definitions, despite using a different way to indicate the same concept, similarities can be drawn on concepts and cornerstones on which new managerial thinking is based, such as: flexibility of working conditions, reconfiguration of spaces and innovation, collaboration; without neglecting the peculiarities of the organization, the degree of autonomy in choices and staff awareness.

"From the outset we had defined 'Smart Working' as letting people work where and when as they wished as long as it delivered the right results, saved costs and respected the planet. Space, technology and people management worked together intensely to make the business more effective." (G. Clapperton & Vanhoutte, 2014).

From this definition, it is understood that for the application of Smart Working, a revolution in managerial culture is needed: the introduction of flexibility, the reorganization of workspaces, new technologies for the achievement of positive results in terms of both effectiveness and efficiency.

"*Smart Working is rethinking work from a smarter perspective, questioning traditional constraints related to place and time, leaving people more autonomy in defining work arrangements against their greater accountability for results. Autonomy, but also flexibility, empowerment, talent enhancement and trust become the key principles of this new approach*". (Smart Working Observatory, 2016).

Smart Working Observatory of Politecnico of Milan focuses attention to the concepts of autonomy, flexibility and empowerment and trust, that are now defined as "key principles". These topics are very import because to overcome the current constraints given by office work, it is necessary to give more autonomy and flexibility, which can be achieved through empowerment and increased trust.

From the definitions above, it is possible to see how Smart Working has evolved and which success factors companies need to optimally implement this new way of working: reconfiguration of working spaces, organizational policies and technological innovation. All this is, however, possible only if a cultural change is applied. A transformation, desired and adopted by the top management of the company, that results in a reduction of control and greater empowerment of employees. So far, the definition of the Smart Working Observatory seems to be more complete and up-to-date and will serve as a reference for further literature review, analysing the main principles and levers.

1.1.2 Smart Working principles

The next sections will present and explain the four main characteristics on which Smart Working is based (Smart Working Observatory, 2016):

- *Flexibility* intended both as the company's capability to react to changes in the environment and as flexibility in the time and place of work for employees;

- *Trust* among people that with Smart Working works on a goal-oriented culture so that they can jointly produce the targeted results;

- *The empowerment and autonomy of the employees* to increase the level of involvement;

- *Collaboration and communication* both in horizontal and vertical direction of the company's hierarchy.

1.1.2.1 Flexibility

It is possible to have two different perspectives when it comes to flexibility: the first is assuming an organizational perspective, the second assuming the worker one.

Adopting the organizational point of view, flexibility is defined as "*the firm's abilities to respond to various demands from dynamic competitive environments*" (Sanchez, 1995).

Thus, flexibility provides an organization with the ability to modify current practices in response to changes in the environment. By consistently scanning the environment and detecting changes, organizations will have to have a pool of alternatives available to accommodate these changes.

Considering the worker perspective, workplace flexibility emphasizes the willingness and ability to adapt to changes, particularly regarding how and when work gets done.

In a flexible workplace, the needs of both employee and employer are met. Workplace flexibility is often used as a tool for retaining and engaging employees. It can also help an organization reach its goals thanks to improved productivity (Doyle, 2022).

Workplace flexibility is a strategy for responding to changing circumstances and expectations. Employees who approach their job with a flexible

mindset are typically more highly valued by employers. Similarly, employers who cultivate a flexible work environment are attractive to employees (Doyle, 2022).

1.1.2.2 Trust

Trust is a fundamental characteristic within business dynamics. To activate a Smart Working project, it is essential to work with a different approach, to be capable of overcoming the concepts of hierarchy, power and control and to stimulate a work culture based on trust (Minghetti, 2014).

Trust is composed by two indispensable elements: character and competence. Character consists of: integrity, motivation, intent toward people; competence, on the other hand: skills, abilities, tangible results.

Stephen Covey in one of his latest publications (The Speed of Trust, 2008) argues that the attribution of trust has enormous potential to create prosperity and success within a business, but he also underlines how this is often underestimated. It highlights how to work on trust and improve it to optimize the results it produces in the company when it is present. He identifies five different types of trust. The basis of it all lies in understanding and learning to apply what are called the "5 Waves of Trust." This concept defines the five contexts in which we create trust (Covey & Merrill, 2008):

- Self-trust: self-confidence and the ability to inspire confidence in others. The goal is to become people in whom one can assign trust. The key principle is credibility.

- Trust in relationships: concerns placing more and more of one's trust in others. These behaviours rely on the principles governing trust in relationships. The result desired is to considerably improve the ability to generate trust and all that goes with it, so that relationships can be improved and ever better results can be achieved.

- Corporate trust: aims at how leaders can build trust with respect to all types of organizations. Alignment is the key principle behind this wave and helps leaders to create structures, systems, and symbols of organizational trust.

- Market trust: this is the wave in which, almost anyone can feel the effects of trust. The founding principle of this level is reputation. It is about how the brand (corporate or personal) can reflect trust in customers, investors, and others operating within the marketplace.

- Societal trust: this is about creating value for others and society at large. The principle behind this wave is contribution. By contributing or "giving back," one neutralizes suspicion and cynicism, inspiring others, too, to create value and contribute.

  Given the increase in employees flexibility, and thus the shift to working by objectives with less supervision through the introduction of Smart Working, it is critical that every form of trust belonging to the first 4 waves be present in order to develop an efficient business environment. Employees' enthusiasm for Smart Working and a positive attitude toward all forms of flexibility are crucial in this situation, but they should not assume that the Smart Working will only benefit the company.

1.1.2.3 The empowerment and autonomy of the employees

The concept of empowerment encapsulates the idea of empowering actors through high involvement aimed at improving performance and the level of efficiency, quality, and profitability (Blanchard et al., 2007). This concept is intrinsically related to the one of autonomy over how work is to be carried out to achieve set goals (Educational Portal, 2014).

To implement the principle of Smart Working autonomy, it is useful to allow employees to choose the manner and organization of tasks to be performed in order to achieve results (for which they are fully responsible). Autonomy

implies a change in evaluation criteria: there is a shift from an evaluation made on the quantity of work to an evaluation carried out on the quality of that work (Flexibility, 2011).

1.1.2.4 Collaboration and communication

A key principle of Smart Working is to use open and emergent collaboration and communication as the main coordination tool. Hierarchy, seen as the predominant form of coordination between people, is no longer appropriate to the pace of work because it risks impeding the flow of activities by making interactions slower and more complex, often without adding real value. (Smart Working Observatory, 2016). These two elements should act vertically, between management and employees, and horizontally, among employees. It is crucial that before implementing Smart Working, all the employees of the company are informed and personally involved in the project so that everyone contributes to the transformation of the organizational approach (Clapperton & Vanhoutte, 2014).

Working from home has advantages on work flexibility but could have disadvantages on the emergence of interpersonal relationships. The impact of working from home, on communication effectiveness and collaboration, can be significant.

To avoid this, new techniques and tools are essential to ensure the same work effectiveness and not diminish the interpersonal relationships that facilitate the achievement of better results.

Nowadays, ICTs are facilitating and stimulating communication and collaboration inside the company (Clapperton & Vanhoutte, 2014).

1.1.3 Smart Working Levers

This section first introduces the four design levers, which will be specifically analysed in the following sections.

To put the organizational principles of Smart Working into action, common and consistent initiatives must be created, guided by four design levers (Smart Working Observatory, 2016):

- Organizational policies: rules and guidelines that allow the flexibility of time, workplace and the possibility to choose and customize the tools used for work;
- Physical layout: reconfiguration of spaces according to the specific activities to be carried out in them, and to enhance the well-being of employees;
- Leadership styles: the appropriate behaviour of managers in exercising authority and control over employees;
- Digital technologies: technologies that allow fast and immediate access to data and documents from anywhere regardless of the device used. Digital technologies support communication, collaboration among employees, employers and clients.

1.1.3.1 Organizational policies

In order to introduce Smart Working, a company should define a set of organizational policies that regulate time and place flexibility. Indeed, Smart Working refers to alternative work options that allow organizational members to customize the spatial and temporal boundaries of their workday (Rau & Hyland, 2002).

Temporal flexibility and spatial flexibility are the two typologies of flexible initiatives (Greenberg & Landry, 2011).

Time flexibility allows employees to arrange their own work shift within the limits set by the company (e.g., variable start of work between 8 a.m. and 10 a.m. and 8 hours of work after the start of work), while the spatial flexibility refers to arrangements that enable an employee to work from a location outside of the traditional office or worksite (Kossek & Friede, 2005).

The introduction of these types of initiatives brings benefits both for the employee, who is able to reconcile work and personal needs, and for the company that, thanks to the reduction of absenteeism, turnover, overtime and employee stress, registers an increase in productivity (Fenwick & Tausig, 2001).

The most common options of time flexibility are:

- Flexitime: employees can change start and finish working time, maintaining constant the total amount of weekly working hours (Haar, 2007);

- Annualised hours: the employee must respect the total amount of working hours during the year, that is fixed, choosing how many hours per day or week he works. This is useful for coping with seasonal fluctuations of demand or for meeting personal requirements (Corominas et al., 2004);

- Compressed working weeks: employees work their standard working hours in fewer days (Colligan & Tepas, 1986);

- Part-time: employee is contracted to work less than typical full-time hours. This form of flexibility allows the employee to obtain the work-life balance and the company to attract a greater number of employees (Perrin, 2001);

- Job share: two or more people share a full-time job. In this case, the responsibilities, tasks and roles must be well coordinated to optimize productivity (Javitch, 2006).

On the other side, the main options in terms of spatial flexibility are:

- Mobile working/Tele working/Home working: a paid work done outside the regular workplace under an employment contract (Lehto & Sutela, 2009) . The use of digital technologies allows workers to have an effective communication with their colleagues or clients;

- Working from other offices: employees may choose to work from other offices belonging to the same organization, from coworking spaces, third party or client offices;

- Sharing space in the office: employees do not have a permanent desk, the stations become mobile and flexible, the workspaces are shared. This behaviour allows an efficient exploitation of offices and facilitates communication and collaboration between colleagues (McIver et al., 2013);

- Working as virtual teams: employees, belonging to the same work team, are located in geographically distant places and communicate through technological tools (Leidner & Jarvenpaa, 1999). This way of working presents advantages especially for employees who, using technological tools, are able to save time and reduce travel (Molino, 2013).

Both spatial and temporal flexibility had positive effects on productivity or self-rated performance, job satisfaction, and satisfaction with work schedules (Baltes, 1999).

1.1.3.2 Physical layout

Enabling Smart Working does not only mean initiating time and place flexibility policies; it also involves rethinking workspaces from a smart perspective, of performing activities in the places designed to be most suitable for them and maximizing the outcome. Rethinking physical spaces makes it possible to improve performance (Inalhan, 2009), foster collaboration (Strauss, 1978) and stimulate innovation.

When designing new workspaces, there are 4 main needs that should be considered:

- Collaboration: when innovation is mentioned, it stands for the subsistence of working collaborative and of a suitable workplace that fosters and enables exchangeability fruitfulness among the different actors involved;

- Modifiability: by changing the physical environment, employees' needs are likely to be fulfilled at any time. Therefore, the same environment may be useful for purposes completely dissimilar to each other at equally different times, thus encouraging flexibility (Senoo et al., 2007);

- Attractiveness: an attractive workplace can bring people together. In fact, research conducted by Vischer in the field of environmental psychology has shown that people need to feel comfortable and safe in the spaces where they perform their tasks (Vischer, 2007);

- Value: the space within which one carries out one's work activities can be interpreted as reflecting an individual identity (Gustafson, 2001).

In order to be able to respond to the needs expressed by workers by optimizing well-being in the work environment in which they work on a daily basis, offices need to be reformulated, providing opportunities to adapt physical locations to the needs that arise.

In this direction, The 4C principle is based on four different work situations: Concentration, Communication, Collaboration and Contemplation. These in turn place very specific demands on the working environment and the furniture. Tailored to the needs of employees, it is possible to minimise errors and thus achieve better results. (Myerson & Bichard, 2016):

- Collaboration: the reformulation of physical spaces must take place in such a way as to facilitate communication and the sharing of ideas among a company's employees, thereby encouraging the growth of knowledge.

- Concentration: the work environment should promote the attention of the people working there; therefore, there must subsist quiet and, at times, even acoustically isolated places, located far from noisy places.

- Communication: places should be planned in such a way as to encourage the propagation of information and the gradual increase of knowledge.

- Contemplation: places should be designed allowing work breaks and encouraging the rest, with the aim of providing more space for creative thinking, while also simplifying the meeting and social relations between individuals.

1.1.3.3 Leadership styles

A leader is one or more people who selects, equips, trains, and influences one or more follower(s) who have diverse gifts, abilities, and skills and focuses the follower(s) to the organization's mission and objectives causing the follower(s) to willingly and enthusiastically expend spiritual, emotional, and physical energy in a concerted coordinated effort to achieve the organizational mission and objectives. (Winston & Patterson, 2006)

It turns out to be crucial, that an innovation that brings about a major change in the company, such as Smart Working, is directed from the top management through strong leadership that exposes and convinces employees of the change in culture, work mode, organizational structure. Managers must communicate, implement, and manage Smart Working within organizational cultures that they both influence and are influenced by. Managers' working patterns send out powerful signals about what sort of working hours or schedules are acceptable. They can lead the way by using Smart Working themselves, thus having the potential to be change agents, influencing the culture and indeed the behaviour of their peers and subordinates (Lewis, 2005).

To support the adoption of Smart Working, leaders must focus on some principles recognized as crucial to pursue a cultural change (Lake, 2014):

- Be oriented to flexibility.
- Be inclined to establish work relationships based on trust.
- Stimulate the knowledge sharing between peers.
- Possess high-levelled communicative and collaborative skills with colleagues, teams, external partners and people in general.
- Make employees feel autonomous and responsible.
- Be focused on the results obtained by employees more than on their presence

The Smart Working Observatory has identified several evolutionary steps of leadership styles and corporate culture through the different extensions of the Smart Working Journey (Smart Working Observatory, 2013). This path is based on 4 different leadership principles that depict which are the most important leaders competencies supporting the use of Smart Working.

The evolutionary steps that accompain leaders through each dimension of the Journey are:

- **Sense of community**: this skill represents the shift that intervenes from a functional and hierarchical approach toward a system of relationships marked by cooperativeness among persons, supporting a sense of equality and belonging of workers, extended to the global organization and broad social networks. In Smart Working models, in fact, it is essential for managers to create a climate of trust, encouraging shared values in organizational functions to simplify communication and cooperation among individuals (Mullen, 1997); this competence is divided into the following degrees of maturity:

- Hierarchy: managers limit clarity and involvement in employee decisions (Koh & Kim, 2003);

- Functional: managers encourage and support individuals to cooperate and share their knowledge with colleagues who are part of the same group and to focus their attention on team issues (Rovai, 2002);

- Family: managers foster an intense feeling of workers' identity and a sense of being part of the organization in which they work, with a focus on their professional "family" (Hill, 1996);

- Company Wide: managers establish informal working relationships within organizational and functional margins (Maton & Salem, 1995);

- Open Network: manager support the establishment of networks of connections (universities, consumers, suppliers and other stakeholders) outside the company in a way that supports the advancement of innovation (Jansen et al., 2009)

- **Empowerment**: independence to make decisions is assessed as the degree of freedom workers have in deciding what to do and what not to do to achieve predetermined goals, based on a strong sense of mutual trust, mutual commitment, and responsibility for results (Conger & Kanungo, 1988). In other words, it assesses which types of decisions are made by the employee and which, on the other hand, are discussed with the supervisor.

  The different degrees of maturity are:

- Command & Control: managers focus their attention on defining and constant monitoring of tasks, without providing their workers with outcomes ambitious (B. Kirkman et al., 2004)

- Flexible Standards: managers assign flexibility to their workers, from the point of view of the manner in which they carry out the assigned task, but within certain limits that are well outlined (Copestake, 2006);

- Performance Based Evaluation: managers define objectives and results and delegate activities and responsibilities to their employees (Merchant & van der Stede, 2005)

- Collaborative Goal Setting: managers discuss and negotiate objectives and expected results with employees collaboratively (Berlew, 1986);

- Full Empowerment: managers involve and empower their employees to proactively define their personal goals, which must be consistent with those of the company (Merchant & van der Stede, 2005).

- **Flexibility**: Ability to promote and manage the organization of work activities in a flexible and adaptable manner to balance personal and business needs (Smart Working Observatory, 2016). Again, this principle finds its articulation a number of evolving stages:

- Restrictive work: managers do not give employees the freedom to choose how to work reference (B. Kirkman et al., 2004);

- Flexible time: managers give flexibility in terms of working hours according to established organizational policies (Almer & Kaplan, 2002);

- Flexible work: managers give employees the opportunity to choose when and where to work, even off-site (Halpern, 2005);

- Work-life balance: managers pay great attention to the wellbeing of people, giving them the opportunity to balance work and private life, favouring an appropriate and responsible use of flexibility (Cummings et al., 2009);

- Border-free work: managers promote total flexibility in the planning of activities and in the choice of working method (Clark, 2000).

- **Virtuality**: Ability to balance the use of digital technologies and other forms of interaction, choosing from time to time the most effective method and tools in light of the goals and tasks to be accomplished (Smart Working Observatory, 2016). There are different evolutive stages:

- Physical: managers communicate and share information with their employees primarily through physical meetings (Chudoba et al., 2005);

- Communicative: managers use IT tools to interact with their employees, through a top-down communication model and do not favour alternative uses of these tools (Shepherd & Martz, 2006);

- Collaborative: managers appropriately use the various means of communication and collaboration, according to the objectives of interaction (Baker, 2010);

- Mobile: managers use different IT devices and tools, including professional solutions, to work with their employees (Dixon & Ross, 2011);

- Fully adaptive: managers encourage their employees to freely choose the preferred methods and tools for interaction and collaboration, in order to best perform their tasks (Kirkman & Mathieu, 2005).

The maturity model found in the figure below, highlights, for each principle, the different leadership attitudes that need to be initiated, which enable the gradual use and dissemination of the Smart Working. Managers can use this model as a tool for self-assessment and description of action plans; it makes, indeed, possible the arrangement of the starting point and definitions of the likely leadership practices to be put in place in order to move toward a higher degree of maturity.

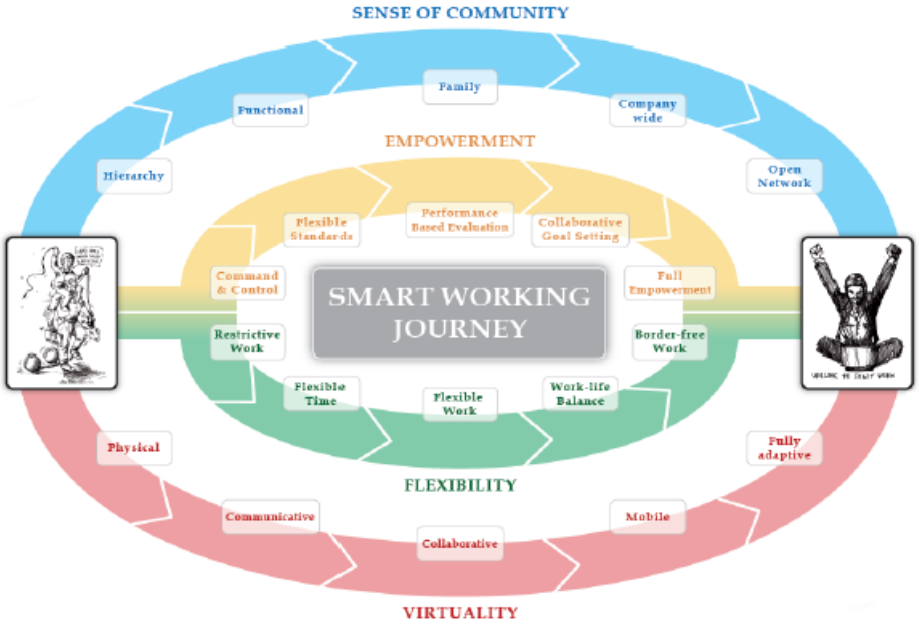

Figure 1- Smart Working Journey (Smart Working Observatory, 2013)

1.1.3.4 Digital technologies

A smart and strategic use of new technologies can not only simplify work, but also facilitate the implementation of Smart Working initiatives and, therefore, foster the activation of the other levers (organizational policies, physical layout, leadership styles).

In a competitive scenario in which companies must be close and ready to meet the needs of customers and suppliers and have to amortize the frequent dislocation of their employees, information and communications technology (ICT) takes on a key role (Corso et al., 2006). Digitalization makes it possible to expand the workspace and make it virtual, so that communication, collaboration and socialization become possible regardless of working hours and workplaces. This creates the prerequisite for the development of Smart Working logics (Smart Working Observatory, 2016).

Digitalization enables companies to improve work efficiency and the effectiveness of internal decision making. It becomes crucial to identify the

potential challenges and barriers that may arise with the inclusion of these types of technologies and to find tools and mechanisms to anticipate these problems, mitigating the obstacles (Smart Working Observatory, 2013).

It is possible to distinguish 3 categories of tools that organizations use to stimulate collaboration, sociability, and accessibility of information:

- Unified Communications and Collaborations (UCC): UCC can be seen as tools for collaborating and communicating, these help to change the technologies of the consumer world and public social networks. Unified Communication (UC) consists of an improvement of Unified Messaging and corresponds to an integration of communication services in real time. UC speeds up innovation as it stimulates, throughout the organization, awareness inherent in new development opportunities, channelling the development of ideas and their deployment (Evans, 2004);

- Social Computing: these tools grant employees to improve information and collaborative technologies, with the mission of supporting relationships among teams of people (Gartner, 2013). Social Computing includes categories such as social networks, wiki, blogs, discussion forums, sharing of streaming media and microblogs that represent a strong push to change traditional methods of communication between employees (Intel, 2009). Applying this type of model requires the transaction to a social business, and thus the massive intervention on the organization of the enterprise that needs to be suitable for this new type of company;

- Cloud Computing and Virtual Desktop: Internet, servers, storage, applications and services can be shared on demand with cloud computing, while desktop visualization provides online access to a virtualized desktop (IBM, 2014). By using the Cloud, employees can access data at any time and from every location, eliminating the constraint of the physical compresence of user and physical storage. Desktop virtualization can be defined as virtualization of computer desktop in order to achieve security and flexibility (Patil, 2012)

The adoption of these new digital technologies has consequences on the data security Indeed, protecting physical data is enough to keep it in the office, but when it comes to digital data, digital security must also be of an advanced level to thwart cyberattacks aimed at stealing that data. Companies need to find a trade-off between digitalization and the resulting data security.

1.1.4 Benefits

The Smart Working model implies a change in the organization of work that, at least potentially, can bring a number of benefits regarding the work-life balance, the productivity, the company competitiveness and so on.

In general, the benefits of Smart Working can be ascribed to three main macro-categories, namely benefits for the employees, the company and society as a whole (Capgemini, 2009).

The benefits that come from Smart Working are briefly listed in this section and examined in more detail in the next chapter to provide a direct link with Sustainability.

The benefits that each **worker** is able to acquire are:

- improvement in the work-life balance of employees who can combine personal needs with work ones, with consequent growth in personal satisfaction and decrease in stress (ilsole24ore, 2022; Doyle, 2022).

- decrease in the commuting that presents an impact also on the territory, as well as on the quality of work and health of individuals (ilsole24ore, 2022; Samek Lodovici et al., 2021; Smart Working Observatory, 2016);

- facilitation of the introduction of women into the labor market, including in functions of managerial responsibility. Indeed, with Smart working, female employees can tend to their child-care and elder care responsibility, while being employed. It does not curtail their work opportunities to weekly hire,

shift work, and casual employment anymore. Smart working ensures they enjoy the same benefits as regular full-time employees without being penalized for tending to their non-work duties (Abdel & Hassan, 2016);

- opportunities for connection and collaboration with the team, customers or suppliers increases as they are enabled by the introduction of digital technologies (Corso et al., 2006).

The benefits to the **company** are:

- growth in the level of productivity and competitiveness (Doyle, 2022; Subha Imtiaz et al., 2009; Baltes et al. 1999; Fenwick & Tausig, 2001);
- better organizational climate and greater employee involvement;
- reduction of operating costs through lower consumption such as, costs of energy, supplies and consumables such as paper, reduction in the level of absenteeism and training time and costs.
- consistent cost reduction due to reduced employee presence in the office when the company decides to change the workplace (structural costs, costs of physical work space)
- the activation of a Smart Working model also leads to a refinement of corporate reputation, thus a source of competitive advantage with consequent growth in the ability to attract and retain a skilled and differentiated workforce (Fishleigh, 2017).

The benefits to **society** also took into account the benefits to the **environment**:

- workplace and worktime flexibility impact on emission cuts resulting from road transport by reducing the need for commuting and by encouraging travel at different times of the day relieving traffic congestion at peak times (Transport for London, 2007)

- Smart Working allows workers to carry out their tasks in different places, such as home, coworking spaces, work hubs or coffee shops. This trend has the potential to modify energy consumption patterns associated with home-work commuting (Schipper et al., 1989).

- new Smart Working practices help to rebalance the distribution of services and infrastructure between the centre and the periphery (Musolino, 2018)

- technology and workspaces optimization allow waste reduction related to the use of offices, consequently reducing CO2 emissions and carbon cost (Worrel et al., 2003).

1.1.5 Limits

However, at the same time, it can also have disadvantages, sensing these as elements of complexity in the concretization of the model itself.

Several studies have proven that not all hypotheses of activating flexibility tools have resulted in satisfactory outcomes, both with respect to psycho-physical well-being and productivity (Bakker et al., 2009).

In fact, if these tools are mishandled and management does not give them the attention they deserve, they can be counterproductive and eventually lead to quite the opposite consequences, causing isolation, reducing contact with peers, and increasing the stress of the workers involved. (di Martino & Wirth, 1990).

Some scholars have observed the growth of hostilities and agitations related to flexibility, such as the difficulty in negotiating domestic and work activities when both take place in the same location and, potentially, at the same time (Tietze & Musson, 2005). A first example is that people often create boundaries between work-life and family. This allows to create two different environments so employees can fully focus on one at a time eliminating the risk of mixing them up. However, working at home increases

the blurring between work and personal life removing the physical barrier and, without the right to disconnect, could increase the possibility of mixing work-life and family. This can be a problem because when work and family are roles primed in the same location, role conflict and tensions in general may occur. This may be particularly salient for Smart Workers who have children at home while they work (Hooks, 1998). Another example of unproductivity caused by Smart Working, tightly related to the one of the boundaries, is that of “interruptions” created by the utilisation of digital technologies that allow people to be almost always available. Work interruptions are defined in two ways: suspension of behavioral performance of a task or suspension of attentional focus (Puranik et al., 2020). In the case of Smart Working there may be family-related interruptions while working or vice versa that lower concentration and, consequentially, productivity.

In addition to these, studies suggest that working from home can cause increased feelings of loneliness and worries; in particular, the absence of physical face-to-face contact and the increased virtuality lead to a higher degree of social isolation (Bloom et al., 2015).

There is also the risk of overworking, indeed, employers could push to extra-work (further to the standard 8 hours of work or contractually agreed upon hours). Research conducted shows that business leaders require employees who perform their duties from home to increase productivity by between 10% and 20% (Tremblay, 2002).

1.1.6 Theoretical Models

In this section, three models are presented that provide general guidelines for the introduction of Smart Working in a company.

Smart Working should be implemented specifically for each company based on its peculiarities, so there is no one-size-fits-all model. Despite this, theoretical models have been created over the years that can serve as a

starting point. These models are first presented briefly and concisely and then go into detail for each one:

▪ Knoll's Integrated Work model (2010): the focus of this model is on how to integrate physical working spaces and the benefits that this can bring to the company

▪ Lake's Maturity Model (2013): here the focus is to analyse the company's level of maturity regarding the implementation of Smart Working.

▪ Clapperton and Vanhoutte's 3B model (2014): This model proposes the three basic elements to be considered in introducing Smart Working in the enterprise, which can be summarized by the following concepts: Bricks, Bytes, and Behaviours.

1.1.6.1 Knoll's Integrated Work model

The Knoll model of "integrated work" includes the notion of both individual and group work modes and emphasizes a dynamic component, the ease of movement of people and flow of work between those modes, as key to organizational effectiveness (O'Neill & Wymer, 2009).

The ways of working are:

- Focus: an individual work mode that occurs within a primary workspace that supports concentration and reduces interruptions.

- Share: a collaborative work mode that can occur in individual or group spaces and centres on the casual exchange of ideas with a small number of colleagues. Sharing is a means of transferring knowledge between employees and can include learning and mentoring.

- Team: Team is a group work mode related to specific work goals that occurs in formal and informal meeting spaces. The teamwork mode is typically project work.

Figure 2- focus, share and team (Knoll, 2010)

Figure 3- Integrated Workspace (Knoll, 2010)

In addition to the work modes and activity behaviours, the workspace needs to facilitate the seamless flow of people and information between the work modes. The efficiency of information flow and physical movement between work modes is critical to organizational effectiveness.

According to Knoll, there are two types of workspace integration:

- **Horizontal workspace:** integration is the ease with which information and people flow between work modes that occur at different physical locations within a facility.

- **Vertical workspace:** integration is the ease with which individuals are able to shift from one work mode to another (such as from focus to share modes) within their primary workspace

Well-designed workspaces ensure the smooth transition between individual and group work

Figure 4- Horizontal workspace integration (Knoll, 2010)

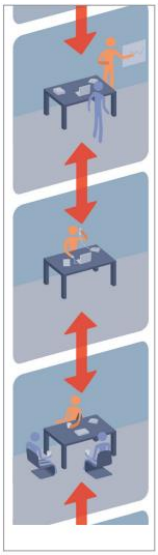

Figure 5- Vertical workspace integration (Knoll, 2010)

1.1.6.2 Lake's Maturity Model

The Smart Working Maturity Model, developed by Lake in 2013, highlights typical stages on the journey towards Smart Working, and the factors that need to be in place to progress. Using this model, it is possible to understand all the maturity stages that an organisation must go through to properly implement Smart Working (from adoption to establishment), the maturity level at which the organisation is at, and the steps that must be taken to achieve well-established Smart Working.

According to Lake, a company goes through four phases before the proper cultural and organizational implementation of Smart Working. Each of these phases is listed below along with a brief description of their specifics:

1. Isolated initiatives: the company starts to implement some limited initiatives such as desk sharing or ad hoc home-working. Here the level of flexibility is quite low.

2. Basic flexibility: the company starts to adopt policies that aim to increase flexible working for employee that ask to work remotely

3. Advancing flexibility and beginning of Smart Working: at this stage the company starts to plan Smart Working. In this phase the focus lies in building and creating a proper environment from a technological and workplace structure point of view capable to support employees working remotely.

4. Smart Working: the Smart Working culture is well-established in the company. There is a shift to a goal-oriented culture based on trust and employees feel no difference between working in the office or from other places.

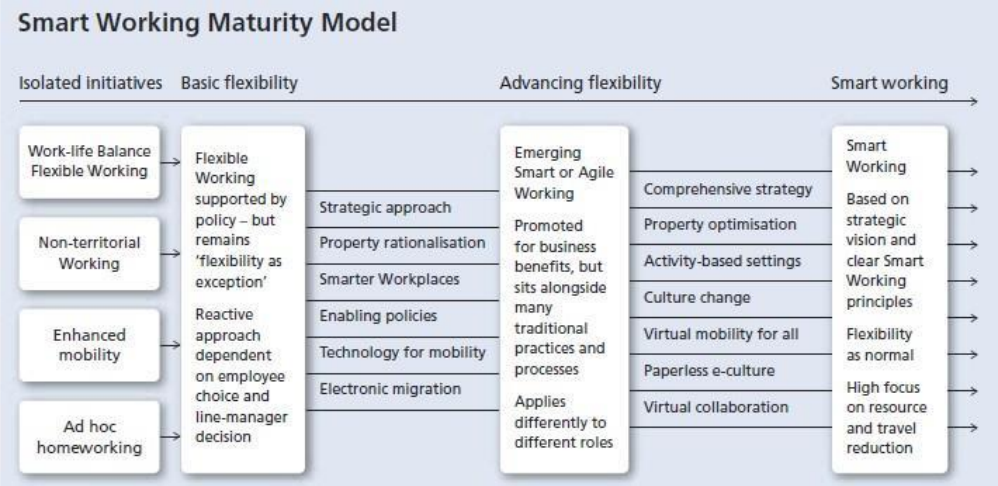

Figure 6-Smart Working Maturity Model (Lake,2013)

1.1.6.3 Clapperton and Vanhoutte's 3B

This model proposes the three basic elements to be considered in introducing Smart Working in the enterprise, which can be summarized by the following concepts: Bricks, Bytes, and Behaviours.

- Bricks: consists of the change of physical spaces. In fact, the internal layout must be rethought from a "smart" perspective in order to allow people to work in the best possible way so as to maximize their performance, creativity, and collaboration with the team;

- Bytes: refers to technology. In fact, the technological equipment turns out to be fundamental for a Smart Working model to be implemented in the company; technological tools allow people to work remotely and to collaborate and exchange information with colleagues, overcoming physical and temporal distance;

- Behaviours: refers to the behaviours of people, particularly employees, which must be oriented toward empowerment and a relationship of trust between manager and employee. It also turns out to be essential to change the managerial culture, particularly with reference to control, which is no longer linked to physical presence, but to the setting of goals and the achievement of set results.

1.1.7 Smart Working in Italy

This section describes the adoption and diffusion of Smart Working in Italy; all data are from the 2021 study of the Smart Working Observatory.

At the beginning of the second quarter of 2021, the advance of the vaccination campaign, on the one hand, and the return of teachers and lecturers, on the other, led to an overall decrease in the number of Smart Workers to 4.7 million in the second quarter and to about 4 in the third quarter. In the public sector, the share of smart workers fell from 43% of the workforce in the first quarter of 2021 to 26% in the third quarter.

One-third of smart workers worked in full remote mode, i.e., five out of five days remotely, and 58% experienced so-called "distributed work," also referred to in some cases as "southern work" or "holiday work" These terms refer to the phenomenon observed during the pandemic of performing work activities for a period of at least two weeks in locations far from home and the workplace. Thus, some workers were able to return to their hometown or live in other provinces or regions for some time.

Notably, 41 percent of those who had the opportunity to work remotely at least some of the time reported that their quality of life had improved or greatly improved compared to the previous year. This is due to being able to lead a lifestyle characterised by a less stressful pace (e.g., avoiding the time and expense of commuting from home to work and vice versa), and having more time to pursue hobbies and interests, family, or personal needs.

The ability to work remotely without restrictions still exists in 54 percent of large companies. However, there are many realities that have moved toward a gradual return to the office. In fact, hybrid work models are becoming more common, with 2 days on-site and 3 days working remotely, or vice versa.

It is possible to analyse three different scenarios depending on whether it is talking about large companies, small or medium-sized enterprises (SMEs) or public administration (PA).

1.1.7.1 Large enterprises

The data show that the experience of forced remote working over the past year and a half has been valuable to many companies in introducing new structured smart-working projects or launching informal initiatives. In fact, 81 percent of large companies report having a structured or informal smart-working model, numbers that indicate strong growth in the phenomenon compared to the pre-pandemic period.

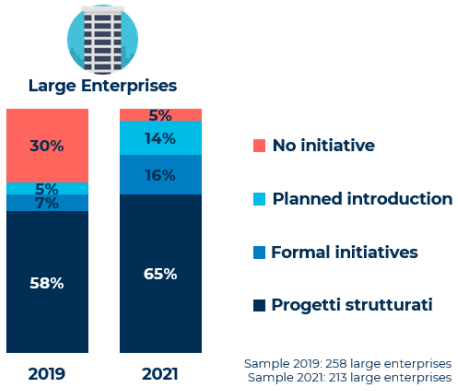

Figure 7- Large Enterprises. Comparison of initiatives undertaken in 2019 and 2021 (Smart Working Observatory, 2021)

1.1.7.2 SMEs

After the pandemic, from February 2020 to November 2021, 62 percent of SMEs allowed at least some of their workforce to work remotely.

Many SMEs say they perform activities that cannot be done remotely, yet the percentage of companies that have adopted smart-working models has increased from 30 percent in 2019 to 53 percent in 2021.

In addition to the ability to work remotely, SMBs have also introduced other forms of flexibility during the year.

Hourly flexibility is present in 58 percent of cases, while the logic of working by objectives is present in 51 percent of cases. The ability to work from remote locations and for longer periods of time is present in 35 percent of SMEs, figures that are significantly lower than those of larger companies.

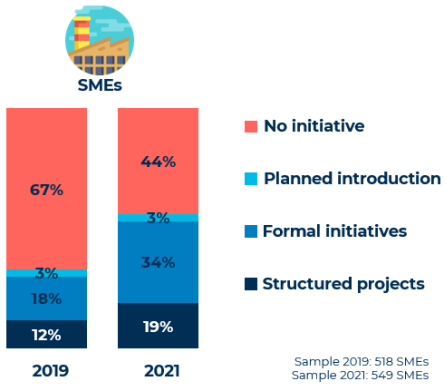

Figure 8- SMEs. Comparison of initiatives undertaken in 2019 and 2021 (Smart Working Observatory, 2021)

1.1.7.3 Public administrations

As a result of the pandemic, there has been an increase from 23% in 2019 to 67% of PAs in the sample reporting the presence of a Smart Working model, structured or informal.

Similar to the private sector, there is also a transition to hybrid work models in the public sector, with 39% of PAs allowing their employees to perform their activities on-site 2 or 3 days per week, while the remaining days are spent working remotely. These figures relate to a scenario that is still in its nascent stages, but illustrate that there is great potential for the transition to truly Smart Working models.

In addition to the possibility of working remotely, hourly flexibility initiatives are also widespread in almost 9 out of 10 institutions, including public administrations.

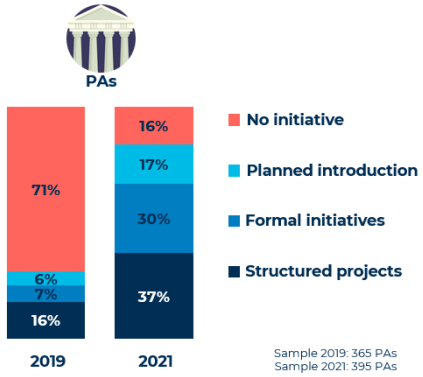

Figure 9- Public Administrations. Comparison of initiatives undertaken in 2019 and 2021 (Smart Working Observatory, 2021)

1.1.8 Normative framework in Italy

In Italy, Smart Working is regulated by Law No. 81 of May 22, 2017 on Agile Working.

Until the publication of this norm, Smart Working was already being practiced in several Italian companies despite the lack of a regulatory framework to refer to. The modalities were then established in collective bargaining between employers' organizations and syndicate and were defined on the basis of the scope in which they were applied.

The law is divided into two chapters. Chapter I regulates self-employment, while Chapter II regulates Agile Work. This thesis will analyse only the

second chapter, which is the one directly aimed at regulating Smart Working.

The articles contained in Chapter II of the Norm deal with the following issues: the definition of Agile Work, working hours, economic treatment, the modalities for termination and the form of the agreement, disciplinary and supervisory power, protection for occupational injuries and illnesses, and then safety at work.

1.1.8.1 art.18 Agile Working

In the Article 18, dedicated to Agile Work, the "ratio" or the objective of the provisions, is first set out. According to the law, Agile Work aims at "increase competitiveness and facilitate the reconciliation of work and lifetimes." There are thus two types of objectives, one purely economic, aimed at benefiting businesses and increasing their competitiveness, and one aimed at protecting the living conditions of workers, with a view to work-life balance.

The definition that the legislature proposes of Agile Working is the following: "mode of execution of the employment relationship, established by agreement between the parties, also with forms of organization by phases, cycles and objectives and without precise constraints of time or place of work, with the possible use of technological tools for the performance of the work activity. Work is performed partly inside company premises and, without a fixed workstation, partly outside, within the limits only of maximum daily and weekly working hours arising from the law and collective bargaining."

The legislator places Agile Work within the scope of subordinate employment, and this allows for confirmation that it is not a new type of contract, but rather a practice of work performance, which must be defined by agreement between employer and employee.

The rule then sets out the places where the work performance is carried out, which can be partly outside and partly inside company spaces.

Regarding working hours, Article 18 stipulates that there should be no time constraints, but only maximum daily or weekly limits set by law or by collective bargaining.

In August 2022, two more paragraphs (3a and 3b) were added to this article with the purpose of giving priority in agreeing on activities carried out in the form of Agile Work to workers, both men and women, who: have disabilities, have one or more children under the age of 12, have one or more children with disabilities. Protecting them, further adding that "the employee who requests to take advantage of agile work may not be sanctioned, demoted, fired, transferred or subjected to any other organizational measure having direct or indirect negative effects on working conditions." The peculiarities of Agile Working, according to the provisions of the norm, can thus be summarized in the following points:

- absence of set hours, but only constraints of maximum daily and weekly work time;

- tasks performed both inside and outside of work spaces and absence of a fixed workstation for work performed in spaces outside of business contexts;

- use of technological tools for the performance of work tasks.

The article also stipulates that the company assumes responsibility for the proper functioning of technological tools and their safety, made available to the worker, so that he or she can adequately perform his or her work.

Incentives of a fiscal or contributory nature, agreed upon for the achievement of productive or disciplinary goals, must also be equally recognized under agile work.

1.1.8.2 art.19 form and withdrawal

Article 19 sets out to establish the terms of the agile work agreement, its content and how to sanction its term. It then establishes that the agreement between the employer and the employee must be put in writing "for the purpose of administrative regularity and proof". It then defines the content of the agreement, which must regulate the performance of work, both in terms of the exercise of the employer's directive power and the means that may be used by the employee. Again, a central issue is addressed, which is that of the right to disconnection. The risk that the worker who chooses this mode of work runs is that of feeling obliged to a continuous digital connection. The provision therefore indicates that "the worker's rest time as well as the technical and organizational measures necessary to ensure the worker's disconnection from technological work equipment" should be defined.

The notice period on the part of the employer may not be less than 30 days if the employee is a permanent contract employee and increases to 90 days for disabled employees.

1.1.8.3 art.20 Treatment, right to continuous learning, and worker certification of competence.

Article 20 establishes the right of the agile worker to enjoy an "economic and regulatory treatment not less than the overall treatment applied, in implementation of the collective agreements referred to in Article 51 of Legislative Decree No. 81 of June 15, 2015, with respect to workers performing the same tasks exclusively within the company." The rule, regarding the definition of the economic and normative treatment of agile work, refers to collective bargaining, thus eliminating forms of economic discrimination.

In Paragraph 2, the article refers to the possibility for the worker employed in Agile Working to be granted the right to lifelong learning, in formal, informal ways and the possibility for these to be regularly certified.

1.1.8.4 art.21 Control and disciplinary power.

Article 21 stipulates that, in addition to the exercise of managerial power, "the exercise of the employer's power of control over the service rendered by the worker outside the company premises" should also be regulated by the agreement related to agile work arrangements, according to the provisions of Article 4 of Law No. 300 of May 20, 1970, and its modifications. Italian Law No. 300 of May 20, 1970, on the Freedom and Dignity of Workers, regulates in Article 4 the use of all instruments that allow the remote control of workers.

According to Paragraph 2, the agreement must also cover disciplinary power, establishing the "conduct related to the performance of work outside company premises," which may concern the execution of disciplinary sanctions.

1.1.8.5 art.22 Work Safety

Article 22 stipulates that the employer must ensure the health and safety of the employee engaged in Agile Working and, to this end, must forward to the employee and the workers' safety representative, at least annually, a written certificate informing them of the general risks and specific risks, related to the performance of work outside the company premises.

1.1.8.6 art.23 Compulsory insurance for occupational accidents and diseases

Article 23 stipulates that insurance for occupational accidents and illnesses is mandatory, and that the agreement on Agile Working arrangements must be subject to the notices required by Law No. 60827 of November 28, 1996, and its subsequent amendments.

In paragraphs 2 and 3, it is then stipulated that the worker is entitled to both "protection against occupational accidents and occupational diseases dependent on risks related to work performed outside company premises," and "against occupational accidents occurring on the way to and from the place of residence to the place chosen to perform work outside company premises." However, this right is guaranteed to the worker only in cases where the choice of the place of work where the work is to be performed, is due to requirements related to the performance of the work or to personal needs, and "meets the criteria of reasonableness."

In this first part of the literature review, all the material on Smart Working necessary for a better understanding of this new form of work, with all its features, levers, advantages and limitations, has been gathered. The goal of this work is to develop a set of indicators that can be used to quantify the impact of Smart Working on Sustainability.

Therefore, the literature review is followed by a chapter on Sustainability, which is essential for understanding the impact of Smart Working on Sustainability.

1.2 Sustainability

In this section, the concepts of Sustainability and sustainable development are analyzed, starting with the various definitions useful for understanding their meaning and significance. Then, the forms of environmental pollution useful for the purpose of this work are presented, thus referring to the environmental impacts caused by Smart Working. Next, the 3 pillars of Sustainability are presented and for each one it is examined how it is affected by Smart Working. After there is the presentation and explanation of the two different types of Sustainability models, strong and weak, and finally, the new development trends of Sustainability and the introduction of the circular economy are explained.

1.2.1 Definition of Sustainability and sustainable development

To provide a general introduction to the topic of Sustainability and what sustainable development is, this section presents several definitions that, being multidisciplinary, analyse the different facets of the two topics.

“Sustainability is *meeting the needs of the present without compromising the ability of future generations to meet their own needs*” (Brundtland G.H., 1987).

This is one of the first definition related to the concept of Sustainability. It is possible to notice that, already in 1987, the definition considers all forms of development, from economic, to urban and community development. The goal is to maintain the economic development compatible with the ecosystem, thus operating in environmental balance.

Another possibility for achieving the goal of clarifying the concept of Sustainability is perhaps offered to us by its etymology: "the term finds its origin in the French verb souvenir, that means to sustain or support" (Brown

et al., 1987) formal aspect of Sustainability (there is an entity to be sustained).

In the University of California in Los Angeles (UCLA) Sustainability Committee, Sustainability is defined as: "*the integration of environmental health, social equity and economic vitality in order to create thriving, healthy, diverse and resilient communities for this generation and generations to come. The practice of Sustainability recognizes how these issues are interconnected and requires a systems approach and an acknowledgement of complexity".*

In this definition the economic and social aspects are explicitly take into account. Sustainability is seen as "integration" among environment, society and economy, thus sustainable actions are evaluated considering the consequences on these three topics.

The importance of Sustainability is further underlined if one considers that "Sustainability, and the terms derived from it (sustainable development), belong to the same class as those few key concepts that underlie every liberal democracy, such as equality and freedom, which are explicitly written into the founding documents of the United States. Terms such as these are called "essentially controversial notions," meaning that there are continuous and endless disputes about the meaning and degree to which anything indicated by the concept can be achieved" (Ehrenfeld J.R., 2008).

"The concept of Sustainability refers to the ability of some actors to maintain a state of a certain system" (Osorio et al., 2005) probably referring to the human species, the only one capable of lending itself to critical reflection on ecosystem conditions and acting accordingly.

"The concept of Sustainability has the historical heritage, conceptual and ethical quality typical of a fundamental principle of law" and, therefore, "like the ideals of justice and human rights, Sustainability can be seen as an ideal of civilization, both nationally and internationally" (Bosselmann, 2008).

Bosselmann believes that rediscovering, explaining, defining, and applying the principle of Sustainability is the most exact path to making it the general paradigm of international law and governance even if as he says "we have only a vague idea of what Sustainability involves or how this goal could be achieved" (Bosselmann, 2008) thus emphasizing the complexity of the term and how to implement it.

The economist Hermann Daly offers another view on Sustainability and describes it as a concept of "justice extended into the future " (Daly, 2001) giving a definition of it in terms of rational use of natural resources, according to which:

- the consumption of renewable resources does not exceed the relative rate of regeneration;

- consumption of non-renewable resources is offset by the production of an equal amount of renewable resources that can replace them in the long run;

- the input of pollutants into the environment does not exceed the absorption capacity of natural receptors.

In the literature, the terms "Sustainability" and "sustainable development" are usually used interchangeably; however, according to some scholars, this is not appropriate.

"Sustainability is the ultimate goal or objective. What exactly defines the building blocks of what is sustainable (whether it is society, deforestation, fisheries, etc.) is dictated by science but ultimately also depends on personal values and different worldviews. Achieving a state of environmental Sustainability requires establishing a framework and developing a process. Certain conditions must be met and certain steps must be taken in the transition to Sustainability. The general framework of sustainable development is the means to achieve Sustainability. So, in short, Sustainability refers to the goal, and sustainable development is the path and framework to achieve it" (Harding Ronnie, 1998).

1.2.2 Forms of pollution

In this section, after an introduction to the general topic of pollution, the environmental impact of the two types of pollution, atmospheric and acoustic, of interest in the study is presented. however, the impact of Smart Working on these two types of pollution is presented later

Pollution is defined as the alteration or contamination of any material or environment by inorganic or organic agents (effluents, wastes, etc.) or bacteria, resulting from various human, productive or sedentary activities (Oxford Languages).

Pollutants are not necessarily of anthropogenic origin but also of natural ones, such as natural gas or dust emissions carried by winds; but the term is associated with human activities in most cases. This section will analyse the form of pollution that will be of interest for the aim of this study: atmospheric and acoustic pollutants caused by human activities.

1.2.2.1 Atmospheric Pollution

From “Atmospheric pollution: a global problem” that is a book written by Elsom, D M are extracted the information of this section.

Anthropogenic and industrial causes of air pollution must be sought in industrial production activities, mineral extraction, waste combustion, and from combustion processes resulting from agricultural activities.

It took a long time to become aware of the danger that polluted air poses to the population of cities in industrial regions and beyond. It took a few dramatic incidents for people to come to consider air pollution a true generalized scourge, responsible for chronic disease. The main pollutants are sulfur dioxide (SiO2), nitrogen oxides (NOx), carbon monoxide (CO), ozone (O3), dust (especially particulate matter having a diameter of less than 10 millionths of a meter), benzene, and lead. These pollutants are

mainly present in gaseous form and typically result from the combustion of fossil fuels, such as from industrial processes or simple city traffic.

Polluted air can be dangerous, even if the pollutants are invisible. It can make people's eyes burn and make them have difficulty breathing. It can also increase the risk of lung cancer.

Natural phenomena can also cause air pollution to increase quickly, however most air pollution is caused by human activities. It comes from burning fossil fuels (coal, oil, and natural gas). When gasoline is burned to power cars and trucks, it produces carbon monoxide, a colourless, odourless gas. The gas is harmful in high concentrations, or amounts. City traffic produces highly concentrated carbon monoxide. Cars and factories produce smog, a thick fog or haze of air pollution that makes breathing difficult. When air pollutants such as nitrogen oxide and sulphur dioxide mix with moisture, they change into acids. Then they fall back on the earth as acid rain. Acid rain can, in the long run, kill all the trees in a forest or devastate lakes, streams, and other waterways.

Greenhouse gases are another source of air pollution. Greenhouse gases such as carbon dioxide and methane occur naturally in the atmosphere. In fact, they are necessary for life on Earth. They absorb sunlight reflected from Earth, preventing it from escaping into space. By trapping heat in the atmosphere, they keep Earth warm enough for people to live. This is called the greenhouse effect. Nevertheless, human activities such as burning fossil fuels and destroying forests have increased the amount of greenhouse gases in the atmosphere. This has increased the greenhouse effect, and average temperatures across the globe are rising. Global warming is causing ice sheets and glaciers to melt.

1.2.2.2 Acoustic pollution

Acoustic pollution is the damage caused to the urban and natural environment by anthropogenic activities due to excessive production of

high intensity sounds (National Geographic Society, 2022). The main consequences are seen in the animal world, disorienting many species and, in some cases, even leading to their death (e.g., the explosion of fireworks cause a high number of deaths among domestic animals, causing heart attacks). It is also capable of causing psychological problems, blood pressure surges and stress in people who are continuously subjected to it over time (National Geographic Society, 2022).

1.2.3 The three Sustainability pillars and how are impacted by Smart Working

The concept of Sustainability encompasses the ability of a development process to sustain over time the reproduction of the world's wealth, which is composed of economic capital ("built up" by individuals), human/social capital (composed of the individuals in a society), and natural capital (i.e., society's natural environment and resources).(Goodland, 1995)

The failure of any of the pillar would undermine the very meaning of sustainable development, which is based on the balance between these dimensions and their desirable union over time. Indeed, promoting sustainable development means seeking the balance between these different components. In other words, sustainable development implies attention aimed equally at to economic, social and environmental needs.

1.2.3.1 Environmental Sustainability

Environmental Sustainability refers to the ability to maintain the quality and reproducibility of natural resources over time, to preserve biological diversity, and to ensure the wholeness of ecosystems.

It refers to the ability to maintain three functions of the environment over time, the function of:

- distributor of natural resources;
- absorber of waste;
- provider of the conditions necessary for the maintenance of life.

"Environmental Sustainability is any action designed to maintain the energetic, informational and physicochemical conditions, which govern all beings, especially the living Earth, the community of life and human life, keeping in mind their continuity and also the satisfaction of the needs of the present and future generations, so that the natural capital is maintained and enriched in its capacity for regeneration, reproduction and co-evolution" (boff L, 2012).

1.2.3.1.1 Environmental Sustainability impact of Smart Working

With regard to environmental impact, three different types of pollution linked to Smart Working are identified: air pollution, noise pollution, and consumption of resources. Smart Working, in fact, directly influences CO2 emissions by eliminating workers' daily commuting (Calabria et al., 2021). Similarly, it influences noise pollution in large industrial centers because, by reducing traffic, there is a consequent lowering of decibels, creating a benefit for both humans and the environment itself (Calabria et al, 2020). By decreasing the presence of employees in workplaces there are also benefits from the point of view of consumption, which can be divided into: energy, food and related creation of plastic and paper waste (in offices with canteen or in-house catering). In the long run, by having fewer employees in the offices, the company might also consider to change the workplace location. Thus, affecting everything related to the construction and sizing of the office, which would be smaller with less impact on the environment. The digitization that comes along with Smart Working also reduces the use of stationery and printed paper.

1.2.3.2 Social Sustainability

Social Sustainability is the ability to sustain conditions of human well-being (security, health, education) equally distributed across classes and gender, so that it “can grow, but never deteriorate” (Beckermann, 1994).

In this way, the category of well-being leads to a more appropriate definition of social Sustainability: “the continued satisfaction of basic human needs (such as food, water, shelter) and higher-level social and cultural needs such as security, freedom, employment and recreation” (Brown B. et al., 1987).

1.2.3.2.1 Social Sustainability impact of Smart Working

Social Sustainability impact of Smart Working is considered to be all the positive or negative changes felt by employees since Smart Working activities are initiated. The factors analysed from a social perspective that affect employee well-being and productivity are: work-life balance, physical health, psychological health, corporate engagement, technostress, and overworking.

Work-life balance refers to the equity of time spent in the work and non-work domains. (Brough et al., 2020)

Work-life balance is impacted by the greater amount of free time each employee has when he works remotely, the flexibility in the scheduling of working time, and the possibility of being able to live in places that are not necessarily close the employee’s workplace (ilsole24ore, 2022). In fact, working remotely there is the absence of commuting and thus the saving of the time it takes to get from home to work and vice versa, which, as a result, increases the free time to use for personal activities.

Thanks to time flexibility each employee can manage his or her own start and end times of the work shift (within the limits given by company

management) thus improving private life management and decreasing personal stress (Doyle, 2022).

Finally, in the case of employees who work far from their hometown or family, by working remotely each employee can get closer to his or her affections more easily increasing his or her well-being and again reducing perceived personal stress.

Physical health is a state of full health and function of a person's body. Signs of physical discomfort are often underestimated, but they can be a wake-up call as symptoms resulting from a work-related stress condition (seyle, 1976). Physical health could be impacted both positively and negatively by Smart Working. Indeed, working remotely impacts the ability to rest more hours by not having to commute to work and, depending on company policy, not having to adhere to strict schedules. Avoiding commuting also reduces the likelihood of having accidents on the way to work. At the same time, not all employees have ergonomic workstations in their homes, and considering that, by staying at home, routine physical activity is also reduced in the long run they could have physical problems such as back pain or stiff neck. (Samek Lodovici, 2021)

Psychological well-being and relational well-being have been included in psychological health.

Psychological well-being derives from people's evaluation of their lives and consists of a cognitive component, which is equivalent to satisfaction with one's life, and an emotional aspect (Diener, Suh, Lucas and Smith, 1999). This is influenced, when working remotely, both by the possibility of being able to enjoy, even while working, all the comforts available in one's own home and by the absence of stress related to commuting given by traffic or any unforeseen events that may happen on the way (Smart Working Observatory, 2016).

Relational well-being describes the well-being of a person embedded in context and community. Specifically, this dimension was declined to assess

relationships within the work context. Three sub-dimensions were considered to investigate it: the relationship with the manager, the relationship with colleagues, and the connection with one's company (Saks, 2006).

Work engagement is defined as a positive, fulfilling work-related state of mind that is characterized by vigor, dedication, and absorption (Schaufeli et al., 2002). Vigor is characterized by high levels of energy and mental resilience while working, the willingness to invest effort in one's work, and persistence even in the face of difficulties. Dedication refers to being strongly involved in one's work and experiencing a sense of significance, enthusiasm, inspiration, pride, and challenge. Finally, absorption is characterized by being fully concentrated and happily engrossed in one's work, whereby time passes quickly and one has difficulties with detaching oneself from work. (Schaufeli & Bakker, 2002)

The level of company engagement is affected by Smart Working in several respects: the shift to a results-based logic increases both the empowerment and autonomy of employees, consequently increasing their attachment to the company and bringing them closer to its values. On the other hand, the distance from the workplace of undermines contact with the brand and with colleagues and superiors, diminishing, especially in new hires, the sense of belonging to one's company (Smart Working Observatory, 2021).

Technostress has been defined as the stress that users experience as a result of application multitasking, constant connectivity, information overload, frequent system upgrades and consequent uncertainty, continual relearning and consequent job-related insecurities, and technical problems associated with the organizational use of ICTs (Tarafdar et al., 2010).

Evidences from the literature showed several symptoms related to technostress, such as anxiety, behavioural strain, technophobia, mental fatigue, memory disturbances, poor concentration, irritability, feelings of exhaustion, and insomnia (Arnetz & Wiholm, 1997); (Çoklar & Şahin, 2011). Among the main frequent consequences of technostress, recent studies

found reduced worker productivity, job performance, job satisfaction and organizational commitment, lowered icts use intention and increased turnover intentions (Ragu-Nathan et al., 2008; Tarafdar et al., 2007; Ayyagari et al., 2011)

Tarafdar and colleagues in the “The impact of technostress on role stress and productivity” proposed a classification, widely accepted in the literature, of five technostress creators:

- Techno-overload, related to ICTs’ potential to compel users to work faster and longer or change work habit;
- Techno-invasion, referring to ICTs’ ability to invade users’ personal life and make the boundaries between work and private contexts more blurred;
- Techno-complexity, describing situations where ICTs’ features and complexity make users feel inadequate with respect to their skills;
- Techno-insecurity, related to potential users’ feeling of being threatened about losing their jobs, due to a replacement by automation or others who have a better ICT knowledge;
- Techno-uncertainty, associated with continuous upgrades and changes in icts that disturb users and force them to constantly learn new aspects of its.

One of the consequences of remote work is the increased use of technology, about which there is a link between ICT and higher levels of stress among workers (Ghislieri et al., 2018). In 2021, 1 in 4 workers was affected by technostress, to a greater extent smart workers (28%) than other workers (22%) (Smart Working Observatory, 2021).

The last factor of analysis is overworking. This is defined as: to work or make a person work too hard or too long (Cambridge dictionary).

This aspect is affected by Smart Working because due to the continuous availability of employees there is a risk of working beyond normal working hours and incurring a merger between private life and work itself increasing the stress of employees and reducing their productivity.

Overworking can be sharply decreased by adding "right to disconnect" to contract clauses regulating hours and workload while protecting employees.

1.2.3.3 Economic Sustainability

Economic Sustainability is defined as the ability of an economic system to initiate permanent growth in economic indicators, through the creation of income and jobs to sustain populations and through an effective combination of resources.

It can be achieved by governing capital (natural, human, social and cultural), taking care not to decrease it so as not to compromise the well-being of future generations.

"There is a growing conviction that not only economic and environmental Sustainability can coexist, but rather that advantageous opportunities can arise from their integration" (Vecchiato et al., 2013).

This results in two obligations for companies: Efficiency, understood as the elimination of waste in existing processes that not only have a negative impact on the environment, but in most cases also reduce costs, and innovation, understood as change both at the level of the production process and of technology through the search for more efficient and therefore less harmful technologies and production processes while maintaining productivity.

1.2.3.3.1 Economic Sustainability impact of Smart Working

The consequences from an economic perspective are determined by the impact on the other two pillars of Sustainability.

A study conducted by the Centre for Economics and Business Research (Cebr) in 2019 on behalf of Citrix explains how the spread of Smart Working affects the profitability of companies.

The study is based on an analysis of survey responses, and results are measured by productivity gains.

According to the results, 72 percent of workers surveyed said at least 2 or 3 additional hours per week could be spent on work tasks if flexible working were available, which, again from Cebr, translated into gross value added (GVA) per capita, at the highest level, means $410 of potential additional GVA per week made possible by flexible working for workers between the ages of 16 and 55 with a dependent child.(cebr, 2019)

The same study was conducted for the increased productivity and reduced costs associated with commuting. 74% of workers surveyed take more than 20 minutes to commute to work and 49% spend more than $20 on commuting. Both worker stress and costs would decrease if they had the option to work in accessible transportation, which would impact productivity and thus GVA per capita. The reduction of employee stress leads to an increase in employee productivity. Higher productivity creates economic benefits for the company (Imtiaz & Ahmad, 2009).

As a direct consequence of the impact on environmental Sustainability, especially on energy consumption (see Chapter 1.2.3.1.1), there is also an impact on the costs associated with energy consumption that Smart Working generates for both the company and the employees.

1.2.4 Sustainability models

It is possible to represent the intersection of the three pillars in two different ways: with “the triple bottom line” and with the “Russian dolls”.

With "**the triple bottom line**" model, Elkington intends to promote the evaluation of a company's performance in relation not only to economic performance but also including social and environmental outcomes by depicting the interconnection and inseparable link between the three aspects, but without clarifying the dependence.

Figure 10-The interconnection of the elements of the Triple Bottom Line concept.
(Dalibozhko & Krakovetskaya, 2018)

From the 3 partial linkages result:

Bearable (Society + Environment = Bearable), with society working towards lifestyle adaptation. In doing so, we are aware of our impact, contributing to a healthier environment and well-being.(Lindell et al., 2021)

Equitable (Society + Economic = Equitable) to achieve an equal and fair share of a nation's resources for its people. Through equitable distribution,

we help eliminate poverty and social inequality and improve society's standard of living.(Lindell et al., 2021)

Viable (Economic + Environment = Viable): A country strives for economic growth and development while keeping environmental protection in mind in its activities. Therefore, investments must be viable to sustain itself, create jobs, contribute to GDP, and protect the environment from harm.(Lindell et al., 2021)

This pattern suggests that "Sustainability" is that small area in the center where all three circles overlap in the implicit belief that none of the three instances is more important than the others, nor is there a strong dependence of one on the other.

Thus, since there is no hierarchy between the 3 dimensions of Sustainability, which are all considered equally important, this model is considered weak Sustainability.

The Russian Doll, which is the concentric circles model proposed by Roger Levett in 1998, synthesizes this three-dimensionality and, more importantly, establishes an order of priority among the dimensions of Sustainability.

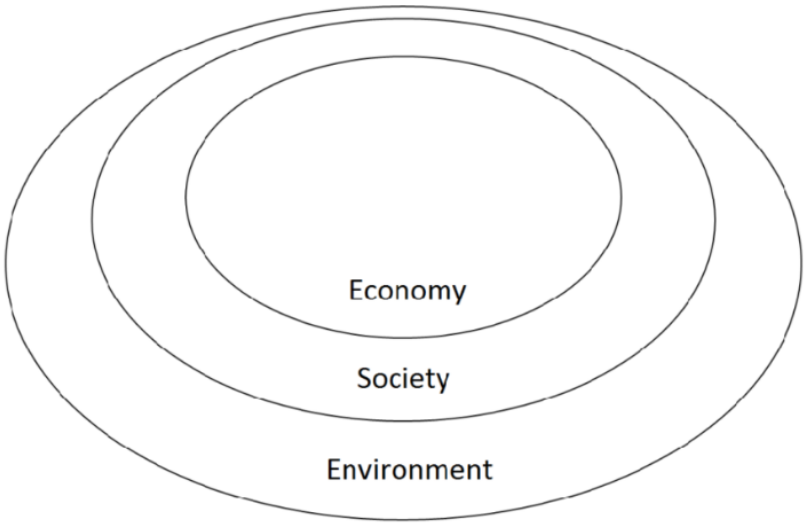

Figure 11-"Russian doll" model for sustainable development (O'Riordan et al. 2001)

Levett's framework, unlike Elkington's which theorizes a balancing process between economic, social, and environmental priorities (the central area of the diagram, where all three intersect), through three concentric circles, emphasizes that the economy is dependent on society and that both are part of the larger environmental system (hierarchical relationship). "It seems essential to highlight how these dimensions are closely interrelated by a multiplicity of connections and, therefore, should not be considered as independent elements, but should be analysed in a systemic view, as elements that together contribute to the achievement of a common end. In summary, development is sustainable if it provides a good quality of life and is within the limits set by the environment. None of these constants is optional; they must be pursued hand in hand" (SOGESID)

Particularly due to this opposition of the ideas of balance between dimensions, the "Russian dolls model" has been called of "Strong Sustainability," as opposed to Elkington's "Weak Sustainability model."

Through the literature review, all notions necessary for the understanding of the future chapters were highlighted. Namely, the basic characteristics of Smart Working and Sustainability were presented, their connection and how Smart Working affects sustainability from a qualitative point of view. By studying the literature, it was also possible to understand what gaps exist in this area and how to fill them

In the next two chapters, the methodology used in the thesis is presented, followed by the indicators used to quantify the impact of Smart Working on environmental, social and economic sustainability.

2 Methodology

This chapter describes the research methodology. First, the objectives of the research are described and explained in detail, followed by an explanation of how the literature review has been conducted (sources and purpose). At the end it will be explained how the indicators that quantitatively measure the impact of Smart Working on Sustainability have been designed.

2.1 Objectives

A review of the academic and managerial literature on the topic of Smart Working supported the identification of research gaps and impacts of the phenomenon that had not been addressed nor quantified yet. That represented the starting point to design the questions and objectives for the present research. The review of the literature highlighted that research on Smart Working and Sustainability conduced so far addresses the qualitative connection between these phenomena. Thus, it emerged a lack of studies aimed at measuring the impact of Smart Working on Sustainability. The main purpose of this research is to address this gap by identifying a set of indicators to help quantify the impact of Smart Working on different areas of Sustainability having seen that this has been defined in the literature only in a qualitative way. To create a set of indicators so that companies can quantify the impact of Smart Working initiatives on environmental, social and economic aspects, it is necessary to understand under which conditions Smart Working is influencing Sustainability.

The literature analyzed forms the basis for developing a set of indicators that can help Smart Working actors (companies and workers) understand Sustainability impacts. In fact, the aspects of Sustainability affected by Smart Working analyzed qualitatively serve as the basis for indicator design. Some of these indicators had already been validated and taken from the literature, the others are the specific objective of the research.

In particular, the present work aims at identifying the impact of Smart Working on environmental, social and economic Sustainability addressing the following research questions:

- From the perspective of environmental Sustainability, what forms of pollution are impacted by Smart Working and how can a company quantify this impact?
- From a social Sustainability perspective, which are the aspects impacted by Smart Working and how can they be quantified?
- What is the cost impact, and thus the economic aspect, of Smart Working from the company and the employees perspective?

Thus, by answering the questions just listed, this paper will provide the design, presentation, and explanation of the indicators at the theoretical level, thus providing a solid foundation on which to conduct experiments in the real world.

2.2 Literature analysis

The literature review was conducted in order to gain a complete understanding of two current phenomena that are extremely diffused: Smart Working and Sustainability. The purpose of this section is to explain how the literature review was done.

It was possible to thoroughly characterize all the characteristics of Smart Working, including its principles, its levers, its advantages, and its limitations, thanks to the analysis of scientific articles and books.

Research for academic articles has primarily been done on Scopus, ISI Web of Knowledge, Google Scholar, and Research Gate, with information from several engineering, social science, business, and management journals being used as sources.

The second part of the analysis has been focused on Sustainability. Due to the importance this topic has gained in recent years, it has been possible to find material that would allow a clear description and understanding of the topic using the same search engines used for Smart Working.

The research phase had three stages to obtain a comprehensive view of the topics under analysis.

The initial investigation section focused on Smart Working analysis. The material provided by the Smart Working Observatory, including its yearly reports and publications, allowed for a considerable improvement in the analysis by incorporating data on previously mentioned issues and identifying new ones. During this stage, Keywords associated with Smart Working were used to search academic articles. At first, only broad factors like Smart Working levers, work-life balance, employee engagement, job satisfaction, and job motivation were taken into account. These keywords were finally researched in different combinations.

The same approach has been applied, during the second stage of the research, to review the literature on Sustainability. The keywords used were "Sustainability," "sustainable development,", "environment," "social," "corporate Sustainability," "forms of pollution," and "health".

The third stage was about “Smart Working” AND Sustainability”. Compared to the other two topics, the material was more difficult to find and the research results, which were necessary as a starting point for the construction of the indicators that will be discussed in the next chapter, were supplemented with logical reasoning on the analysis of possible scenarios on the possible impacts that led to specific parallel research, such as: the average emissions of a car, the average consume of a car, the energy consumption to heat an office or a house, etc.. The keywords used were a combination of Smart Working and the aspects of Sustainability, such as: “Smart Working Sustainability”, “Smart Working environmental impact”, ”economic feasibility of Smart Working”. Related to the social welfare of employees resulting from the use of Smart Working, the economic

consequences of Smart Working on a company, and finally the consequences on the environment.

A preliminary screening of the numerous papers relevant to this topic was necessary due to the sheer volume of them. This has specifically been done by reading the abstracts and choosing only those that are relevant to the issues being investigated. These articles were listed into an Excel file indicating the main information about each article, including the title, author, source, publication year, justification and remarks, and the topics covered.

2.3 The set of indicators

The explicit or implicit design of an indicator development process determines how participating actors are selected, how they interact, and how decisions are taken (Rametsteiner et al., 2011).

This section explains the steps that followed the literature review. First, the rationale for choosing the Sustainability model is explained, which is then used as the basis for identifying the indicators. Then, it is explained how the indicators were developed. These indicators will be presented and explained in the next Chapter.

2.3.1 Weak Sustainability vs Strong Sustainability

There are many papers in the literature explaining how Smart Working impacts corporate Sustainability, and this work was born out of the need to measure this effect in a quantitative way with the aim of getting an accurate picture of the consequences of adopting this new way of working.

The first step to be taken in order to create the set of indicator is to understand which Sustainability model to adopt between weak Sustainability (the triple bottom line) and strong Sustainability (Russian doll). As already explained in the previous chapters a weak Sustainability

model is developed graphically as three circles that intersect in pairs and then all together in the center creating the area of Sustainability (see Figure 7), and therefore an activity is defined as sustainable if and only if all three macro areas are positively affected, in other words an activity is defined as sustainable if it is at the same time positive from the environmental, social and economic perspective. In this model all three areas of analysis have the same relevance thus forming intermediate levels when only two out of three are affected.

Strong Sustainability, on the other hand, is developed as three concentric circles of different diameter (see Figure 8). There is a hierarchy where first in importance is the environment, after society and finally the economic part. This model turns out to be more limiting for the start of Smart Working projects from the company's point of view because it does not give the possibility to independently evaluate the different impacts generated.

The triple bottom line was adopted for the creation of this set of indicators because it allows the three areas of interest to be analysed independently thus adapting to the different priorities pertaining to different companies. For example, there might be companies that are more concerned about the environmental and social perspective or others that prefer social and economic, and by analysing the three areas independently it is then possible to understand whether the consequences are of corporate interest or not.

2.3.2 The areas of analysis

The second step was the analysis of the three macro areas of Sustainability.

In fact, for the purposes of this study, it was necessary to firstly divide the concept of Sustainability into its environmental, social, and economic aspects, which were in turn analysed and broken down into other, more elemental aspects as explained in the following paragraphs.

After studying the literature on Smart Working and Sustainability and selecting the Sustainability model as a starting point, the real work of identifying indicators began. First, an Excel file was created with 3 different sheets (each for a different area of Sustainability). The general structure of the three sheets was the same and consisted of the five columns that will be analyzed below:

- Pillar: in the first column was simply assigned one pillar per sheet.
- Influenced factor: each pillar was divided into factors that are influenced by Smart Working.
- Depends on: In this column, it was explained what each affected factor depends on relative to Smart Working.
- Source: To keep track of the source from which the information was taken

In the following sections, each area is analysed in more detail with the corresponding excel sheet to make the concept more practical and understandable.

2.3.2.1 Environmental impact

From the literature review, there are three factors impacted by Smart Working on environmental Sustainability: air pollution, noise pollution, and consumption.

The variables found in the literature that affect air pollution and can be affected by Smart Working by avoiding commuting are: the percentage of employees who come to the office by car (the higher this variable, the higher the air pollution), the distance between home and work (the higher this variable, the higher the air pollution), and the percentage of employees who take public transportation to work (the higher this variable, the higher the air pollution).

The same variables found for air pollution were also found for noise pollution. In fact, it has been analysed in the literature that both types of pollution depend on the car: the air pollution from commuting, and the noise pollution due to the noise caused by the cars.

The last impacted factor on the environment analysed was consumption. From the literature, it appears that the variables impacted by Smart Working that influence consumption are: energy consumption and paper waste generation.

Any variable found that was still too large to analyse from the point of view of creating an indicator was again broken down.

energy consumption was broken down into energy consumption for lighting, work equipment, heating and cooling. For all four variables, as the consumption of one variable increases, so does the energy consumption.

The second variable found in the literature that affects consumption is paper waste. Again, the higher the paper waste the higher the office consumption.

Thus, arriving at a breakdown into elementary factors that are influenced by Smart Working and their connection to environmental Sustainability.

At the end of this process, it was possible to create the indicators based on the relationship between each elementary variable and the influencing factors. Each elementary variable was examined to understand how Smart Working might affect it: for example, for air pollution in relation to car exhaust, the average car exhaust and the reduced commuting that would result from Smart Working were examined.

All the indicators and all the reasoning carried out on them will be presented in the next chapter

2.3.2.2 Social impact

Following the same process for social Sustainability, five factors impacted by Smart Working were identified: work life balance, physical health, engagement, technostress, and overwork. These factors were in turn decomposed into elemental variables on which they depend and which can be influenced by Smart Working. The relationship between each of these elementary variables and the previously presented factors was then assessed.

Based on the literature, it was found that work-life balance depends on the following factors: more free time (the more free time, the higher the work-life balance), flexibility of schedule (the more flexible the schedule, the higher the work-life balance), possibility of living close to family or increasing their contact time through remote work (the more time spent with family, the higher the work-life balance).

Physical health, on the other hand, depends on the following factors in the context of Smart Working: ergonomic workstations (the more suitable the workstations are, the better the physical health), the possibility of resting more hours due to the elimination of commuting (the more rested a worker is, the less stressed they are, the better their health and the more focused they are), more sedentary work (when daily physical activity decreases, physical health also decreases).

Engagement depends on the following factors: Change in the method of task assignment, with Smart Working generally moving from a logic of task assignment with monitoring to a logic of assignment by results (as freedom to do the work increases, employee well-being increases, and so does engagement), less contact with corporate headquarters (decreases sense of belonging, decreases engagement), less contact with supervisors and colleagues (increases difficulty of coordination, decreases engagement).

Factors influencing technostress, which in turn are influenced by Smart Working, are: Techno Overload, Techno Invasion, and Techno Complexity. As these three variables increase, so does employee stress.

Finally, overworking is influenced by the following factors: lack of the right to switch off (increases the risk of work-life fusion, increases stress, reduces productivity), constant availability of employees.

Since they are parameters that can hardly be translated in a quantitative way, scales found in the literature suggested by the Smart Working Observatory were adopted. The explanation of each scale used will be presented in the next chapter.

2.3.2.3 Economic impact

The economic impact of adopting Smart Working has two different perspectives: the one of the company and the one of the employees.

For each perspective, two different types of costs have been identified as affected by Smart Working practices: operating expenses (OpEx) and capital expenses (CapEx).

Operating expenses, operating expenditures, or “OpEx,” refers to the costs incurred by a business for its operational activities. In other words, operating expenses are the costs that a company or a person must make to perform its operational activities (Corporate Finance Institute).

Within OpEx and CapEx, it is possible to distinguish two types of impact on costs: the impact incurred by the reduced office presence and the cost impact that the company has to bear in connection with Smart Working.

Considering OpEx, having a reduced presence in the office could be translated into lower energy consumption, stationery and cleaning expenses. The cost that a company has to bear in connection with Smart Working are all those cost necessary to train employees and enable them to perform their activities remotely without hindrance: training courses on Smart Working both from the managerial point of view (how to manage the team, how to include and encourage all employees, etc.) and from the

operational point of view (how to manage programs for video calls, office package, cloud, etc.), costs of software for all employees remotely (such as subscriptions to paid programs that can also be used from home on work computers).

Considering CapEx, Smart Working affects both its set-up and the size of the office only if the company decides to change its office location. In fact, when acquiring or setting up a new office, it is relevant, for the company, to evaluate the reduced presence of employees by optimizing investment expenses. While considering the cost directly connected with Smart Working the company has to take into account economic aid to employees to create workstation at home, technological upgrade of offices.

Considering instead the employee's perspective as OpEx, four effects on costs were found: Costs associated with commuting, costs associated with staying away from home, costs associated with home energy use and costs associated with moving to a cheaper place to live (moving further away from the office).

The first two categories of costs are related to in-presence activity and refer to costs associated with commuting that may depend on car-related expenses (such as gasoline, and maintenance related to the wear and tear of the car) or costs related to season tickets to any public transportation, and finally costs that occur for dining out and any costs incurred by an employee as a result of spending the day away from home.

The third refers to the change in costs that employees have when working remotely: the increase in utility bills due to both the use of digital devices and the increased presence at home (e.g. the use of personal computer, heating system, cooling system).

Working remotely also favours moving to less expensive areas than urban centers, as it affects both the cost of daily living and the cost of housing (renting or buying).

The only CapEx identified for employees is for setting up a workstation at home.

The processes analyzed above, used to assess the impact of Smart Working on the three areas of Sustainability, were based on a thorough study of the literature, followed by a specific study of each of the components of the 3 areas of Sustainability, which allowed, through argumentation, to develop the indicators that will be presented and explained in the next chapter.

3 The indicators

This chapter presents the indicators created for the purpose of helping organizations to quantify the impact of Smart Working on the three considered aspects of Sustainability.

The first set of indicators considered in this chapter are those related to the assessment of the environmental impact of Smart Working, then those related to the social impact, while the chapter concludes presenting the economic perspective of the phenomenon.

All the formulas presented are designed to be adapted as much as possible by companies, and therefore require that companies wishing to use the indicators enter data as input.

3.1 Environmental impact indicators

As already mentioned, the indicators presented in this work concern the impact of Smart Working on the environmental Sustainability (see chapter 1.2.3.1.1): air pollution, noise pollution and business consumption related to everyday operational activity (energy, stationery, etc.).

3.1.1 Air pollution

In terms of Smart Working, air pollution is mainly caused by commuting between home and work.

Reducing commuting and thus the use of the car or public transportation also reduces CO2 emissions, so the formula can be used to calculate how much CO2 per employee is not generated by working remotely depending on the type of vehicle used, the daily miles traveled, and the annual days of smart work.

Since this specific impact has a positive effect on the environment (as the number of days of Smart Working increases, CO2 emissions decrease), the indicator measures the CO2 emissions not generated by Smart Working (CO2 avoidance)

$$CO2avoided_i = MeanUsed_i * D_{H-W_i} * 2 * \#days\ SW_i$$

Where:

I: is the employee

MeanUsed [kg CO2/person*km]: is the “Specific GWP impact” of the means of transportation used by employee "i". This value is given in the table 1 and depends on the type of transport used for commuting.

D H-W(i) [km]: is the kilometres between the home of employee "i" and the workplace multiplied by 2 because round trip must be considered.

#daysSW(i) [days/year]: is the number of days per year in which employee "i" work remotely .

From the research "Sustainable production and consumption in remote working conditions due to COVID-19 lockdown in Italy: An environmental and user acceptance investigation" by Fabiani and colleagues (2019) it is possible to have data on the impact on GWP that corresponds, for each specific means of transport, to kg CO2/person*km.

Means of transport	Specific GWP impact	Unit of measure	Ecoinvent dataset (transport)
Bus	0.109	kg CO_{2eq}/person*km	Regular bus processing
Train	0.074	kg CO_{2eq}/person*km	Passenger train processing
Small car, EURO 3, gasoline (*)	0.299	kg CO_{2eq}/km	Passenger car, small size, petrol, EURO 3
Small car, EURO 5, diesel (**)	0.234	kg CO_{2eq}/km	Passenger car, small size, diesel, EURO 5
Small car, EURO 5, gas (**)	0.224	kg CO_{2eq}/km	Passenger car, small size, natural gas, EURO 5
Mid-size car, EURO 3, gasoline (*)	0.368	kg CO_{2eq}/km	Passenger car, medium size, petrol, EURO 3
Mid-size car, EURO 5, diesel (**)	0.310	kg CO_{2eq}/km	Passenger car, medium size, diesel, EURO 5
Mid-size car, EURO 5, gas (**)	0.282	kg CO_{2eq}/km	Passenger car, medium size, natural gas, EURO 5
Large car, EURO 3, gasoline (*)	0.437	kg CO_{2eq}/km	Passenger car, large size, petrol, EURO 3
Large car, EURO 5, diesel (**)	0.386	kg CO_{2eq}/km	Passenger car, large size, diesel, EURO 5
Large car, EURO 5, gas (**)	0.340	kg CO_{2eq}/km	Passenger car, large size, natural gas, EURO 5
Hybrid/electric car (***)	0.173	kg CO_{2eq}/km	Passenger car, electric
On foot/By bike (****)	0.005	kg CO_{2eq}/km	Passenger, bicycle
Motorcycle	0.125	kg CO_{2eq}/person*km	Passenger, motor scooter processing

Figure 12- Specific GWP impact related to means of transport (Fabiani et al., 2019)

As described above, the formula calculates CO2 avoidance specifically for each employee. To calculate the annual CO2 avoidance for the entire company, all the results achieved by each employee in Smart Working must be added together. The total effect is then:

$$CO2avoided = \sum_{i=1}^{n} CO2avoided_i = \sum_{i=1}^{n} MeanUsed_i * D_{H-W_i} * 2 * \#days\ SW_i$$

3.1.2 Noise pollution

Related to this topic, no data have been found expressing the contribution each machine makes to noise pollution, so designing an indicator is very complicated. There are researches, however, that analyze the health damage involved in these types of pollution, the decibels that people living in cities are subjected to on average, the average decibels produced by each car, and finally there are researches that analyze the differential between noise pollution during pandemic and during normal living standards.

According to the World Health Organisation (WHO), noise is second only to air pollution in the impact it has on health. It is a major cause, not only of hearing loss, but also of heart disease, learning problems in children and sleep disturbance. Yet traffic noise could easily be halved, with existing technology, if more stringent limits were adopted (https://www.transportenvironment.org/previous-work/vehicle-noise/).

3.1.3 Business consumption

In this section, the environmental perspective is taken and indicators of the impact on total consumption by Smart Working are presented.

In order to calculate the environmental impact, it is necessary to consider the difference between office and home. Namely, while consumption decreases in the office due to the reduced presence of employees, it increases in the homes of those who work from home.

It is necessary to distinguish between consumption and the associated costs, as there is a significant difference between the subjets impacted. Consumption affects the environment, while costs affect those who have to bear them (companies or workers)

The following, initially explains why computers are not included in the calculation of the impact on consumption, and then presents the indicators that measure the energy savings for printers, heating and cooling that depend on Smart Working in the two assumed scenarios.

Company’s consumption depend on both the office area and the number of employees present, as with the impact on consumption, so two scenarios will be analysed: the space used in the office remains constant or there is a reduction in the space used.

The first energy consumption that can be analysed is that of the personal computer, which, of course, from a business perspective there would be a saving in energy consumption, but this would not be found from the point of view of environmental impact since it would still be used in the same way remotely thus shifting equal consumption from the office to the employees' homes.

The indicators presented below refer to the first scenario:

Smart Working usually also sets in motion a digitization process that reduces both paper consumption, thanks to increased email exchanges

and use of the cloud, and energy consumption from printers and copiers, which can be as high as 63 kWh per year; if they are turned off outside working hours, consumption can drop to 48 kWh (https://www.sportelloenergia.ape.fvg.it).

It is assumed that the office will continue to be visited by employees, albeit in smaller numbers, but that they will no longer need the printers due to digitalization through Smart Working and therefore some of them will be switched off. Multiplying the number of printers that are no longer used because they are not needed by the average annual consumption of these devices, the associated electricity savings can be determined.

So the energy savings related to printers is:

$$energy\ savings_{printers} = 63kWh * \#printers$$

The third factor that was analysed was heating.

Again, from an environmental perspective, it is important to consider both the decrease in consumption associated with heating in the office due to reduced employee presence and the increase in consumption in the homes of employees who work remotely

In order to calculate the impact of Smart Working on consumption, it is again necessary to make the difference between the decrease in consumption in the company and the increase in consumption in the homes.

To obtain the daily decrease, the hourly energy consumption constant per employee in the office (Fabiani et al., 2021) was multiplied by the number of hours of the shift.

To determine the increase in daily household consumption associated with heating, first it is considered whether the heating in the apartment was autonomous (i.e., required to be turned on and off by the homeowner) or centralized (a system commonly found in apartment buildings) and thus automatically turned on for all apartments in the apartment building. Then, the daily consumption, which depends on the type of house (Fabiani et al., 2021), was multiplied by the area of the house

After taking the difference and calculating the daily impact of the employee going smart, it was multiplied by the number of days the employee goes smart.

Calculating the savings from the environmental perspective for values greater than zero means that the decrease in consumption in the office was greater than the increase in consumption at home and therefore positive for the environment, vice versa for values less than zero.

$$energy\ savings_{heating} = \left[0.244 * Daily\ working\ hours_i - k * \left(\frac{house\ consume_i}{heating\ days} * Area\ of\ house_i\right)\right] * \#days\ SW_i$$

Where:

0.244 [kWh/(h*individual)] is the average hourly energy consumption related to the heating system per individual in offices

Daily working hours [h/day]: is the hours in a shift of the employee “i” in the office

k: is a binary factor. Its value can be either 0 or 1. If the heating in the house of employee “I” is centralized, so it is turned on regardless of whether the homeowner wants to turn it on or not, k will have value zero making maximum energy savings from the environmental point of view. If, on the

other hand, the heating system is autonomous, so that the homeowner turns it on and off as needed, k will have value 1.

House consume[kWh/(m^2*year)]: corresponds to the consumption shown in the table after crossing house typology and construction period.

Heating days[days/year]: are the days in which the house is heated

Area of the house [m^2]: corresponds to the square meters of the dwelling.

#daysSW(i)[days/year]= Number of days during the heating period in which the employee “i” work remotely

The necessary data were found in the literature to be able to calculate the energy required to be able to heat the workplace and employees’ homes during working hours. Looking at the two tables below, it is possible to understand the energy consumption of the workplace (left) based on the hours of each shift and that of the homes (right) considering the different types and thus the different energy requirements to heat them.

Daily working hours (h)	Daily energy consumption (kWh/day*individual)
8	1.954
4	0.977
6	1.466

Figure 14- Daily energy consumption for offices considering different working times. (Fabiani et al., 2021)

House typology	Construction period	kWh/m²y
Single family house	Before 1920	144.4
	1920–1950	142.3
	1950–1980	141.3
	1980–2000	97.1
	2000–2010	81.5
	After 2010	66.4
Multifamily house	Before 1920	100
	1920–1950	113.5
	1950–1980	105.2
	1980–2000	88
	2000–2010	74.6
	After 2010	58.2
Terraced house	Before 1920	121.1
	1920–1950	115.3
	1950–1980	119.2
	1980–2000	89.9
	2000–2010	80.9
	After 2010	66.6
Apartment block	Before 1920	110.5
	1920–1950	103.2
	1950–1980	99.2
	1980–2000	69.5
	2000–2010	70.3
	After 2010	53.4
College (data not available – assimilated to apartment block)	Before 1920	110.5
	1920–1950	103.2
	1950–1980	99.2
	1980–2000	69.5
	2000–2010	70.3
	After 2010	53.4

Figure 13- Thermal energy needs of houses (Fabiani et al., 2021)

After the calculation for all employees you have to do the summation of all individual energy savings:

$$energy\ savings_{heating_{tot}} = \sum_{i=1}^{n} energy\ savings_{heating_i}$$

n= the number of the company's total employees working remotely

The same reasoning can be applied to refrigeration.

In the literature there are only data expressed in kWh/m^3, which are not usable unless, due to Smart Working, there are variations in the volume exploited by the company and thus differences in the volume to be refrigerated (case analysed later). The indicator will gain validity when a study is done that can make refrigeration calculable. The formula for calculating is:

$$energy\ savings_{cooling} = [X * Daily\ working\ hours_i - (refrigerator\ consume * Refrigerated\ Volume_i * Time)] * \#days\ SW_i$$

Where:

X= is the consumption kWh/h*individual (corresponding to that for calculating heating) with respect to this type of data in the literature nothing has been found.

Refrigerator consume [kWh]: that is the consume of the system of refrigeration

Refrigerated volume [m^3]: it is the that the employee have to refrigerate

Time [h/day]: the time when the cooling system is turned on in a day

#daysSW(i)[days/year]= Number of days in which employee "i" work remotely during the cooling period (annual consume)

Unfortunately, data measuring kWh/(day*individual) have not been found in the literature, and therefore, at the moment, although the indicator might fit (heating and cooling being two comparable consumptions) there is no possibility to quantify exactly.

Again linking it back to heating, the formula for saving on total consumption is:

$$Energy\ Savings_{cooling_{tot}} = \sum_{i=1}^{n} energy\ savings_{cooling_i}$$

n= the number of the company's total employees working remotely

There is also to be considered the possibility of reduction of space in the offices (e.g., a 3-floor office where 1 floor is not used due to less employees in the office). In this case in addition to the indicators listed above there would be to consider the reduction of total energy consumption (lights, ventilation, heating, cooling, etc.) proportional to the reduction of the spaces multiplied by the time in which the area is not used. In other words, if are considered three floors, one of which is not used two days per week (1 week = 5 days), the problem splits into two parts. The first part concerns the space in use (the two floors in use). To calculate the impact of Smart Working on the energy consumption of the used space, the differential indicators explained above (which depend on the number of employees) should be used

On the other hand, in order to take into account the savings in consumption for the unused space (third floor), an indicator is used that takes into account that 33% of the total consumption corresponding to the consumption of the third floor (assuming 3 floors with similar area and structure) does not occur during 2/5 of the weekly time.

Generalizing, the differential impact would be:

$$Energy\ Savings_{Not\ Used\ Space} = \frac{area\ not\ used}{Total\ area} * \frac{days_{not\ used}}{week} * Total\ Consume$$

Where:

(area not used)/(Total Area)= is the percentage of space that is not used.

(days not used)/week= The % of the time the area is not used.

Total consume [kWh/year]= the total energy consumption before stopping using the area

The total savings is given by the sum of all the savings calculated above:

$$Total\ savings_{energy} = energy\ savings_{printers} + energy\ savings_{heating_{tot}} + energy\ savings_{cooling_{tot}} + Energy\ Savings_{Not\ Used\ Space}$$

Thus having the total impact on energy consumption for the factors just analyzed it is possible to convert into CO2 emissions impacted by Smart Working. In the 2018 report done by the Institute for Environmental Protection and Research, the CO2 emission for the production of 1 kWh in Italy was analyzed. It was found that the average value for the thermoelectric sector is 444gCO2/kWh (Caputo, 2020). Through this figure it is possible to transform energy consumption (saved or increased) into CO2 emission (avoided or caused) dependent on Smart Working. The formula is:

$$CO2\ avoided_{energy\ savings} = Total\ savings_{energy} * 0{,}444$$

Where:

Total savings (energy) [kWh/y] = the sum of all savings related to energy consumption

0,444 [kgCO2/kWh] = the kg of CO2 emitted to produce 1kWh in Italy.

3.2 Social impact indicators

The second area of Smart Working impacts on Sustainability is related to the social aspects. Due to their nature, social factors are more difficult to capture. However, a number of scales has been developed in literature for measuring the aforementioned aspects. The company can understand the impact of Smart Working projects on social Sustainability by comparing the results of the survey conducted before the Smart Working project was launched with the results of the same survey conducted afterwards.

The factors from the literature that are influenced by Smart Working are these: work-life balance, physical health, work engagement, technostress, and overwork.

3.2.1 Work-life balance

The questionnaire developed by Monique Valcour, presented in "Work-Based Resources as Moderators of the Relationship Between Work Hours and Satisfaction With Work-Family Balance" in 2007, can be used to analyse the impact of Smart Working on work-life balance (see Annex 1).

Satisfaction with work-life balance: to understand the employee's level of satisfaction about the balance between work and life, the survey is structured on different topics.

The survey is about how the employee handle: work and family and in what way, time and attention devoted to personal and work life, and needs of work and family.

Each candidate surveyed has a scale of 1 (very dissatisfied) to 5 (very satisfied) to answer.

Having been able to prove that there are correlations between these five elements, it is possible to assess the influence of Smart Working on work life balance

3.2.2 Physical health

"A safe working environment is a key factor in competitiveness, and it can help meet the EU's targets for smart, sustainable and inclusive growth. It plays a key role in ensuring a sustainable long working life for healthy and skilled workers." (*László Andor,* Ex *Commissioner for Employment, Social Affairs and Inclusion of the European Commission)*

Both companies and employees should place a high priority on maintaining their health and well-being. The quality of life, longevity, and productivity of an individual are all strongly influenced by their state of health. A healthy workforce is essential to a strong economy since unwell employees reduce productivity for businesses (Eurofound).

The EU's policy places a high focus on the health, safety, and well-being of workers. The Europe 2020 strategy aims to ensure that everyone, including those with different health capacities, can engage in paid work. The EU, through Directive 89/391/EEC on measures to improve the safety and health of workers, places an explicit responsibility on the employer to adapt work to the individual.

Health and well-being in the workplace are a broader issue than exposure to risks, accidents and occupational diseases; it is the outcome of a

multitude of settings and conditions. Organisations and workers need a range of resources to ensure health and well-being in the workplace; how work is organised and the organisational culture are also important. Physical risks, being the most visible, originally received the most attention; however, psychosocial risks are receiving increasing prominence as a workplace health hazard (Eurofound).

Workers can be exposed to a range of physical risks, including: tiring and painful positions, repetitive hand or arm movements, carrying heavy loads, breathing in smoke, dust or vapour, noise and vibrations.

Considering these risks Eurofound has devised the "**European Working Conditions Survey**“ (EWCS) (see Annex 2). The aim of this survey is to assess and quantify working conditions of employees and self-employed, analyse relationships between different aspects of working conditions, identify groups at risk and issues of concern and progress, monitor trends and contribute to European policy development, in particular on quality of work and employment issues.

3.2.3 Work Engagement

Work engagement can be measured through the Utrecht Work Engagement Scale (UWES) designed by Schaufeli and Salanova in 2002 (see Annex 3). This scale consistes of 3 sub-components of work engagement: "vigor," "dedication," and "absorption” (see Chapter **1.2.3.2.1**)**.** All items are scored on a 7-point frequency rating scale ranging from 0 (*never*) to 6 (*always*).

Validity studies that have been carried out with the UWES show that work engagement is indeed negatively associated with burnout, albeit that the relationship between vigor and exhaustion and between dedication and cynicism is somewhat less strong than was expected.

Burnout refers to the emotional depletion and loss of motivation that result from prolonged exposure to chronic emotional and interpersonal stressors on the job (Leiter et al., 2015a). Exhaustion, cynicism, and inefficiency are the three dimensions of burnout according to the Maslach Burnout Inventory (MBI), one of the most widely accepted scales for measuring burnout. Exhaustion encompasses a lack of physical, cognitive, and emotional energy, cynicism refers to an emotionally flat, expedient connection to one's work and inefficiency is a lack of confidence in the contributions of one's work (Leiter et al., 2015).

Engaged employees exhibit positive job attitudes, experience good mental health, and seem to perform better than those who are less engaged. Finally, engagement is not restricted to the individual, it may crossover to others thus leading to what has been labelled collective engagement (Schaufeli & Bakker, 2004).

3.2.4 Technostress

As already explained (see Chapter **1.2.3.2.1**), technostress is a phenomenon that stems from three "creators":

- Techno-overload, related to ICTs' potential to compel users to work faster and longer or change work habit (Tarafdar, M. et al., 2010);

- Techno-invasion, referring to ICTs' ability to invade users' personal life and make the boundaries between work and private contexts more blurred (Tarafdar, M. et al., 2010);

- Techno-complexity, describing situations where ICTs' features and complexity make users feel inadequate with respect to their skills (Tarafdar, M. et al., 2010).

There is an Italian research consisting of two studies conducted on the "technostress creators scale." Study 1 provides an Italian translation of the

brief version of the technostress creators scale, useful to investigate technostress among both remote and traditional workers in the Italian context. Second, Study 2 shows some evidences about antecedents and consequences of techno-stressors experienced by workers during the Covid-19 emergency (Molino et al., 2020), more specifically to the role of workload, which refers to the individual perception of having too much work to do, too diverse tasks to carry out and/or not enough time to accomplish the assigned job (Carlson, 2003).

These three elements are analysed through eleven items divided as follows: four items for techno-overload, three items for techno-invasion, and four items for techno-complexity. Participants use a Likert scale from 1 = strongly disagree to 5 = strongly agree. (see Annex 4)

3.2.5 Overwork

To analyse the impact of Smart Working on overwork, the "Dutch Work Addiction Scale" (DUWAS) created by Schaufeli and Taris in 2004 is adopted. Several indicators of overwork such as working longer than one's contractual work hours, taking work home, and working during the weekends or holidays have been shown to be positively associated with Workaholism (Schaufeli, Taris, & Bakker, 2006). Workaholism is characterized by an irresistible inner drive to work very hard; it is a combination of working compulsively and excessively (Taris & Schaufeli, 2003).

It consists of ten multiple-choice questions with a scale of 1 (almost never) to 4 (almost always) in which the company try to understand the employee's approach to work and denote attitudes of "working excessively" or "working compulsively." After these first questions there are four others related to work-related facts such as: hours one should work and hours one works in the realm of reality, etc. The translated Italian version of this survey, although having fewer questions than the original, remained consistent in terms of results with the original version. (see Annex 5)

3.3 Economic indicators

The economic impact of Smart Working can be calculated by adopting two different perspectives: the one of the corporate and the one of each employee. The following sections presents indicators that, in differential terms, can help a company and employees understand the economic feasibility and consequences of a Smart Working project

Both the two perspectives, in order to be able to compare costs, are divided into: capital expenses and operating expenses.

As operating expenses are considered all those expenses that are repeated periodically (monthly, weekly, daily).

Capital expenses, on the other hand, include all those costs that occur only at the beginning of Smart Working activities.

3.3.1 Corporate perspective: operating expenses impact

The first cost type analysed is operating expenses (OpEx) that include all those costs associated with the maintenance and administration of a business on a day-to-day basis including: energy costs, stationery costs, cleaning costs, software costs and possible financial aid for employees to cope with rising utility bill costs.

Operating expenses regarding consumption depend on both the office area and the number of employees present, as with the impact on consumption, so two scenarios will be analysed: the space used in the office remains constant or there is a reduction in the space used.

Starting with the first scenario (space used constant) the operating expenses impacted are: the cost of energy and the cost of stationery.

Considering the cost of energy, as indicated in chapter 3.1.1 on the environmental impact of Smart Working on consumption, work equipment, heating and cooling will change, and so will the costs associated with them.

To calculate the financial difference between the time before and after Smart Working, it is enough to multiply the energy costs by the proven difference in consumption.

Starting with computer consumption, having to calculate the impact of Smart Working and staying with the corporate perspective, the impact on energy costs is given by the average value of workers for the daily energy consumption of a computer for energy costs.

The indicator expressing energy cost savings related to computers generated by Smart Working is:

$$energy\ cost\ saving_{pc} = 0{,}25 * \ time * energy\ cost * \#daily\ smart\ worker * 220$$

Where:

Pc is personal computer

0,25 [kwh]: is the average consume of a laptop expressed in kwh (energit)

Time[h/day]: time of use during the work shift, which usually, in the case of PCs, is equal to the duration of the shift.

Energy cost [€/kwh]: cost of energy for the company.

#daily smart worker[pc/day]= Average daily number of employees in Smart Working that corresponds to the average number of pc not used in the company each day

220[day/year]: average working day in a year

Regarding the cost of printers, the impact of which has already been calculated in the section on environmental impact (see chapter 3.1.3), the formula for calculating the cost of energy is:

$$energy\ cost\ savings_{printers} = energy\ savings_{printers} * energy\ cost$$

$$energy\ savings_{printers} = 63kWh * \#printers$$

Where:

63kWh= average annual consume of a printer

#printers = the number of dismissed printers

Energy cost [€/kwh] : cost of energy for the company.

If, on the other hand, the impact on the cost of heating is analyzed, having to adopt a business perspective, it is necessary multiply by the cost of energy the difference between consumption at "full capacity" and consumption with employees working remotely.

The indicator will then be:

$$energy\ cost\ savings_{heating} = 0.244 * Daily\ working\ hours_j * \frac{heating\ \ days}{year} * \#daily\ smart\ worker * energy\ cost$$

Where:

0.244 [kWh/(h*individual)] is the average hourly energy consumption related to the heating system per individual in offices

Daily working hours [h/day]: is the hours in a shift of the employee “i” in the office

heating days/year: are the days in which the workplace is heated

#daily smart worker= Average daily number of employees in Smart Working

Energy cost [€/kwh]: cost of energy for the company

The same reasoning as for heating can be made for cooling keeping well in mind the limitations of the indicator explained in the chapter on environmental impact.

$$energy\ cost\ savings_{cooling} = X * Daily\ working\ hours_i * \frac{cooling\ \ days}{year} * \#daily\ smart\ worker * energy\ cost$$

Where:

X= is the consumption kWh/h*individual (corresponding to that for calculating heating) with respect to this type of data in the literature nothing has been found.

Daily working hours: is the hours in a shift

cooling days/year: are the days in which the workplace is refrigerated

#daily smart worker= Average daily number of employees in Smart Working

Energy cost [€/kwh]: cost of energy for the company

In the second scenario (with the change of the space used by the office) the cleaning and lighting expenses related to the unused space and the time the space is not used will also have to be considered. In other words, to the calculations for the first scenario that still need to be done for the used portion of the office space, you need to add the savings from the unused space that will reduce the energy consumption for lighting, cooling, and refrigeration, as well as the cost of cleaning that space.

It can be assumed that the savings on energy for lighting, cooling and heating are proportional to the unused space. If, for example, we consider an office of 900 square meters divided equally over three floors and one floor is closed due to unuse, it is conceivable to approximate the reduction in lighting, cooling and heating consumption to 33%, which corresponds to the portion of unused area.

Following this reasoning the indicator will be:

$$Cost\ savings_{not\ used\ space} = \frac{area\ not\ used}{Total\ area} * \frac{days_{not\ used}}{week} * (total\ lightning\ cost + total\ heating\ cost + total\ cooling\ cost + total\ cleaning\ cost)$$

The cost of software is usually a renewal and it is simply, within the types of software related to Smart Working, the difference between the total cost before Smart Working and the total cost after implementation.

This is because the software needed for Smart Working is not just designed for it. For example, the use of the company cloud could exist regardless of remote working.

$$Software\ costs = Total\ software\ costs_{after\ SW} - Total\ software\ costs_{before\ SW}$$

To cope with increases in employees' energy costs, companies, with the aim of not financially burdening their workers as a consequence of Smart Working, could offer contributions to energy spending.

These contributions would, of course, depend on internal company decisions as to both their existence and amount.

$$contribution\ cost_{energy} = \#employees_{SW} * contribution\ amount$$

The total impact on operating expenses will be:

$$Cost\ Savings_{OPEX} = energy\ cost\ saving_{pc} + energy\ cost\ savings_{printers} + energy\ cost\ savings_{heating} + energy\ cost\ savings_{cooling} + Cost\ savings_{not\ used\ space} - Software\ costs - contribution\ cost_{energy}$$

3.3.2 Corporate perspective: CapEx costs impact

Within the CapEx cost category, Smart Working impacts on: the cost of upgrading office technology, the cost of setting up the office, and the savings related to the purchase or to the construction a possible new smaller office.

Considering the technological upgrade of the office, it is possible to assume that most companies do not need it considering that to be able to interface with smart workers one simply needs a computer and a pair of headphones with a microphone, which in any case, could still be considered general expenses and not related to Smart Working.

This cost is also impacted by economies of scale in that the unit price of upgrading each workstation will also be impacted by the number of workstations one wishes to upgrade (if 10 computers are ordered, the unit cost of each pc will be higher than if 100 computers are ordered).

Since the cost is therefore highly variable, a generic indicator that tracks this expense is preferred:

$$Technologic\ cost = \#workstation * price\ workstation_{unitary}$$

Regarding the cost of acquiring, building, or equipping a new work location, taking into account the rotation among employees, the reduction in needed space given by Smart Working affects the design and consequently the cost of new work locations.

In contrast to the costs calculated above, a differential formula must be used to calculate the impact, since these are costs that the company would incur anyway, but which are affected by Smart Working.

Starting with the construction or purchase of a new building, the impact will depend on the cost per square meter (which depends on the location of the structure) and the percentage reduction in needed space, dependent on company policies, which, of course, will be the differential and therefore savings factor.

$$cost\ savings_{building\ or\ acquiring} = cost\ of\ space * (Area - Area_{SW})$$

Where:

The cost of space: is measured in €/m^2.

Area = is the area that the company needs to build or acquire a new location without the implementation of a Smart Working project

Area (SW) = is the area that the company needs to build or acquire a new location with the implementation of a Smart Working project

The same reasoning can be made for the setting of the work location, which, like the cost of building or acquiring a new location, has an impact given by Smart Working. The indicator therefore takes into account the change.

The difference is that here the set-up cost can be calculated in both €/workstation and €/m^2, and so based on the input data it will be that:

$$cost\ savings_{set\ up} = set\ up\ cost * (\#workstation - \#workstation_{SW})$$

$$cost\ savings_{set\ up} = set\ up\ cost * (Area - Area_{SW})$$

Finally, there are the costs purely associated with starting a Smart Working project: training courses at the managerial and operational levels, software costs, and possible financial aid for employees to set up their own workstations at home.

Training courses introduce managers and employees to a new way of working in term of collaboration, communication, leadership styles, result-oriented appriasals…. In operational-level courses, employees are introduced to the digital world and learn how to: use the necessary software (cloud, shared workbooks, and videocall software), how to manage their time by working by objectives (logic that, as mentioned, is applied when moving to remote work activities), the best way to coordinate with their team, safety when working from home and even how and where to set up their own workstation at home.

In management-level courses, on the other hand, in addition to the topics already listed, other fundamentals are learned: remote task management, team management, and goal management.

$$course\ cost_{training} = \sum_{i=1}^{n} \#course_i * course\ cost_i$$

Where:

n: the total number of different types of courses purchased

#course: the number of courses purchased for each type "i"

course cost: the cost of the course of type "i" in €

The last cost that goes into the total capital expenses is the financial support for setting up the workstation at home. Usually, when adopted, a fixed amount is given to each employee tied to the purchase of support devices for working from home and this can include any device that can make working more comfortable such as: ergonomic chair, ergonomic desk, additional monitor, headset, computer, mouse, keyboard, etc.

$$contribution\ costs_{home\ workstation} = contribution\ amount * \#contributions$$

The total impact on capital expenses will be:

$$cost\ savings_{investments} = cost\ savings_{building\ or\ acquiring} + cost\ savings_{set\ up} - Technologic\ cost - \ contribution\ costs_{home\ workstation}$$

3.3.3 Employees perspective: OpEx impact

In this section, all the operating expenses incurred by Smart Working are presented from the employee's point of view. As the term itself suggests, the first consequence of Smart Working is being able to work from home without having to travel to the office. Therefore, the first indicator analyzes the savings that each employee has by avoiding the commute.

The second analyzed consequence of working from home is the savings in lunch and coffee breaks that each employee takes during their workday.

The third analyzed cost results from the increase in energy consumption (electricity consumption for work equipment, heating and cooling), which has already been analyzed in chapter 4.1.3 from an environmental point of view. The indicators related to the differential total energy consumption are multiplied by the costs, taking into account the perspective of the worker

and the economic impact, in order to understand the impact of Smart Working on the worker in monetary terms.

Relative savings and costs are summed to make the total impact clear.

3.3.3.1 Commuting cost

Commuting costs can be of two types, distinguished by the means of travel used to get to work: costs associated with the car (gasoline and wear and tear) and costs associated with traveling by public transportation (single tickets or periodic passes).

By adopting Smart Working, the savings on fuel consumption are related to the days when employees work remotely. The yearly savings for each employee are:

$$Commuting\ savings_{fuel} = \frac{2 * D_{H-W} * days_{SW}}{car\ consume} * fuel\ cost$$

Where:

2= are the round trip between home and office

D(H-W) [km]: is the avarage distance in km between home and office of an employee

Days(sw): the days the employee works remotely each year

car consume: the consumption of the employee's car expressed in km/l

Fuel cost: the cost of gasoline expressed in €/l

Regarding the costs related to public transportation, it should be considered the mode of travel (whether done with single tickets or subscriptions that can be weekly, monthly or yearly) and whether Smart Working saves on these costs. In other words, if the employee has a monthly subscription and, based on the frequency of working remotely, has no convenience in suspending this subscription then it cannot be considered that Smart Working is impacting on cost. Conversely, again following the example, in the case where there is a single ticket purchase each time the employee works remotely it will be a savings created by Smart Working.

There will be two indicators to use based on the category purchased by the employee (ticket or subscription)

$$cost\ savings_{public\ transportation\ sub} = \#subscription\ avoided * cost\ of\ subscription$$

Where:

#subscription avoided: is the number of subscriptions not renewed each year (if weekly=48; if monthly= 12; if annual=1)

Cost of subscription: simply the cost in € of the subscription

$$cost\ savings_{public\ transportation\ ticket} = days_{SW} * cost\ of\ ticket$$

Where:

days(SW)= Number of Smart Working days per year that corresponds to the number of tickets avoided each year

cost of ticket: the unit cost of the ticket expressed in €/ticket

3.3.3.2 Cost of living the workday away from home

As costs of living the workday away from home it is referred to all those workers who live at such a distance that going home on their lunch break is impossible. This is a cost that is not incurred when the employee has tickets for lunch or there is the company canteen. Due to lack of average values to be included in the indicator, it is provided in a generic form:

$$cost\ savings_{day\ far\ from\ home} = (launch\ cost + break\ cost * \#of\ breaks) * days_{SW}$$

Where:

launch cost: average cost of a launch near the office

break cost: Breaks are also considered as coffee etc. is consumed

#breaks: during the day it is possible for bi to take more than one break

Days(SW): Number of days in which the employee work remotely per year

3.3.3.3 Cost of energy

The increase in energy consumption given by the increased presence in the home during the day also causes, of course, an increase in the cost associated with utility bills.

The new consumption, however, depends on several factors that include the heating system, the cooling system, and computer use (lighting used for working at home can be considered negligible).

As already presented while introducing the corporate perspective (see Chapter 3.3.1), the indicator for energy consumption referred to the use of a laptop while working remotely is:

$$energy\ cost_{pc} = 0{,}25 * \ time * \#daysSW * energy\ cost$$

Where:

0,25 [kwh]: is the average consume of a laptop expressed in kwh (energit)

Time[h/day]: time of use during the work shift, which usually, in the case of PCs, is equal to the duration of the shift

Energy cost [€/kwh]: cost of energy for the employee

#daysSW= number of days in a year in which the employee work remotely

Regarding the energy consumption for heating, please refer to section 4.1.3 for the calculated energy consumption for environmental impacts. In particular, in the indicator measuring the environmental impact of heating, the second term refers to the additional energy consumption for the employee due to the heating of the working environment during Smart Working, which is multiplied by the energy cost.

The indicator that energy annual cost related to heating is:

$$heating\ cost_i = k * \frac{house\ consume_i}{heating\ day} * Area\ of\ house_i * \#daysSW_i * energy\ cost$$

I: refer to the employee in Smart Working

k: is a binary factor. Its value can be either 0 or 1. If the heating in the house of employee "i" is centralized, so it is turned on regardless of whether the homeowner wants to turn it on or not, k will have value zero making maximum energy savings from the environmental point of view. If, on the other hand, the heating system is autonomous, so that the homeowner turns it on and off as needed, k will have value 1.

House consume [kWh/(m^2*y)]: corresponds to the consumption shown in the table after crossing house typology and construction period

Area of the house: corresponds to the square meters of the dwelling.

#daysSW(i): Number of days in which employee "i" work remotely during the heating period

Energy cost [€/kwh]: cost of energy for the employee

House consume data is provided in the table below

House typology	Construction period	kWh/m^{2}y
Single family house	Before 1920	144.4
	1920–1950	142.3
	1950–1980	141.3
	1980–2000	97.1
	2000–2010	81.5
	After 2010	66.4
Multifamily house	Before 1920	100
	1920–1950	113.5
	1950–1980	105.2
	1980–2000	88
	2000–2010	74.6
	After 2010	58.2
Terraced house	Before 1920	121.1
	1920–1950	115.3
	1950–1980	119.2
	1980–2000	89.9
	2000–2010	80.9
	After 2010	66.6
Apartment block	Before 1920	110.5
	1920–1950	103.2
	1950–1980	99.2
	1980–2000	69.5
	2000–2010	70.3
	After 2010	53.4
College (data not available – assimilated to apartment block)	Before 1920	110.5
	1920–1950	103.2
	1950–1980	99.2
	1980–2000	69.5

Figure 15- Thermal energy needs of houses (Fabiani et al., 2021)

Regarding the energy consumption for cooling, please refer to section 4.1.3 for the calculated energy consumption for environmental impacts. In particular, in the indicator measuring the environmental impact of cooling, the second term refers to the additional energy consumption for the employee due to the cooling of the working environment during Smart Working, which is multiplied by the energy cost:

$$cooling\ cost_i = k * refrigerator\ consume * Refrigerated\ Volume_i * Time * \#daysSW_i * energy\ cost$$

k: is a binary factor. Its value can be either 0 or 1. The variable assumes 0 if there is no refrigeration system in the employee's home, 1 if there is.

Refrigerator consume [kWh]: that is the consume of the system of refrigeration

Refrigerated volume [m^3]: it is the that the employee have to refrigerate

Time [h/day]: the time when the cooling system is turned on in a day

#daysSW(i)= Number of days in which employee "i" work remotely during the cooling period (annual costs)

Energy cost [€/kwh]: cost of energy for the employee

The amount of the difference in bill costs for each employee in relation to Smart Working is given by:

$$bill\ cost = energy\ cost_{pc} + heating\ cost_i + cooling\ cost_i - company\ contribution_{bill}$$

The last operating cost impacted by Smart Working is the cost of living. In fact, no longer having the need to go to the office every day, employees may choose to relocate in a place that is less expensive in terms of cost of living.

The factors to be considered in calculating the cost of living are many and depend from place to place, the one that is comparable, however, and that impacts an employee's economy in no small way, is the cost of rent, which will be calculated as follows:

$$rent\ savings = rent - rent(sw) * 12$$

Summarizing the total impact on opex will be:

$$OPEX\ savings$$
$$= cost\ savings_{day\ far\ from\ home} - bill\ cost + rent\ savings$$
$$+ trasportation\ savings$$

3.3.4 Employee perspective: capital expenses impact

From an investment perspective, employees do not always have to incur costs in order to create their own workstation at home. In fact, the scenarios one may encounter are: the workstation is complete, the workstation needs improvement, the workstation does not exist at home and must organized from scratch. The result of the investment cost will then be equal to the sum of all expenses to which the employee is subject minus the company contribution. The indicator for measuring this cost is:

$$workstation\ cost = cost\ of\ workstation - company\ contribution$$

4 Conclusions

The health emergency experienced intensely and pervasively in recent years, and the ecological emergency that is under everyone's eyes, are the reasons for the progressive and gradual emergence of the combination of Smart Working and Sustainability.

Both are the result of the new needs that have arisen with the emergence of the imminent dangers that all know: the need to manage an unforeseen epidemiological emergency and the need to manage an already foreseen ecological emergency.

As is often the case, humanity recognized the benefits of a new way of working in correspondence with the need to find a sudden solution to the critical problem that emerged during the 2020 pandemic: continuing to work even in the face of social distancing.

Smart Working has positioned itself as a real revolution in the way of working in many ways, including its profitable environmental impact. Since the 1970s, it has been understood that the Earth's resources are finite and that the ideals of a consumer society would soon lead to the total exploitation of resources and people, marking the irreversible regression of the planet.

The analysis conducted in this paper starts from the literature that has highlighted the characteristics of Smart Working with a privileged view of its essential function in terms of Sustainability. The two terms of the question are closely related, and the pandemic citizens are leaving behind has really played the role of igniter and accelerator of a process of understanding that would otherwise have taken time (Nicosia, 2022).

What we wanted to explore here is the close relationship between the use of Smart Working and the side effects in terms of sustainability, from a qualitative perspective. This was done both from an observation point inside the workplace and thus highlighting the effects in terms of workers' well-

being and corporate productivity and profitability, and by shifting the view outside the workplace and thus on the impact on the environment

Thus, in the course of the research, the procedures for assessing the impact of Smart Working on the three areas of sustainability were considered. This path then led to the development of indicators that are the focus of the entire paper.

After an in-depth analysis of the two terms of the question (Smart Working and Sustainability) and after noting the lack of indicators in the literature that can help in a practical way to quantify the impact of Smart Working from an environmental, worker, and economic perspective, an attempt was made to include as many variables as possible that are affected by the implementation of Smart Working activities in order to help organizations accurately quantify the impact of Smart Working initiatives by relying on specific sets of indicators.

Thus, by analyzing the different possible scenarios that could occur along with the creation of specific indicators for each macro area of Sustainability, an attempt was made to understand the actual impact in quantitative terms.

The basic idea is that companies using these indicators have the opportunity to verify the impact that the introduction of Smart Working could have on each of the three areas considered here: the environment, the economy of a company and the well-being of its employees.

4.1 Limitation of the work a future direction of research

Some limitations of the work are related to the calculation of some indicators.

One of them concerns noise pollution, defined as the damage to the urban and natural environment caused by anthropogenic activities due to the

excessive production of high intensity sounds (National Geographic Society, 2022). It is known that noise pollution in the centers is decreasing due to Smart Working and, consequently, to the consequent reduction of car traffic due to the possibility of working from home. What is not known, however, is how to quantify the impact, because it is not possible to determine a differentiated value for the decibels perceived by each car with the data available today. In other words, to calculate the impact of Smart Working on noise pollution, a study is needed to define the decibel impact of each car.

A second one concern the indicators used to quantify energy consumption for heating and cooling.

Regarding the energy consumption for heating, major factors were not taken into account to calculate it accurately. These factors are the energy efficiency of the work building, the doors, the inventory, the lighting and also the floor where the offices are located. The absence of these factors affects the calculation of the energy consumed for heating, so that exact quantities cannot be determined.

For cooling, the elements just described for heating are still relevant, since they are not considered in this category either, but they have an influence. In addition to these factors, there is the absence of a number that exists for heating and is included in the formula as a parameter to be defined in the future. The parameter you are referring to is the number that expresses energy consumption in kWh as a function of one person per hour. In other words, it indicates how much energy is needed to cool the room for a certain number of hours, depending on the number of people present. This figure is necessary to calculate the impact of Smart Working on energy consumption, assuming that the space remains unchanged while the number of employees present decreases. From daily life experience, it is known that as the number of people in a room changes, so does the temperature (think of indoor events where the heat is much more noticeable when there are too many people).

A third one is the cost of living calculation, which only takes into account the impact on rent of being able to live in places that are further away from the workplace, since the times when you have to go to the office are reduced by being able to work from home.

Other limitations are related to the nature of the work itself. Namely, all indicators were developed from the theoretical point of view through the study of literature and logical considerations. There is a lack of experiments that would both allow a practical insight into possible results and errors and confirm the reliability of these indicators, which could be improved or confirmed as they are.

Based on the latter limitation, a possible future direction is practical testing in companies. Indeed, by testing, it will be possible to detect errors, improve existing indicators and even create new ones.

Moreover, given the above limitations, these indicators are not yet able to calculate everything with extreme accuracy. Studying and working on them, it is possible to improve the accuracy of calculations.

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Appendixes

Appendix 1 work life balance

Work-Based Resources as Moderators of the Relationship Between Work Hours and Satisfaction With Work-Family Balance

Satisfaction with work–family balance:

Indicate from (1) very dissatisfied to (5) very satisfied, your level of satisfaction with the following two items:

1. How successful do you feel in balancing your paid work and family life?
2. Are you satisfied or dissatisfied with the balance between your job or main activity and family and home life?

Indicate from (1) very dissatisfied to (5) very satisfied, your level of satisfaction with the following five items:

1. the way you divide your time between work and personal or family life
2. the way you divide your attention between work and home
3. how well your work life and your personal or family life fit together
4. your ability to balance the needs of your job with those of your personal or family life
5. the opportunity you have to perform your job well and yet be able to perform home-related duties adequately

The measure of **work hours** was constructed as the sum of the following two items:

1. How many hours do you work in a typical week, including paid breaks but excluding lunch and overtime?
2. How many hours of overtime do you work in a typical week?

Items asked respondents to indicate, on a scale of (1) minimum amount to (5) maximum amount, how much **complexity their job entailed**. Sample items include:

1. How much opportunity does this job give you to do a number of different things?
2. How much opportunity does this job give you for independent thought or action?

Control over work time was measured with a five-item scale Items asked respondents to indicate, on a scale of (1) none to (5) a great deal, how much control they had over aspects of work time, including the following:

1. when you begin and end each workday or work week
2. the number of hours you work each week
3. when you can take a few hours off
4. when you take vacations or days off.

Gender was a dummy variable coded 0 men and 1 women.

Appendix 2 EWCS 6th edition

https://www.eurofound.europa.eu/sites/default/files/ef_survey/field_ef_documents/6th_ewcs_2015_final_source_master_questionnaire_in_english_v2.pdf

Appendix 3 UWES

Appendix
Work and Well-Being Survey (UWES)

The following 17 statements are about how you feel at work. Please read each statement carefully and decide if you ever feel this way about your job. If you have never had this feeling, cross the "0" (zero) in the space after the statement. If you have had this feeling, indicate how often you felt it by crossing the number (from 1 to 6) that best describes how frequently you feel that way.

Never	Almost Never	Rarely	Sometimes	Often	Very Often	Always
0	1	2	3	4	5	6
Never	A few times a year or less	Once a month or less	A few times a month	Once a week	A few times a week	Every day

1. At my work, I feel bursting with energy.[a] (VI1)
2. I find the work that I do full of meaning and purpose. (DE1)
3. Time flies when I am working. (AB1)
4. At my job, I feel strong and vigorous.[a] (VI2)
5. I am enthusiastic about my job.[a] (DE2)
6. When I am working, I forget everything else around me. (AB2)
7. My job inspires me.[a] (DE3)
8. When I get up in the morning, I feel like going to work.[a] (VI3)
9. I feel happy when I am working intensely.[a] (AB3)
10. I am proud of the work that I do.[a] (DE4)
11. I am immersed in my work.[a] (AB4)
12. I can continue working for very long periods at a time. (VI4)
13. To me, my job is challenging. (DE5)
14. I get carried away when I am working.[a] (AB5)
15. At my job, I am very resilient, mentally. (VI5)
16. It is difficult to detach myself from my job. (AB6)
17. At my work, I always persevere, even when things do not go well. (VI6)

Source: Schaufeli and Bakker (2003).
Note: VI = Vigor scale; DE = Dedication scale; AB = Absorption scale.
a. Shortened version (Utrecht Work Engagement Scale–9 [UWES-9]).

Appendix 4 Technostress creators scale

Original Items	Italian Translations
Techno-overload	
I am forced by technology to work much faster	*Sono costretto/a dalle tecnologie a lavorare molto più velocemente*
I am forced by technology to do more work than I can handle	*Sono costretto/a dalle tecnologie a fare più lavoro di quello che riesco a gestire*
I am forced by technology to work with very tight time schedules	*Sono costretto/a dalle tecnologie a lavorare con scadenze molto strette*
I am forced to change my work habits to adapt to new technologies	*Sono costretto/a a cambiare le mie abitudini lavorative per adattarmi alle tecnologie*
Techno-invasion	
I spend less time with my family due to technology	*Trascorro meno tempo con la mia famiglia a causa delle nuove tecnologie*
I have to be in touch with my work even during my vacation due to technology	*Devo rimanere in contatto con il mio lavoro anche durante le vacanze, le serate e i weekend a causa della tecnologia*
I feel my personal life is being invaded by this technology	*Sento che la mia vita personale è stata invasa da queste tecnologie*
Techno-complexity	
I do not know enough about technology to handle my job satisfactorily	*Non ne so abbastanza di tecnologia per gestire il mio lavoro in modo soddisfacente*
I need a long time to understand and use new technologies	*Ho bisogno di molto tempo per comprendere e utilizzare nuove tecnologie*
I do not find enough time to study and upgrade my technology skills	*Non trovo abbastanza tempo per studiare e aggiornare le mie capacità tecnologiche*
I often find it too complex for me to understand and use new technologies	*Trovo spesso troppo complesso per me capire e usare le nuove tecnologie*

Note: Likert scale from 1 = strongly disagree to 5 = strongly agree.

Appendix 5 DUWAS 10 IT

Indagine su Lavoro e Benessere (DUWAS-versione breve) ©

Le seguenti 10 affermazioni riguardano quello che lei prova rispetto al suo lavoro. Per favore legga attentamente ogni affermazione e decida quanto spesso, rispetto al suo lavoro, lei si sente nel modo descritto. Per ogni affermazione indichi l'alternativa che meglio descrive la frequenza con cui si sente in quel modo. Per esempio, se lei non ha mai o quasi mai fatto esperienza del sentimento descritto, faccia un cerchio intorno all' "1" (uno) dopo l'affermazione. Se lei ha fatto sempre o quasi sempre esperienza del sentimento descritto, faccia un cerchio intorno al "4" (quattro).

(Quasi) mai	Qualche volta	Spesso	(Quasi) sempre
1	2	3	4

1.	Mi sembra di essere di fretta ed in corsa contro il tempo	1	2	3	4
2.	Continuo a lavorare dopo che i miei colleghi hanno smesso	1	2	3	4
3.	E' importante per me lavorare intensamente anche quando quello che faccio non mi piace	1	2	3	4
4.	Mi tengo impegnato e 'metto molta carne sul fuoco'	1	2	3	4
5.	Sento che c'è qualcosa dentro di me che mi spinge a lavorare intensamente	1	2	3	4
6.	Dedico più tempo al lavoro che a socializzare con gli amici, ad hobby o ad altre attività del tempo libero	1	2	3	4
7.	Mi sento obbligato a lavorare intensamente, anche quando ciò non è piacevole	1	2	3	4
8.	Mi ritrovo a fare due o tre cose contemporaneamente, come ad esempio consumare il pranzo, scrivere un promemoria e utilizzare il telefono	1	2	3	4
9.	Mi sento colpevole quando mi prendo del tempo libero dal lavoro	1	2	3	4
10.	E' difficile per me rilassarmi quando non lavoro	1	2	3	4

WE = Working excessively (Lavorare eccessivamente); *WC* = Working compulsively (Lavorare compulsivamente)

Ore lavorate

a. Ufficialmente, quante ore lavora alla settimana?

_____ ore

b. In realtà quante ore lavora alla settimana (straordinari inclusi)?

_____ ore

b. Quanto tempo impiega, complessivamente, per andare al lavoro e per tornare a casa dal lavoro?

_____ minuti

c. Io lavoro *(per favore indichi)*:

- ☐ in orario normale
- ☐ su turni; se sì
  - ☐ solo turni di giorno
  - ☐ solo turni notturni
  - ☐ sia turni di giorno che turni notturni