

2022

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A MULTIFUNCTIONAL PRODUCT DESIGN FOR PERFORMING WORK FROM HOME.

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Dissertação apresentada ao IADE - Faculdade de Design, Tecnologia e Comunicação da Universidade Europeia, para cumprimento dos requisitos necessários à obtenção do grau de Mestre em Design do produto e do espaço realizada sob a orientação científica da Doutora Sara Roby Malheiro Cardoso Rodrigues, Professora Auxiliar do IADE da Universidade Europeia.

Dedico este trabalho à minha família que apesar de estar longe, sinto-os sempre perto de mim, com um abraço de apoio.

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palavras-chave

Escritório em casa; Design do produto; Trabalho
Objetos multifuncionais; Ergonomia.

resumo

Sabe-se que recentemente poucas situações tiveram um impacto tão grande na forma como as empresas trabalham como a pandemia de SARS-COV2. Numa tentativa de evitar a propagação do vírus, as empresas e os seus empregados foram forçadas a trabalhar sob o regime do trabalho remoto, o que teve um impacto positivo na produtividade dos empregados, mas nem sempre com as condições e equipamentos adequados. Hoje em dia, o trabalho híbrido que combina trabalho em casa e no escritório é uma realidade para muitas empresas, pelo que criar um local de trabalho em que as características fisiológicas, anatómicas e psicológicas sejam tão equilibradas quanto possível é uma necessidade real. Esta investigação procurou compreender como, através do design, um produto pode ser criado para oferecer condições favoráveis para se realizar trabalho a partir de casa. Da mesma forma, também se procurou compreender os fundamentos ergonómicos necessários para realizar o trabalho da forma mais apropriada. Para atingir este objetivo procurou-se compreender a forma como os espaços de trabalho evoluíram ao longo da história e que continua a evoluir até nos dias de hoje. Foram também realizados estudos de casos e uma investigação sobre os espaços de trabalho em casa usados durante o confinamento devido à pandemia, utilizando a técnica do questionário. Toda a informação e dados obtidos, contribuíram para a criação de uma proposta de produto multifuncional, que tenta oferecer as características necessárias para trabalhar a partir de casa de uma forma adequada.

Keywords

Home office; Product design; Remote work; Multifunctional objects; Ergonomics..

abstract

It is known that recently few situations have had as great an impact on the way companies work as the SARS-COV2 pandemic. In an attempt to prevent the spread of the virus, companies and their employees were forced to work under remote working, which had a positive impact on employee productivity, but not always with the right conditions and equipment. Today, hybrid work that combines work at home and in the office is a reality for many companies, so creating a workplace where physiological, anatomical and psychological characteristics are as balanced as possible is a real need. This research sought to understand how, through design, a product can be created to provide favorable conditions for doing work from home. Likewise, it also sought to understand the ergonomic fundamentals needed to perform work in the most appropriate way. To achieve this goal, we sought to understand how workspaces have evolved throughout history and continue to evolve today. Case studies and an investigation into the home workspaces used during the pandemic confinement were also conducted, using the questionnaire technique. All the information and data obtained, contributed to the creation of a multifunctional product proposal, which tries to offer the necessary characteristics to work from home in an adequate way.

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1.0 INTRODUCTION

A healthy work environment is essential, not only for achieving health but also for making a positive contribution to productivity, work motivation, work ethos, and the overall quality of life of employees (Casas, 2006). In this sense, Casas (2006) considers the workplace as a priority environment for health promotion in the 21st century.

Workplaces throughout history have been developing and adapting to the changing needs of each generation, which make up the labour market (Clarín 2017). An important part of this evolution is due to the inclusion of technology in offices such as telephones, machines, personal computers, and other devices. The different ways in which people used to do their work have gone hand in hand with the distribution of such technologies (Casas, 2006). As technology has advanced and computers have become increasingly dynamic, the home office movement, and remote working, have become more prevalent among employees (Xavier, 2020). Remote working is considered to be a model that has already been applied in several companies over time. Despite having emerged in the 1960s, most employers did not consider its benefits until the advent of the SARS-COV2 pandemic in the early 2020s, when employees were forced to work from home (Xavier, 2020). A report by the International Labour Organisation (ILO) showed that previously only 20% of the workforce in the United States, and less than 2% in Latin America resorted to working from home. In the case of Portugal, three out of five companies did not have a home office policy before the pandemic, forcing 70% of employees to enter this system according to a study by Human Resources magazine (Macaire, 2020). Globally during the pandemic, according to the study conducted by Adobe, up to 67% of employees implemented this new work scheme, reporting positive experiences and great benefits for the companies (Macaire, 2020). The pandemic experience demonstrated that working from home is viable for employees, as they can be just as productive working remotely as if they were working in a face-to-face environment (Pier & Torre, 2021).

However, this type of change in the way of working has a lot to consider beyond employee productivity, especially in terms of health and safety (Reyes, 2021).

Considering the home environment as the main setting for work, the home office has brought many advantages for both companies and employees. However, many organizations did not prepare their staff for this change. This had a negative impact on many employees as they did not have the necessary tools and ergonomic environment to create a home office (Marquez, 2021).

Bradley (2021) considers that the hybrid model is currently the model that many companies have opted for to continue working. This model of working involves combining aspects of home office with office-based work (Bradley 2021). According to Lynda Gratton, in her article *How to do Hybrid Right*, staff are seeing the advantage of greater flexibility in where and when they work as a result of the pandemic (Pier & Torre, 2021). As the hybrid model is the model chosen by many companies for their employees to work, the starting question for this research arises: How can the right conditions for remote working from home be created through a product? The main objective of this research is to develop a product proposal that has the right characteristics for employees who conduct work remotely from home. To meet this objective, the focus of this research is mainly on understanding the current state of the home office, the activities that employees perform, the environment in which they work, and what their main needs are when working.

The development of this study was divided into different parts to meet the main objective. In the first part, an introduction to the proposed study is presented, in which the problem is addressed in a general way with the research question and the main objective. The second part is dedicated to the theoretical framework, addressing the following topics: origin and evolution of workspaces throughout history, contemporary models of workspace, remote work and its evolution in recent years worldwide, remote work due to the SARS-COV2 pandemic, ergonomics in workspaces, deepening the study of anthropometry, lighting, ventilation, and the thermal and acoustic environment. To conclude the theoretical framework, the chapter on multifunctional objects presents a brief analysis of them; this chapter shows how designers from different periods responded to the multiple needs of users through a single object. According to Paredes (2005), the changes and the current lifestyle that society has adopted since the end of the 19th century imposed a familiar environment in reduced spaces. Multifunctional furniture has often become a response to this problem, as it has differentiated characteristics that allow it to be

inserted in different environments, including small spaces (Lorenzo, 2006). Due to this problem, it was decided to deal with the design proposal of the presented product from the perspective of the multifunctionality of objects. The third part is dedicated to the development of the research methods used; as a first method, three case studies were carried out; a home office and two desks. The analysis of the cases was done through a SWOT analysis for each one, presenting also the similarities and differences between them. For the second method, the questionnaire technique was used. A questionnaire was developed to find out the current situation of the home office employees. In the fourth part, the sample obtained, the presentation, and the analysis of the data obtained from the questionnaire are presented. In the fifth part, the product proposal for employees working from home is developed. The design of the product considered the theoretical framework and the results of the questionnaire. Finally, concluding remarks about this study and subsequent project future lines of research are presented.

2.0 THEORETICAL FRAMEWORK

2.1 ORIGIN AND EVOLUTION OF WORKSPACES

The Origin

According to Saval (2014), the question of when and how offices were created is a question with no easy answer. For Saval (2014) the origin can be associated with the invention of writing and the corresponding ability to keep records in a systematic way. Saval states that the office, despite the fact that millions of people worked in one, remained unnoticed because it used to be considered as a scenario "too banal to merit a serious investigation" (Saval, 2014).

The beginning of offices is related to the workers who have never left it in centuries of evolution: the administrative workers (Garrido, 2017). According to Iza (2016), wherever record keeping and accounting were necessary there have always been offices. Shortly after humans settled in fixed populations of increasing size, writing and arithmetic were discovered and have resulted in "offices". Iza (2016). Office work is considered to be preceding written language, where for example the organization of accounts was already being carried out in civilizations that did not yet have an alphabet and even before the appearance of money (Garrido, 2017). Archaeologists believe that writing may have emerged from the primitive marks that were made to keep accounts of stocks in warehouses. This has been 5,300 years ago; being able to conclude that in a way these warehouses could have been the place where the first clerks worked (Garrido, 2017). In ancient Egypt for example, all payments made in spices had to be recorded. This system required to have numerous warehouses where it was possible to store all the goods but also needed enough space for all those who were keeping the accounts. It is from that moment that the figure of the scribes appears. The scribes, besides being able to read and write, had to have knowledge of accounting and mathematics. The constant complexity of administrative tasks prompted the search for larger spaces for those who managed these tasks (Garrido, 2017). In (Fig. 1) the position and way of working of the scribes can be observed.

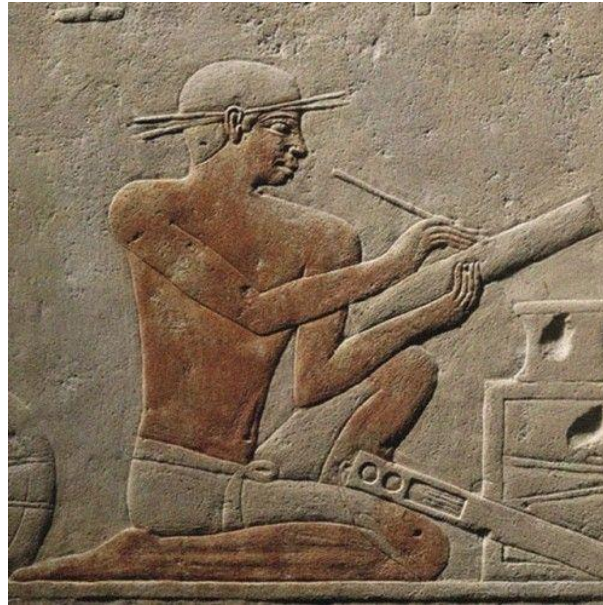


Fig 1 Egyptian Scribe. source: Science photo(2022)

The scribes' offices were formerly part of a palace or in its case a temple of great dimensions, and a room was destined to keep the parchments or writings where the scribes carried out their work. References in ancient texts speak of these rooms and define them as libraries. However, they were considered true offices since the parchments were used to record records and other administrative functions such as treaties and decrees, in addition to recording all acts and events of the empire and not for writing or poetry (Iza, 2016). Therefore they can be considered in a certain way as the precursors of today's offices (Iza, 2016).

In some civilizations such as the Greek civilization, the ancestors of clerks worked in temples, places that they considered noble. Ancient documents from Mesopotamia mention that administrative matters such as the registration of rents, gifts, and the distribution of food and salaries occurred in these religious buildings (Saval, 2014). The temple of Athena in Greece was the central treasury headquarters during the 5th century BC. Temples had previously been limited to worship activities, however later, in addition to serving as the place for the physical deposit of monetary reserves, they served as an administrative centre where financial transactions took place (Iza 2016).

For Kellaway (2013) the first workspace itself dates back to the 15th century, when medieval monks created the "Scriptorium," a cubicle-shaped desk designed for copying manuscripts, where its name literally translates as "place to write" (Fig. 2).



Fig 2. Scriptorium Medieval. source: Arkiplus(2022)

The 18th Century

Although the existence of offices dates back as far as the Egyptian, Greek and Roman civilizations, office buildings were not regularly constructed until the 1880s. Prior to this time, spaces dedicated to the conduct of any activity were usually small rooms within a larger house. Images of ancient castles or monasteries showed rooms where medieval monks worked on manuscripts and made use of their Scriptorium. Although it was not until the 1880s that office buildings were built on a regular basis; previously with the expansion of the British Empire and the increase of trade in other parts of the world, the first office building was built in 1726 in London and was known as The Old Admiralty Office. This building served to manage the large amount of paperwork generated by the Royal Navy and included meeting spaces and the Admiralty Boardroom, in use to this day (Yin 2011). Kellaway (2013) defines the office as the place where the administration of tasks is often done: the home of the workers. Although a building such as the Old Admiralty office already existed, in the 18th century in London most office work was done in the houses. The proprietors usually lived upstairs of the store, where also the clerks lived whom they treated

somewhat like domestic servants (Kellaway, 2013). It was in 1729 that East India House was built in London, which served as headquarters for the East India Trading Company and its legions of workers. By this time, the advent of a centralized and concentrated space to administer an ever-increasing amount of paperwork had gained momentum, with new offices springing up all over London (Mansson, 2021). The "East India House is very significant to the history of offices, as it eventually created a very large and complex bureaucracy (Bowen, 2002). According to Bowen (2002) it "started in 1600 as a company that administered the long-distance trade with Asia, which generated large volumes of documents. By the mid-18th century, it had an empire in India" (Fig. 3).



Fig. 3 East India House source: (Kellaway 2013)

The 19th Century

By the 19th century, the historic office changed from being a single space in a residence to occupying every room in the house. Over time, neighbourhoods became populated with homes dedicated to office space, creating the first commercial neighbourhoods (Yin, 2011). By 1880, the demand for buildings was designed exclusively to house commercial uses, as converted homes could no longer meet the

specific needs of businesses. Offices required a greater concentration of space and proximity to other businesses within the same geographic area (Yin, 2011).

The first commercial offices composed of large skyscrapers appeared in the industrial cities of the northern United States at the end of the 19th century. This new architectural phenomenon was made possible by the invention of electric lighting, air conditioning systems and the telegraph system, and meant that offices no longer had to be located next to factories, but still retained control over production and distribution to distant markets. However, it was the birth of the elevator and steel frame construction that further led to a radically new way of working and consequently heralded the growth of office design as a discipline, and the history of office design entered a new period (Yin, 2011). These early office buildings were developed in Chicago, forming commercial districts. With the invention of the electric elevator in 1880, buildings were able to meet office occupancy needs (Yin, 2011). The invention of the gearless electric elevator in 1902 laid the foundation for skyscraper design. New York's Beaver Building and Chicago's Majestic Building were among the first to embrace it. In the decades that followed, skyscrapers changed dramatically (Saval, 2014.) In an attempt to increase employee efficiency, reduce costs and maximize profits, mechanical engineer Frederick Winslow Taylor published "The Principle of Scientific Management," which suggested that science-based meticulousness was the secret to productivity. This school of thought, better known as "Taylorism," laid the foundation for the history of open-plan offices. However, at the time, open-plan offices resembled factory-like grids in which managers could observe all workers from their private offices (Kellaway, 2013 (Fig. 4).

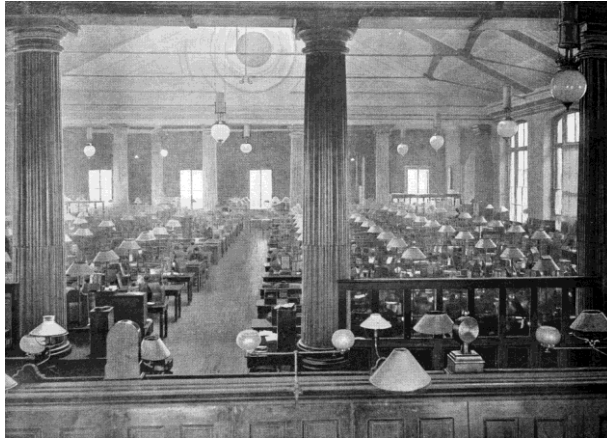


Fig. 4 The telegraph instrument galleries, General Post Office, London. source: Kellaway 2013

St. John (2017) considers American architect Louis Sullivan as a pioneer in the study of the formal articulation of the high-rise office building. Delicate naturalistic ornamentation and a forceful form condensed his mystical vision of a new and vital democracy based on industrialization.



Fig. 5 Wainwright Building Plan by Louis Sullivan Mo. 1890-1891

The 20th Century

The 20th century is an important century in the development of office buildings because the first one that has been considered a modern building was built (Yin, 2011). It was in the year 1903 that Frank Lloyd Wright designed the Larkin Administration Building in the United States (Crisóstomo, 2019). The Larkin Building was a precursor in many ways to the new needs and potential of the modern office (Yin, 2011). The building had all the basic principles of today's offices: open-plan floor plans, teamwork areas, and fit-out facilities with centralized systems (Mozas, 2017) (Fig. 6) Wright took the client's needs into account and designed a clean, well-lit interior (Crisóstomo, 2019). Although the building was unique for its time, it would take several years of its construction for designers and theorists to examine the principles Wright used for the design of workspaces (Yin 2011) that at the time made a difference, among some of the innovative details were the steel office furniture, the use of air conditioning, dividers and hinged glass doors with metal frames (Mozas, 2017).



Fig. 6 Larkin Administration Building in 1903 Source: A history of the office n.d

Until the 1930s, office buildings generally did not achieve great heights; most skyscraper designs by architects such as Mies van der Rohe or Walter Gropius, were never built (Yin, 2011). The first "thoroughly modern tower office building" built in the world was the Philadelphia Saving Fund Society building and designed by William Lescaze and George Howe in 1932 (Yin, 2011). Another building during the 20th Century that would mark the dominance of open spaces is the Johnson Wax Building in Wisconsin, United States, designed by architect Frank Lloyd Wright in 1936. This building is considered one of the 25 best buildings of the 20th Century due to the innovation in its architecture, furnishings and work plan. Wright, decades ahead of his time, employed innovative modular furniture; but he also prioritized productivity by placing a 200-person sales force on a single floor. The Johnson Wax Company's open-plan office embodied the theory of Taylorism (Lecce, 2018.) In addition to innovating work furniture, he incorporated new design elements such as bright lights, warm spaces, and cork ceilings, these played an important role in absorbing office acoustics (Lecce, 2018) (Fig. 7).



Fig. 7 The Johnson Wax Administration Building Workroom; source: domus.it

Lecce (2018) mentions that the most difficult part of Wright's experiment was what he would consider to be the workroom, a large open space 40 by 60 meters in plan and 6 meters in height supported by hollow "dendriform" columns, alluding to its tree-like shape. Following the spirit of organic architecture, Wright thought it was

very important that he designed all the furniture, so in 1937, Wright sketched the first version of a desk and chair intimately linked to the building in its conception; he planned more than 40 different pieces of furniture for the administrative building. The furniture was composed of straight and rounded forms, these managed to reflect the orthogonal and circular geometries of the building (Lecce, 2018). Lecce (2018) indicates that in addition to the shapes that make the furniture blend in with the interior, Wright introduced a number of features intended to increase the comfort of the office workers such as different heights on the work tables, various compartments for storing documents, as well as chair backs. The materials used for the furniture were welded die-cast aluminium tubing, magnesite, maple for the employee desks in the large workroom, and hickory for the executive desks in the penthouse (Fig. 8).



Fig. 8 Workstation designed by Frank Lloyd Wright. source: Scjohnson.com

As skyscrapers and other large commercial buildings were developed, the workplace was transformed into a large space where private offices and open plan workstations were mixed with typewriters and, in some cases, a kitchen or cafeteria area for staff (Lecce, 2018). Despite the fact that by the mid-20th century offices with open spaces dominated, these spaces were nevertheless designed with rigid structures and organized hierarchically with workplaces assigned to each person (Zoltán, 2014). The mass worker at work had a designated location and the spaces dedicated to

management and direction in the peripheries of the buildings, were facing the workers in order to control them, and blocking natural light to the central areas. Once a worker had achieved a certain status they deserved a privileged view and natural light, perhaps a boardroom and armchairs for visitors. The space was private so that highly confidential meetings could be held and business decisions made without being seen or heard. Therefore, the spaces were intended for individual and concentrated work (Crisóstomo, 2019).

At the moment when office design emerged as a real and tangible concern, where many large companies aspired to have offices that reflected their corporate image focused primarily on strength; the Great Depression and then World War II halted this momentum. After this forced hiatus, a new approach known as Burolandschaft was adopted (Zoltán, 2014). Burolandschaft can be directly translated as "office landscape" and represents a reinvention of the completely new workspace, which consists of free and open plans of furniture that are distributed around a large, loosely and non-structurally divided space with different environments (Ljungbeck, 2017). For this reinvention of space, partitions and floor plans were used to create differentiation of areas and some level of privacy. Departmental workers, such as IT or media, were grouped more loosely in a space where they could easily interact more frequently, whereas bureaucratic corporate management staff were located in more regimented and subdivided areas (Ljungbeck, 2017) (Fig. 9).



Fig. 9 An example of a Burolandschaft workplace; source: k2space 2022

The period of post-war prosperity in the United States, along with advances in construction methods created a great opportunity for new construction projects. Skyscrapers were reaching new heights during the 1950s, for example Mies van der Rohe's Seagram which completed its construction in 1958. Buildings like the Seagram sealed the exemplary image of the "office tower" (Buhler, 2020). Reception spaces enhanced by elevators gave a sense of prestige and status to the notion of the office building that had until that moment been developed. Architects increasingly focused on designing spaces that promoted a positive and impactful corporate image (Yin, 2011). Although Burolandschaft evolved within buildings, a new approach emerged and is known as the Action Office. This model could be differentiated from the Burolandschaft because it included a variety of alternative work environments for staff, causing greater freedom of movement and a higher degree of privacy when working (Yin, 2011). The super-economic mentality and the fast-paced culture that was being experienced in those times caused an increase in the middle management team (Ljungbeck, 2017). These middle managers were too important for a single desk office in a space but were still considered too junior for a single office in the corner of the space (Ljungbeck, 2017). This increase in middle management staff resulted in the advent of Cubicles in the late 20th century. Although productivity increased slightly, the sense of community and socialization in the workplace disappeared (Ljungbeck, 2017). The history of office design at that time took a downturn and became a "stack 'em high; sell 'em cheap" model, and entered what is now widely recognized as one of the most depressive periods in office design (Yin, 2011)(Fig. 10). This way of working where employees had to work in a "trapped" fashion between large partition walls continued for almost two decades. It took the advent of technology in the workplace to force companies to consider office design in a more holistic and human-centred way (Zoltán, 2014).



Fig. 10 An example of a cubicle farm workplace; source: k2space 2022

The advent of the computer forced the first adaptation: from the processing, use and communication of information to the physical organization of offices. It also required people to be anchored to their workstations. The interior architecture of buildings had to face the challenge of adapting to higher energy demand and a greater volume of wiring infrastructures (Crisóstomo, 2019) (Fig. 11).



Fig. 11 An example of an Open plan office using the new technology of computers; source: Huffspot 2013

21st Century

Years later the rise of the Internet in the early 21st century, is not only considered revolutionary in terms of promoting connectivity, but also it had an innovative effect on the design of work areas within offices. With the development of technology in mobile devices, laptops and the web, employees were able to start working from anywhere, ushering in a golden period for office design, where new, more flexible ways of working became popular. As the workforce became more mobile, it became evident that employees could work anywhere and no longer needed to be stationary at their desks, becoming normality to see people working in cafes, coffee shops and from home, whereby companies started to adopt these new ways of working (Ljungbeck, 2017). As mobility became the norm, office design started to adopt "hot desking," in which staff did not have an assigned space but chose an available space to work in (Ljungbeck, 2017).

2.2 CONTEMPORARY WORKSPACE MODELS

One of the most commonly used terms in recent times to take advantage of the demands in the process of designing a new work environment is flexibility. Employees are often asked about their current working conditions, where most often they say that the office they work in is not encouraging concentration, collaboration with colleagues and the execution of confidential discussions (Zoltán, 2014). Today's businesses demand ever-increasing levels of productivity, both from employees and from the buildings in which they work. What was an important idea years ago to promote remote work, became for many a reality in current times. With the combination of various technologies such as instant messaging software, webcams and other online collaboration tools, it is not essential to commute every day to an office if there is the possibility to work at home (Zoltán, 2014); Topic to be deepened later.

Nowadays, the way workspaces are organized very different compared to years ago. However, some of today's office spaces are not yet configured to allow collaboration between workers, so it is increasingly important for companies - to remain

competitive - to provide their employees with a work environment that responds to their different and changing needs (Pollack Periodica 9, 2014, 2).

According to Zoltán (2014), it is almost impossible in a traditionally organized open space environment to concentrate. Privacy was considered the solution for different companies to the problem of concentration, trying to achieve that employees were able to make confidential calls or hold conversations. This resulted in cellular offices offered privacy, but made spontaneous communication difficult, as all common-use facilities are in closed rooms, as are the offices themselves, which are lined up along a central corridor occupied by up to four employees. Zoltán (2014) considers as the main pros of this type of space layout, low background noise and natural light; and as cons the isolation and low transparency, which cause a lack of communication. Low space-efficiency is also a consequence of this structure since the valuable naturally illuminated and ventilated space on the façade is an important element and this area is often reserved for service functions (Fig. 12).



Fig. 12 Standard layout of a cellular office;
source: Office spaces for more innovation and space efficiency (2014)

But also through time flexible combined offices¹ were created, in which open spaces were interchanged with cellular office formats. This typology of diagram was quite reserved, due to the real estate costs that arose, and it was developed to combine the advantages of open space and cellular office formats while reducing their disadvantages. The result was a concept that was both cooperative and private, thanks to the transparency of the glass walls towards the central facilities (Zoltán, 2014) (Fig. 13)

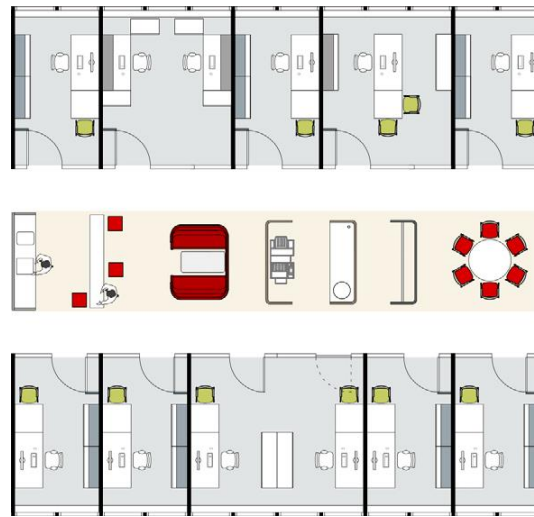


Fig. 13 Standard layout of a combined office; Source: Office spaces for more innovation and space efficiency (2014)

Since the beginning of the 21st century, the field of workplace design continues to evolve through the perception of the office environment as a place that encourages experimentation and supports creative thinking (Yin, 2011). Zoltán (2014) mentions that the most favoured model of work environment within an office is the activity-based one, also known as ABW (Activity-Based Working) in which fewer individual workspaces are offered, but with more space dedicated to interactive work in a range of diverse functions and sizes. This working model is characterized by placing areas

¹ Combined Offices: consist of a mix of cellular and open-plan offices. Work cells are typically occupied by a single employee and arranged around a common area that includes discussion nooks, service areas, kitchens, etc. Cells are connected to the common area by glass walls and doors." (ASR A1.2 definition).

with sofas in an ambient zone for the analysis and reflection of ideas, modular stations to easily create team projects, individual modules for tasks that require concentration or meeting rooms with integrated technology to share relevant information (Gebesa, 2021). In this activity-based office layout typology, the space is optimized for all types of collaboration, from large formal meetings to casual interactions when two people pass each other in the hallway. Some studies have shown that professionals get 80% of their ideas from casual interactions (Allen & Henn, 2007). Innovative work environments offer not only spaces to meet and interact with others, but also quiet and intimacy to concentrate on work and research (Zoltán, 2014). In this style of office, the areas are common and do not belong to a specific department (Gebesa, 2021).

This way of working inside offices was implemented by different companies around the world such as Yahoo offices (Fig. 14), Google (Fig. 15), and Facebook among others.



Fig. 14 Yahoo international offices; source: Designboom.com



Fig 15. Google office in Dublin; Source: Designboom.com

According to Schriefer (2005) it would be impossible to accommodate new ideas and technologies in uninspiring places, where disruptive actions distract from work. The opportunity for quick transitions from collaborative work to concentration is necessary, where the space must be designed to force more intense interaction (Schriefer, 2005). By using the activity-based office concept, no one is tied to a desk; there are numerous opportunities to create diverse work environments. Employers who opt for this desk diagram typology need to be aware that workers do not need to sit at their desks to work (Schriefer, 2005).

One of the design patterns, which is used in this type of workspace diagram to encourage collaboration, is one in which self-organized teams work together face-to-face, either in enclosed spaces and shared open spaces in groups of various sizes (Zoltán, 2014) Individual team members may need comfortable options to focus on work. Workspace design should also accommodate employees working alone or in the presence of others. The application of medium-height panels on blocks ensures privacy even in face-to-face desk combinations, allowing concentration on work without workers feeling isolated. For more privacy or confidentiality, fully enclosed spaces are also needed; a small-sized space, the so-called think-tank, (Fig. 16) consisting of seating, a table, and an electrical connection, is the place where workers go if they need time for research, confidential phone calls or face-to-face conversations (Schriefer, 2005).



Fig 16. Example of a Think-tank; Source: stylepark 2012

At the beginning of the 21st century, unsocial business centres inspired coworking spaces. American programmer Brad Neuberg created in 2005 the first coworking space: Spiral Muse "home of wellness" in San Francisco. Babb et al, (2018) define coworking as the arrangement in which workers from different companies share an office space, which allows for cost savings and convenience through the use of common infrastructures, such as equipment, utilities and reception and custodial services. The coworking momentum only confirmed that work was no longer strictly tied to a specific desk, or to the office in general (Frank, 2020). In 2008, laptop sales surpassed PC sales in the United States. Which demonstrated the interest in having technological equipment that allowed for flexibility when working in different locations (Frank, 2020). Technology continues to be an important part of the changes in the workplace, with an increasing number of people being able to perform their work remotely, office design must once again adapt to the changing nature of work (Yin, 2011). The role of the designer is more important than ever in the world of idea-driven office design strategy and new trends (Yin, 2011).

2.3 REMOTE WORK

The way we work has evolved beyond any conceivable recognition of the workplace of 50 years ago. The office today is no longer a building in which everyone meets, but also, homes, coffee shops and numerous other "third places" are considered "offices" in virtual meeting places (The History of Office Design 2022). Schriefer (2005) mentions that not only the ways of working within offices have been modified, but also in how these activities are performed. An example of these changes is remote work. According to Delgado (2021), remote work "consists of performing work activities remotely, either from home or another distant location". On the other hand, the Royal Spanish Academy (RAE) defines it as "work that is performed from a location outside the company using telecommunication networks to fulfil assigned workloads".

According to Crisóstomo (2019), what has really revolutionized the office and the ways of working are the new mobile technologies. Mobility implies that work does not necessarily have to be carried out in the office, neither is there an obligation to have a fixed assigned position. The line of separation between the office and other public spaces has not only been overcome but has rather disappeared. Information technologies (ICT) have evolved the way in which individuals interact with the environment, as they allow immediate communication with people located in different parts of the world, the convenience offered by technology in everyday life allows people to perform their daily activities and fulfil acquired responsibilities (Crisóstomo, 2019). New technologies are changing everything, from the way we live to the way we work. There are tools today that have become indispensable, for example, the use of cell phones. This leads to the fact that the needs in general, but especially of space, that people have today are not the same as they had before, without going any further than 30 years ago (Crisóstomo, 2019). Similarly, within companies, ICT plays an important role in the development and improvement of company processes, allowing the implementation of remote work (Reyes, 2016). This modality allows workers greater flexibility in the development of all their activities, both work and personal (Martínez, 2007). This working model has become a trend in places such as the United States and Europe, where studies have been conducted that demonstrate the benefits of remote work (Amozorrutia, n.d.).

The Global State of Remote Work (2018) study conducted by OwlLabs in the United States revealed that in 2017 85% of companies that were hybrids allowed or required remote work. However, in those years globally, not all companies allowed remote work. OwlLabs in 2018 guaranteed that remote work would be the way of the future without foreseeing what was going to happen next. According to the study conducted by Upwork, by 2028, 73% of departments will have remote workers. The study found that 48 per cent of younger generation managers composed of Millennials² and Generation Z³ primarily are director-level, showing they have a major influence on workforce planning. This influence will only grow with these younger generations

² Millennials: Born between 1981-1996 source: Pew Research Center (PRC)

³ Generation Z : Born between 1997 y 2012 source: Pew Research Center (PRC)

making up 58 per cent of the workforce by 2028, an increase of 38 per cent from today (Evans, 2021).

As these studies show, there is no doubt that working remotely increased over the years. Although remote work in recent years was already a reality, with more and more companies opting for this methodology, it was in 2020 that the biggest experiment in the workplace in recent times was carried out due to the SARS-COV2 pandemic. Many companies worldwide were forced to operate, keeping employees at home for months at a time. The return to the office was left in the hands of employers and offices underwent significant changes to become workspaces, but spatially conditioned to avoid the spread of the pandemic (A history of the office 2022). Recent articles such as Remote Work statistics (published in 2021), demonstrate remote work statistics in 2020 before and after the spread of the pandemic due to SARS-COV2⁴. The article presents statistics based on different studies on remote work. It can be highlighted that 99% of remote workers want to continue working remotely in the future and 90% of remote workers would recommend working remotely to a friend (Marinova, 2021). According to research conducted by Flexjobs and Global Workplace Analytics, remote work has grown by 115% in the last decade. According to these statistics, the growth of remote work has been 10 times faster than in other areas of work. Based on this data, it is concluded that remote work is growing in popularity every year (Evans, 2021).

2.4 REMOTE WORK DUE TO SARS-COV2 PANDEMIC

COVID-19 (SARS-COV2 disease) is first and foremost a human tragedy that has affected the lives of millions of people. The pandemic has not only changed patterns of personal interaction, with increased health measures, social distancing and increased use of technology and digital communication. It has also fundamentally altered the way we work (Nediari et., 2021). Each company is responsible for taking the necessary precautionary measures to stop the spread of SARS-COV2, and physical distancing remains the most effective tool. In this sense, companies were forced to

⁴ Severe acute respiratory syndrome coronavirus

have remote work as their first choice as a work methodology as long as it was carried out without any problems (Nediari et., 2021). As mentioned above, remote work "consists of performing work activities remotely, either from home or another distant location" Delgado (2021). So for this research, the focus will be on performing work activities from home.

As the SARS-COV2 pandemic spread in the early 2020s, offices and schools were shut down and a much more technological world was entered. The "new normal" as Kermit et al. (2020) mentions has traded formal business meetings for the informal home. Meetings that were mostly in person changed to web conferencing, and face-to-face classrooms in school changed to virtual lessons. The pandemic has forced more screen time, forcing long periods of time to be spent in spaces that are not meant to serve as offices, which in many cases are poorly designed for extended use (Kermit et al., 2020).

The long-term implications and effects of SARS-COV2 are still unknown. However, the imminent return to the physical office requires certain measures in the design of workspaces and furniture to protect workers and prevent the spread of the pandemic. The official ways of working in the future are still unknown, but different companies are betting on remote work. One example is the case of Twitter, where its co-founder Jack Dorsey argues that it would be possible to "work from home forever, if our employees have a role that they can perform from home and are in a situation that allows them to do so" (Clayton, 2021). However, not all companies only want to go for the remote work methodology; companies such as Silicon Valley technology companies like Google, Facebook, Apple etc. are committed and hope to apply the flexible or hybrid work model where they propose that most of their staff spend some time working from home and sometime in the office (Clayton, 2021).

An Ipsos survey of 12,500 employed people in 29 countries for the World Economic Forum found that most employees want flexible working to become the norm. And almost a third (30%) said they would consider looking for another job if they were forced to return to the office full-time. Within the same survey, 64% said they are more productive with a flexible work schedule and only one-third complain of burnout. Only one in three said they felt disengaged from work when working remotely. However, a majority (66%) said employers should allow more flexible

working in the future. The survey highlights that 53% before the pandemic worked most or all of the time in an office. Three-quarters (76%) of those who now work from home said this is a consequence of the SARS-COV2 pandemic (Ipsos 2021).

History shows that workplaces as well as ways of working have constantly evolved. Today, the role of the office is undergoing possibly the most disruptive change seen in recent times, the COVID-19 pandemic changed the way work is done (Hogarty, 2021). The latest technology makes it possible to work effectively from almost anywhere with a Wi-Fi connection. This allows for the creation of new workspaces that fit the needs of modern workers. Therefore, with the steady growth seen in recent times of remote work, the project that unfolded is justified; the design of a product that supports remote work done from home.

2.5 ERGONOMICS IN WORKPLACES

The International Ergonomics Association (IEA) defines ergonomics as the scientific discipline that deals with the interactions between humans and other elements of a system, as well as the profession that applies theory, principles, data and methods to design in order to optimise human well-being and overall system performance. Ergonomic principles are dedicated to the optimisation of human well-being and the improvement of the entire workplace environment (International Organisation for Standardisation [ISO], 2004). Psychological factors also play an important role in relation to well-being in the workplace. For example, diverse and complex tasks as well as control and autonomy are considered important requirements for reducing work stress: Employees should be able to influence task planning, sequencing, work equipment and speed (Hackman, et al., 2000).

Ergonomics applies in different fields of application such as cognitive ergonomics, environmental ergonomics, ergonomics applied in industrial design, ergonomics and office automation, judicial ergonomics and human reliability among others (Llaneza, 2008). However, for the purpose of this research, the ergonomic approach will focus on ergonomics for industrial design, as it focuses on the human-object relationship when humans use the object or product as a specific activity. Industrial design can be

defined by different authors. Industrial design is concerned with adapting objects to a human being, with the aim of increasing human performance (Villareal n.d.) Bonsepie (1999) defines industrial design as a design discourse, through a scheme composed of four interrelated spheres: Firstly the user, who effectively wishes to carry out an action; secondly, there is a task that the user wants to accomplish; thirdly, there is the artefact that the user needs to carry out the action; and fourthly, there is the interface, which connects the three previous spheres to the human body, and is where the designer directs his or her attention. Through the design of the interface, it is possible to articulate the action space for the user (Bonsiepe, 1999). According to Erlhoff and Marshall (2007, p.212), industrial design aims to improve the functional, interactive and aesthetic qualities of industrially manufactured products for human use. In the case of the designer Bruno Munari, although he does not define industrial design as such, he explains that design must be applied when there is a problem and that it needs a solution. Brunari (1981) breaks down from this his design methodology into the following phases: Problem, problem definition, problem components, data collection, data analysis, creativity, data collection on materials and techniques, experimentation, modelling and verification, resulting in the solution to the problem.

When it comes to ergonomics, the requirements encompass the general work environment as well as equipment such as lighting or chair and desk furniture, as well as information technology (IT), hardware such as computers, screens, mice and other input devices, and the characteristics of the work situation such as breaks or the type of task that each worker performs (Hackman, et al., 2000).

As reflected above, work is increasingly being done remotely, with more and more employees regularly working from workspaces created at home or in locations other than a conventional office (Kermit et al., 2020). Although there is already a lot of research on how to create an ergonomic office, there is still no research showing how the "mobile workplace" should be designed and in this case can be used at home (Janneck et al., 2017). Having a home workspace suitable for work reduces tension, stress, and concentration problems (Janneck et al., 2017).

Due to the SARS-COV2 pandemic as previously mentioned, workers moved instantly from the office to the home with their different technological devices. Given this need, workers created an area that they consider a work area, which in many cases did not have the necessary characteristics to develop their work comfortably (Naylor, 2020). Workers used dining tables and chairs and other improvised desks, and many times these spaces became areas with dual functions, potentially used by several people in the family nucleus. As Gerding (2020) mentions, a very common scenario during the pandemic was to see children taking school lessons online while adults working in the same space. These home offices in many cases did not fit to the needs of the worker (Gerding, 2020). From an ergonomic point of view, uncomfortable workspaces may contribute to the fairly rapid onset of body discomfort that can lead to more serious problems in the future (Kermit et al., 2020).

The home office: ergonomic lessons from the "new normal" (2020) presents the results of a survey of all faculty at the University of Cincinnati in 2020, with the objective of this study being to understand the home workplace during the pandemic. For the development of the study all staff submitted photos of their home workplace and once the survey was completed their home offices were assessed by an experienced ergonomist. The instructions asked for two photos of the staff, one from a rear view of the person using the computer in the office area and one from the side. In (Fig. 17) a series of pictures of some of the survey participants are presented, in the caption of the pictures, the most common home office problems detected by the ergonomists are shown. Based on the feedback received from the respondents, the ergonomists presented some of the negative points of teachers' home workspaces:

- Office chairs are often a source of problems. The best chairs have the following key components: adjustable height, adjustable armrests, five casters, and lumbar support in the back of the chair. However, few chairs in a house have all of these components, and a new chair may be out of budget.

- Secondly, it was clear that a large number of workers were given a laptop computer to work on at home, resulting in poor back and neck postures, either due to placing the laptop on the lap or putting it on the desk. In either case either way, the laptop monitor is too low and results in the worker looking down, often for a long time.

- Thirdly, the workstation or desk is also a common source of concern, starting with the hard surface at the corners and edges of the desk and, in particular, the one that often comes into contact with the wrists and forearms. Contact stress is especially problematic when the armrests of the chair are too low or not used.



Fig. 17 Examples of common problems found in the home offices: (a) poor chair, hard edge on desk surface, external monitor off to side, (b) hard and nonadjustable wood chair, (c) large monitor to side, laptop monitor too low, no back on chair, (d) forearms leaning on edge of desk due to not using properly adjusted armrests, (e) back not support by the back of the chair, (f) working on a monitor to side causing neck to rotate, (g) split between external monitors directly in front, and (h) walking on a treadmill may cause fall risk. Source: Ergonomics in design (2020)

The previous study summarises several of the problems that can be encountered when the decision is made to work remotely from home without adequate conditions. In the case of this research, the points of ergonomics will be addressed, in order to avoid these problems and which are applicable to the development of the home office product; anthropometry, lighting, thermal environment, ventilation, and acoustic environment; these points in addition to all the literature seen throughout this research will serve as a scientific basis for the development of the product design.

2.5.1 ANTHROPOMETRY

Anthropometric measurements have great involvement in the design of an ergonomic working environment for work from home employees. There are existing body dimensions that are essential to consider in designing furniture, especially for office ergonomics (Reyes, 2021). For this research, the collection of all required anthropometric dimensions for the office workstation is adapted to the ISO 7250 as the standard for all office worker's body dimensions (Fig. 18)

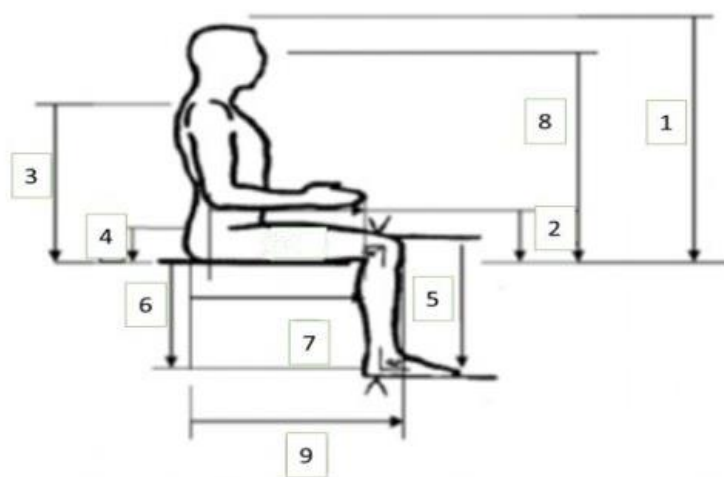


Fig. 18 Anthropometric data required in ergonomic furniture for the work from home employees: sitting height (1), elbow height (2), shoulder height (3), thigh clearance (4), knee height (5), popliteal height (6), Buttock knee length (7), eye height (8), forearm hand length (9), source; Reyes (2021)

Table 1 shows the basic worker's body dimensions, the description according to ISO 7250 and the descriptive statistics for measured anthropometric dimensions for both male and female workers.

No. According to Figure	Employees body dimensions	Description of the body dimensions according to ISO 7250	Body Dimensions Min.	Body Dimensions Max.	Both Female and Male Percentile	
					5th	95th
1	Sitting Height	Vertical distance from a horizontal sitting surface to the highest point of the head (vertex)	76 cm	125 cm	48,69cm	121,73cm
2	Sitting Elbow Height	The vertical distance from the bottom of the tip of elbow (olecranon) to the sitting surface, measured with the elbow in 90° of flexion	16 cm	28 cm	9,35 cm	37,4 cm
3	Sitting Shoulder Height	The vertical distance from the top of the shoulder at the acromion process to the sitting surface measured with a stadiometer	52 cm	93 cm	34,59 cm	79,25 cm
4	Thigh clearance	Vertical distance from the sitting surface to the highest point on the thigh	20 cm	49 cm	25,98 cm	73,42 cm
5	Knee height	Vertical distance from the floor to the highest point of the superior body of the patella	45 cm	61 cm	31,82 cm	64,47cm
6	Popliteal height	Vertical distance from the foot-rest surface to the lower surface of the thigh immediately behind the knee. Bent at right angle	42,5 cm	55,5 cm	28,81 cm	60,46cm
7	Buttock knee length	Horizontal distance from the foremost point of the knee-cap to the rearmost point of the buttock	36 cm	49 cm	28,08 cm	56,77cm
8	Eye height, Sitting	Vertical distance from a horizontal sitting surface to the outer corner of the eye	138 cm	164 cm	100,37 cm	192,06
9	Forearm hand length	The distance from the posterior end of the elbow to the longest finger of the hand while the upper arm is at an angle of 90° with the lower arm measured with a vernier caliper	37 cm	49 cm	43,93 cm	44,15 cm

Having a working station for work from home employees is currently preferable due to its capability of increasing comfortability while reducing the chance of stress in the long time run. Reyes (2021) mentions three criteria that she considers Determinants for ergonomic design for work from home employee's workstation: Visual interface, manipulation and body support (Fig. 19) Based on Table I, Reyes (2021) suggests several criteria that can be taken as guidelines for employees who require a home-based workstation (Table 2).

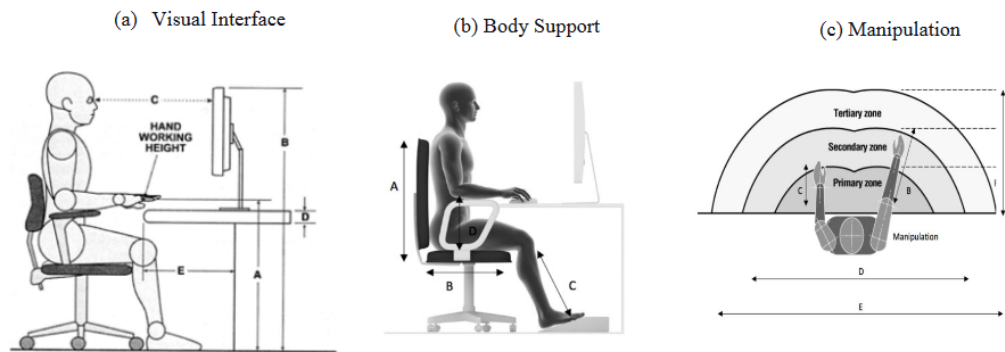


Fig. 19 Data Lenharth System (2017), Shaver (2015), and Silo Tips, Augustus (2018). Anthropometric data required in considering visual, manipulation and body support systems source: (Reyes 2021)

Features	Anthropometric Measure	Design Dimension	Recommendations
Visual	A. Sitting Shoulder Height	79.25cm	95th percentile of both female and male of sitting shoulder height
	B. Eye Height	192.06cm	95th percentile of both female and male of Eye height
	C. Forearm hand length	43.93-44.15cm	5th and 95th percentile of both female and male of forearm hand length
	D. Sitting elbow height	37.4 cm	95th percentile of both female and male of sitting elbow height
	E. Knee height	64.47cm	95th percentile of both female and male of knee height
Manipulation	A. Sitting Shoulder Height	79.25+5cm	95th percentile of both female and male of sitting shoulder height +5cm allowance for materials
	B. Sitting Shoulder Height	34.59 cm	95th percentile of both female and male of sitting shoulder height
	C. Forearm hand length	43.93-44.15cm	5th and 95th percentile of both female and male of forearm hand length
	D. Elbow Span	111.11cm	5th and 95th percentile of both female and male of elbow span
	E. Arm Span	209.37cm	5th and 95th percentile of both female and male of arm span
Body Support	A. Sitting Shoulder Height	34.59cm	5th percentile of both female and male of sitting shoulder height
	B. Forearm hand length	43.93-44.15cm	5th and 95th percentile of both female and male of forearm hand length
	C. Knee height	31.82cm	5th percentile of both female and male of knee height
	D. Sitting elbow height	9.35cm	5th percentile of both female and male of sitting elbow height

Table 2 Determinant criteria for ergonomic design for work from home employees' workstations. Adapted from: Reyes 2021.

Based on the information presented above, these dimensions can be used as a guide to propose a product that meets the necessary anthropometric requirements and thus avoid possible physical injuries caused by bad posture. It should be noted that when developing the product proposal, both aesthetic and functional elements will also be taken into account. Due to the SARS-COV2 pandemic, home offices are likely to be a mainstay for a large part of the population, both in the short term and in the long term, companies will continue with home offices to reduce the possibility of potential widespread pandemic contagion (Kermit et al., 2020). As a result, workers will need adequate home offices.

According to Dainoff et al. (2012) For the home office, workers often prefer mobile devices such as laptops, tablets and smartphones. Working with a laptop increases the danger of unfavourable positions because it offers less adjustment possibilities, leading to neck and back pain. In addition, the screen size is often below the recommended values. It is known, however, that handheld devices such as tablets or smartphones increase the strain on the wrist and neck (Alzhrani, 2020). So when working with a screen, the upper part of the screen should be adapted to the level of the eyes, maintaining a horizontal line of vision; this allows keeping the head and neck in a straight position and the shoulders relaxed, avoiding muscular pains caused by a bad posture.

Many of those who work at home or remotely face the challenge of designing their own workplace without extensive ergonomic knowledge, or without the financial and organisational support from their company to verify workplace safety (Rafalski et al., 2015). Workers may not have sufficient space or adequate office furniture such as ergonomic chairs or adjustable tables, resulting in unfavourable sitting positions (Jent, 2017). Home offices are attractive to workers due to less commuting, better work-home balance and less stress due to being in the comfort of home. As home "offices" become a permanent option for many employees, home "offices" will need to incorporate sound ergonomic concepts to ensure the long-term health of employees. Otherwise discomfort can spill over into more detrimental conditions such as musculoskeletal disorders (Reyes, 2021).

2.5.2 LIGHTING

According to Joan Blasco, a professor at the Barcelona Polytechnic School, more than 80% of the information people receive is visual, which is why lighting is so important. Sight has two mechanisms called accommodation and adaptation; while accommodation allows us to focus our sight on a specific point according to distance, in accordance with the interest and needs of the observer, adaptation makes it possible to adjust the sensitivity of our sight to the level of the existing lighting. The set of factors that determine the relationship between illumination and vision are visual angle, visual acuity, brightness or luminance, contrast, brightness distribution in the visual field, glare, light diffusion and colour (Blasco, et al., 2000).

In order to talk about lighting it is necessary to have the existence of a light-producing source and an object to be illuminated (Escobar et al., 1998). The magnitudes that must be known are illuminance or level of illumination and luminance (Escobar et al., 1998). Blasco et al. (2000) defines luminance as the characteristic of the luminous aspect of a light source or of a surface illuminated in a given direction, which produces a sensation of brightness in the visual organ. Illuminance or illuminance level, on the other hand, is related to the quantity of light reaching a given surface.

In a given office, many tasks with different reflectances may be present which affects luminance, therefore for office lighting, the amount of light is specified in terms of illuminances and usually the average illuminance (E_{med}) at the height of the working plane. In order to measure the illuminance, equipment called Luxmeter is used (Escobar et al., 1998). Table 3 shows the appropriate illuminance levels according to the activity to be performed, these illuminance levels are based on DIN 5035-2:1990, ISO 8995:2002 and DIN EN 12464-1.

Level	illuminance (lux)	Activity
1	15	
2	30	Orientation, only temporary stays
3	60	
4	120	Light visual tasks with high contrasts. Ex.: warehouse work, mines, waiting rooms, painting work
5	250	
6	500	Normal visual tasks with medium detail. Ex.: office work, data processing, reading
7	750	
8	1000	Demanding visual tasks with small details Ex.:technical drawing, color comparison, assembly of small elements in electronics
9	1500	
10	2000	Very demanding visual tasks with very small details Ex.:miniaturized component assembly, watchmaking, engraving, fine assembly, with very tight tolerances
11	3000	
12	≥ 5000	Special cases Ex.; operating rooms

Table 3 Illumination Levels. Adapted from: Miguel, A.S.(2013)

The luminance of a surface depends not only on the amount of light incident on it but also on the reflectance of this surface. A matt black surface absorbs 100% of the incident light, a glossy white surface reflects almost 100% of the light (Bayona, 2015). Most of the visual information that the human being receives is not only due to the luminance but also to the luminance variations that the eye detects in the visual field, i.e. the luminance contrast (Bayona, 2015.) Regarding the luminance contrast, the perception of an object will be related to the differences in luminance between the object or detail being observed and the background. The sensitivity of the eye to contrast detection also increases with the "adaptive luminance". Naturally, this luminance depends on both the level of illumination and the reflectance of the surrounding surfaces (Bayona, 2015).

The amount of light on a specific task or work plane determines the visibility of the task by affecting visual acuity, contrast sensitivity or the ability to discriminate differences in luminance, colour and accommodation efficiency on focusing efficiency

on tasks at different distances (Escobar et al., 1998). As explained in the 3rd edition of the encyclopaedia of the International Labour Organisation (1998), the higher the amount of light and up to a certain maximum value (glare limit), the better the visual performance.

The degree of safety with which a task is performed depends to a large extent on the quality of lighting and visual capabilities. The visibility of an object can be altered according to different factors, one of the most important according to Escobar et al. (1998) is the contrast of luminances due to shadow reflection factors, or the colours of the object itself and colour reflection factors. A lighting system should avoid dazzling glare and provide the right contrast conditions as well as the implementation of correct colours. It is important to examine the light in the workplace, not only quantitatively but also qualitatively. The first step is to study the workplace, what activities the worker performs and the mobility of the person doing the work. The recommended lighting level for the desk area is considered to be 500 lux. If the lighting is too low, it can strain the eyes and lead to reduced concentration and a drop in productivity (Escobar et al., 1998). For computer-only work, 200-300 lux is optimal, but not concentrated on the screen. In the case of working only with paper, a spotlight with 500 lux can be added over the reading or working area (Endesa, 2020).

When referring to lighting it is important to consider both natural and artificial lighting. When designing a work area, both should always be taken into consideration (Blasco et al., 2000). Natural light causes less visual fatigue than artificial lighting. Among the main advantages of natural lighting are less eyestrain, a better appreciation of colours, psychological contact with the outside world through a window, and increased well-being. Except in very specific situations where the worker is in a certain position and the light falls directly on him/her, natural lighting tends to produce glare (Bayona, 2015.) and also excessive contrasts in the field of vision. In cases where natural light is not possible, it is necessary to use artificial lighting or as in most cases supplement natural light. The quality of the artificial light will be better the closer the spectrum of this light is to that produced by the sun (Bayona, 2015). According to various studies the ideal temperature of this artificial lighting is cooler lights between 4,000 and 5,000k, which are more suitable for

creating a working environment that requires short distances and greater attention (Bosch, 2020). When working at home, it may be possible to choose the right workspace with respect to lighting. If natural lighting is available, it is ideal not to turn your back to the source of that light; this will cause a reflection on the screen, resulting in glare. The best location is in front of the light source or perpendicular to it (Bosch, 2020). When natural lighting is no longer available, the ideal is to opt for general lighting, which should ideally avoid shadows or reflections that do not allow the activity being carried out to be seen. If there is no alternative to reinforce the general lighting, a flex lamp can be used to help illuminate the work area (Bosch, 2020).

2.5.3 THERMAL ENVIRONMENT

Human beings possess a mechanism that allows them to adjust their internal body temperature to approximately 36 °C throughout the year and in all climates under more or less normal conditions. "One of the obligations of designers is to try to maintain the environmental conditions of spaces within the ideal ranges of comfort and convenience" (Flores, 2001, p127). A temperature of 21°C or 22°C degrees is considered to be the ideal temperature for comfort in a work environment, but one study recommends creating dynamic work environments in which temperatures are varied moderately on a continuous basis to benefit the health of workers (Palau, 2019). It is argued that while it is traditionally assumed that a fixed, constant temperature is ideal for comfort and health in an enclosed space, moderate cold and variable temperature can have a positive effect on workers' health and be acceptable at the same time (Palau 2019). Subjecting the body throughout working hours to a temperature variation above 22°C and below 21°C will cause the metabolism to accelerate, consuming more energy and helping to prevent diseases such as obesity and even producing beneficial effects on the immune and cardiovascular systems.

In Portugal, according to Decreto-lei 243/86, de 20 de Agosto, the temperature in workplaces should range, as far as possible, between 18°C and 22°C, except in certain climatic conditions, when it can reach 25°C. The same decree states that the humidity of the working atmosphere should be between 50% and 70% (Ferreira, 2021).

As in the natural climate, in indoor and artificial spaces, climatic elements such as temperature, pressure and ventilation work together, so it would be difficult to improve the temperature of a room without taking ventilation into account or vice versa. Ventilation, humidity and even lighting have an impact on temperature, so to define the appropriate temperature, the needs of each user, the number of people in the same place, the dimensions of the space and the activity or activities to be carried out in that context must be considered (Flores, 2001). According to Ferreria (2021), when there is no excessive cold or heat in the work environment, activities can be carried out with greater productivity, to achieve the right temperature, in the case of the "office" at home it is possible to achieve this temperature through a residential air conditioner that helps to promote the right temperature to carry out the work.

2.5.4 VENTILATION

The importance of the atmosphere lies in the chemical elements of which it is composed, as they are indispensable for life. Oxygen is vital and mixed with other elements in the right proportions it forms the natural chemical composition of the air, but this composition tends to decompose and become unbalanced quickly and violently, mainly in enclosed places (Blasco et al. 2000). Carbon dioxide increases 100-fold with respiration. Some scientific theories say that a human being can tolerate only 0.14 to 1 per cent or even 5 per cent of carbon dioxide for very short periods of time (Flores, 2001). Flores (2001) states that what is serious is that carbon dioxide accumulates in the environment, reaching unbreathable and dangerous percentages when air renewal is inadequate and insufficient. In addition to human respiration, other environmental pollutants prevail, such as smoke, gases and vapours produced by food, chemicals, machinery, vehicles, cigarettes and other combustion. In a space there are not only these polluting elements, but also others that produce heat or cold during its operation, such as man himself, white goods, machines, electronics, and lighting systems which significantly alter the ambient temperature and can be regulated by means of ventilation systems (Flores, 2001). Palau (2019) mentions that large amount of compounds are emitted by machines used in work environments, such as printers, and photocopiers, as well as in very specific cases such as adhesives, paints and cleaning and disinfectant substances,

indoor air is often up to ten times more polluted than outdoor air. Although it is almost impossible to reduce the use of certain machines and equipment due to the activities to be carried out in the working environment. It is recommended to use a fan or other means of air renewal to ensure the safety of the personnel working in the premises and to avoid problems caused by the concentration of organic compounds in the environment. Ventilation can be achieved by natural or mechanical means, this can be through doors and windows, with the use of a fan and exhaust fans. Many times these means can be used simultaneously in ventilation systems (Palau, 2019). A very important parameter to consider is the air renewal per occupant; this is done by means of the minimum outdoor airflow. As a recommended value, and given the uncertainty of a fixed value, a minimum of 12.5 l/second and occupant is recommended. In order to obtain this value, work must be done in two directions: increase ventilation or reduce the amount of occupancy (Flores, 2001).

The characteristics of ventilation systems vary according to the number of people occupying the area; indoor conditions such as air temperature, humidity and radiant temperature; outdoor climatic conditions; the type of activities carried out in the areas to be ventilated and the degree of contamination in these areas (Flores, 2001). Ventilation can be produced in three different ways: spontaneous ventilation, which is considered an irregular and uncomfortable system, because it occurs when the air is filtered through windows and doors, it does not fully comply with the objective of conducting clean air, extracting contaminated air or regulating the temperature; artificial ventilation, also known as mechanical ventilation, is produced by means of fans that force air circulation and can be extraction or aspiration, impulsion or pressure and balanced ventilation; and finally, there is natural ventilation, which uses the force of the wind and temperature differences to achieve air movement (Palau, 2019). This system is undoubtedly the most economical and practical, as it only requires the use of windows, balconies, doors and vents to allow outside air to enter the interior space without difficulty (Flores, 2001). Natural ventilation is considered the most appropriate compared to artificial ventilation because the user experiences fewer problems as a result of sudden temperature changes caused by artificial climates. In order to maintain adequate ventilation in the home, it is recommended that at least one air change is made every day by opening windows to avoid condensation inside the house. When ventilating the rooms, it is ideal to do so for at

least 30 minutes to eliminate the humidity produced during the night by breathing. If cross-ventilation is possible inside the house, the best practice is to open two windows on opposite sides of the house in order to generate an internal current and to renew the air more quickly. If forced ventilation is necessary, this can be done by means of mechanical elements. Airtight windows can also allow for air exchange to ensure indoor air quality, although it should be noted that these windows must be regulated by technical codes (Flores, 2001).

2.5.5 ACOUSTIC ENVIRONMENT

The sphere of action of noise is the same as that of the individual and affects people everywhere, in factories, at home, at school, in places of entertainment, at rest areas or in the street. This means that when a worker carries out his activity in a noisy environment, he ends his day and does not cease his noise exposure, but simply changes his environment, which is still noisy (Blasco et al. 2000).

Both noise and vibrations are the most widespread physical aggressors in companies and cities, and their consequences are often underestimated (Blasco et al. 2000). Noise can temporarily alter human hearing, cause errors, affect work activities through incorrect actions due to the defective reception of orders, instructions and information. As well as increase stress and produce alterations in the nervous system and, in general, a reduction in the body's defences against various illnesses (Blasco et al. 2000). It is considered that 8 hours of exposure to a sound level of 85 dB(A) is the permissible limit, with no harm to health. However, it has been shown that although there is no health damage up to this level of 85 dB(A), there may be psychological discomfort that causes a decrease in attention, concentration and interest, and as a possible consequence, an increase in wrong decisions and a loss of quality in work activities (Blasco et al. 2000). The damage that can be caused depends on the sound level and sound frequency, and on the multiple circumstances of the activities to be performed, such as the objectives of the activity, the demand for concentration and attention, the responsibility, and the importance of the activity (Blasco et al. 2000). It has been found that most people do not consider soundproofing their workspace at home until noise becomes a problem. Noise transmission can be caused by the

activities inside the house or by the noise that may be generated in the surroundings of the workspace (Blasco et al. 2000). López (2021) mentions some recommendations that can be easily applied and that contribute to the reduction of noise in the work environment at home: to decorate, choose soft materials and surfaces that work as sound absorbers; use a carpet, as well as serving as an acoustic absorber, it reduces impact noise; use curtains as well as an acoustic absorber and acoustic diffuser, if they have a wavy shape, they will break the sound wave.

All the ergonomics points discussed above with a focus on workspaces will serve as a theoretical basis for the product proposal. It is necessary to take these points into account so that employees can work in suitable conditions from home. Most of the research mentioned in the previous points is focused on ergonomics in workspaces in general and not specifically focused on workspaces at home, so the product will adapt all the guidelines to create ergonomic conditions suitable for working from home.

2.6 MULTIFUNCTIONAL OBJECTS

Multifunctional design is not something from this time, but it has been evolving over time along with people's skills and creativity (Gava, 2015). According to Villa (2002), the furniture was adjusted according to the needs of everyday activities. In the same room, overlapping activities were performed, such as living and working, so the furniture was therefore the furniture reconciled between them, requiring them to have multiple uses. For this reason, the furniture used to be disassembled and portable, as needed. For Tramontano (1993), due to the small space of the compact dwellings, the production of several movable elements for the dwellings was required, for greater functionality of the objects and maximum use of the space.

Rojas (2007) mentions that one of the most important objectives that designers have is to know in depth the technique, function and aesthetics of an object. The resolution of the need through the functionality of an object is only the transfer of a way of solving some activity, from the previous synthesis process that the designer carries out for the design of the object. The designer must be in charge of interpreting the user's need by invoking the user's satisfaction (Rojas, 2007).

The functional aspect of the objects is generated in the design, from a technical resolution and not from formal or casual attributes and as such, this resolution will be the product of the investigation and adequate interpretation or not, of the user's needs. It is necessary to establish the functional criteria of the objects around the user, without neglecting at each stage of the design process, the qualitative analysis of the formal, ergonomic and structural aspects, i.e. the integral resolution of the object (Rojas, 2007).

It is increasingly noticeable that the world is gradually filling up with objects that incorporate in their designs more functions than those that the user usually understands, uses and enjoys during the use of a new product (Rojas, 2007). Currently, technological advances have greatly benefited the object and furniture industry, its constant development has allowed for greater versatility when adapting to different spaces, covering different aesthetic and functional specifications (Calderón 2011). According to Calderón (2011), referring to the house as such, nowadays a typology of reduced spaces has been developed in different cities. Therefore, it is not possible to introduce the desired amount of objects or furniture; it is then where the need for space-saving arises in a certain way, being precisely one of the main characteristics offered by the design of multifunctional objects.

The denomination of multifunction in objects is a term that means that the objects have been conceived by the designers to cover some other operative aspect of their main functional quality, and incorporate at least two different determinations of use or functions, in the context for which they have been developed (Rojas, 2007). If the multifunctional concept is relevant to an object, it is desirable that it is incorporated into the design of the object and solves more than one functional requirement that is beyond human possibility (Rojas, 2007).

2.6.1 EXAMPLES OF MULTIFUNCTIONAL OBJECTS

In order to get to know various possibilities of multifunctional objects and spaces, different projects are discussed below: Le Petit Cabanon by the architect Le Corbusier, multifunctional objects by the designer Joe Colombo and the designers Bouroullec. It is pertinent to mention these projects to understand the way in which they manage to develop their multifunctionality, standing out for their materiality, innovation and functionality in different periods.

Le Petit Cabanon can serve as a reference for this chapter on multifunctional objects, not because Le Corbusier's main objective was to create objects of this nature, but because it is relevant for the way in which he was able to take advantage of space to create a completely habitable space; through the play of forms, he was able to use some spaces to carry out more than one activity (Barba, 2013).

Le Petit Cabanon inaugurated in 1951 by the architect Le Corbusier proposes an indirect way of approaching the domestic theme. This small holiday cabin, stood out not for its dimensions, its typological classification, or its landmarks, but everything related to its uses (Moonteys & Fuertes, 2001). At the Petit Cabanon, everything was developed in the simplest and most adequate way to satisfy basic needs. Near the entrance, the bathroom was divided only by a curtain; the space was adapted to accommodate two beds and a table leaning against the wall. In one of the corners, the sink was installed, which in his turn serves as a small front cabinet assisting the separation of one of the beds. And at the other end, the cupboard for storing some objects. Two small wooden boxes in the form of a stool as drawers were used to sit on and store some things. The openings were designed to offer two essential services: a view of the space and ventilation. After the toilet, a long, narrow vertical slit for quick, folding evacuation of odours. In one of the beds, a small rectangular window, through which the vegetation outside could be observed (Barba, 2013). The Petit Cabanon lacked other functional elements that were not considered essential for Le Corbusier, such as a bathtub or a kitchen unit. For this, bathing in the sea and eating in the nearby restaurant facilities were expected.

Figure 20 shows the materiality of the interior, as well as the elements that made up the petit Cabanon. Figure 21 shows an axonometric description of all the spatial components of the Petit Cabanon.



Fig. 20 Interior view from the table in le Cabanon; Source: petitcabannon.blogspot

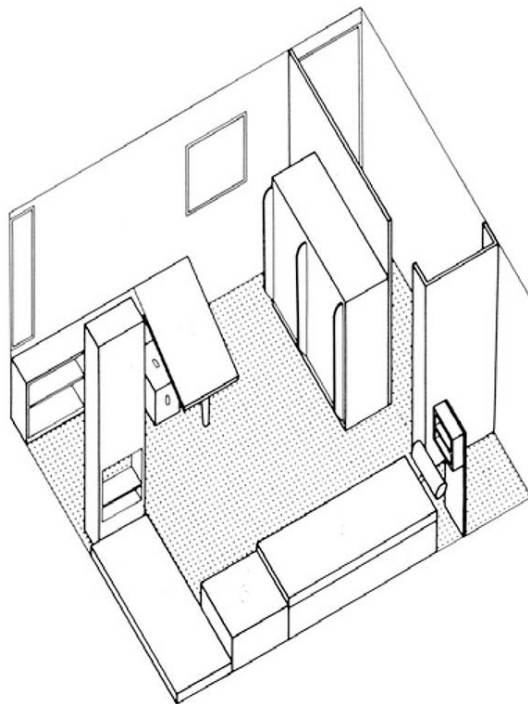


Fig. 21 Axonometric descriptive of spatial components;
source: Barbas (2013)

The Petit Cabanon is important to highlight the way in which Le Corbusier knew how to use and organise the space despite its small size; the construction consisted of a rectangular box measuring 3.66 x 3.66 metres and a height of 2.66 metres. These dimensions were sufficient to meet basic needs. Another important point to highlight is the way in which Le Corbusier took advantage of the furniture itself both vertically and horizontally for the division of spaces that at the same time functioned as compartments to store some belongings.

Martínez (2017) considers designer Joe Colombo (1930-1971) as one of the most important designers of the 1960s due to his proposals in the field of interior design and furniture design. From the beginning of his career, Colombo was interested in product systems for the home, as evidenced by his Combi-Centre container unit, the Additional Living System, Mini-Kitchen, Tube chair and Multi chair (Fig. 22) which were characterised by the fact that they could be configured in various ways to allow for flexible seating positions, and which reflected his main design objective: adaptability. His most futuristic creations were the integrated micro-environments, in which traditional furniture pieces were replaced by functional units to create multifunctional environments (Magalhães, 2009).



Fig. 22. Joe Colombo, Multi-chair, 1970 source: www.sportlogic.com

The Tube-Chair consists of a set of padded plastic tubes of different diameters that could be snapped together with metal clips, creating a variety of sitting or reclining configurations. The tubes can be inserted into each other and can be easily stored or transported in a bag (Fig. 23)



Fig. 23 Tube-Chair; Source: Capellini.com

The Mini-Kitchen was the first of Joe Colombo's innovative products to include new ideas of flexibility and space planning (Magalhães, 2009). This unitary block combines a refrigerator, two electric hobs, a hinged worktop, an integrated can opener and storage space. The Mini-Kitchen unitary block was on wheels, the aim being that the mini-kitchen could be moved around or out of a room and, when it was finished being used, it could be closed like a box (Magalhães, 2009). "Things have to be flexible", said Colombo in 1966. The storage was based on drawers of different dimensions that were integrated around the main structure saving as much space as possible (Fig. 24).



Fig. 24 Joe Colombo, Mini-kitchen, 1963; source: mapage.noos.fr

Joe Colombo's design focus is on the selection of materials, flexibility and modularity of objects. In his work, he leads the search for objects that serve to characterise individual areas. Joe Colombo's design represents Colombo's idea of the modern house: "The problem today is to provide furniture that is basically autonomous, independent of its architectural housing and so interchangeable and programmable that it can be adapted to any present and future spatial situation". According to (Magalhães, 2009) Joe Colombo imagined a future with experimental designs and installations, where the dwelling is no longer perceived as a system of furnished compartments, but as a neutral and open space, where all the installations and functionalities of the dwelling installations can be infinitely reorganised (Magalhães, 2009).

It is worth highlighting in Joe Colombo's designs the coherence between his thinking and the objects designed by him; in which all the objects have the possibility of being able to be organised and adapted in different ways, according to the user's needs. In addition to the flexibility of the objects designed by Joe Colombo, we can highlight the interest in creating compact objects that could be easy to transport, while economizing the space of use.

In 2019 the Bouroullec brothers designed a product that aims to explore the trend of life-work balance, giving rise to a design that manages to inspire work at home, in the office, in shared spaces and everywhere in between; this proposal responds to the rise of life-work spaces and changing attitudes towards aesthetics in the work environment (Neira, 2019). Grid provides privacy in open interior spaces, its core structure serves as a base for modular seating, shelving, tables and screens. Its flexible core design allows objects to be integrated in different ways depending on use, creating a playful and multifunctional environment for informal meetings, presentations or simply relaxing (Neira, 2019). High side panels create private spaces, while low side panels offer less visual division; in terms of materiality, the structure can be clad with acoustic upholstery or with a metal grid that allows communication between the inside and outside of the module (Fig. 25).



Fig. 25 Tall side panels with acoustic upholstery or as a metal grid;
source: designboom.com

On the outside, a shelf can be added to create a desk that can be used in a standing or seated position (Fig. 26). The sides can be fully upholstered as a sofa, or one of them can function as a built-in side table. The grid also has power and data point units that provide connectivity (Neira, 2019).



Fig. 26 Sit-stand desk; source: grid.establishedandsons.com

Several points stand out about this product: Like the previous examples, it highlights the way in which spaces with small dimensions can be used productively. The grid is based on a basic module with two L-shaped sides. Each side is 2.5 metres long enclosed by high or low side panels depending on the use, but which also serve as a backrest. It also highlights the flexibility, and a grid can be assembled in different ways: as a U-shaped module creating a more enveloping effect; as a straight module without a seat functioning that works as a partition; or as a straight module with a seat offering a bench. The use of materials and the different heights at which the product can be occupied allow privacy and openness according to the use of each user. Its flexible central design allows it to be integrated in different ways depending on the use, creating a playful environment. Combining all its elements, it can become a space to work, to do recreational activities such as watching television or simply to relax.

As a conclusion of the study of multifunctional objects, the following important points are taken into account during this research: the configuration of the objects, which allows the use of most of the objects in reduced spaces; the flexibility in the form, that let fulfil different functions and satisfy different needs of the user; the use of the diverse materiality of the objects and the way in which through the same object

different scenarios can be created, in this way different experiences and experiences are created in the users.

2.7 FINAL SUMMARY

As presented in the previous chapters, the working environment is no longer necessarily considered a fixed location within an office. The way people work is constantly changing and as such, workspaces have been modified over time. Theoretical research has allowed us to know, throughout history, how workspaces have developed; how they have responded to all the needs of employees through the different morphologies of both space and product, as well as the functionality and use of materiality according to the historical moment in which they were created. It is necessary to mention how spaces and working behaviours have changed over time, and that today this change persists, with the design of workspaces undergoing constant change.

The ergonomic points focused on the aforementioned workspaces, in addition to anthropometric dimensions, allow us to know elements that are not tangible: such as lighting, thermal environment, ventilation or acoustics; but which are undoubtedly elements that must be taken into account during the design process, creating spaces and products that are comfortable for the user to whom the product is addressed.

Just as the ways of working are constantly being altered, so the space in which these activities are carried out is being altered in order to meet the desired objectives. Multifunctional objects serve to understand the flexibility that a product can have from its design, being able to fulfil different functions according to the use given to it by the user. For this research, this flexibility and adaptability of uses in an object is valued. These characteristics will allow to create a connection between the work space and the home environment, having the necessary tools to adequately develop the work tasks.

The theoretical basis of this research was formed by the historical development of workspaces throughout different eras, as well as the ergonomic parameters necessary for the comfort of the human being when working and the functionality, flexibility and adaptability of uses that an object or product can have, served as a theoretical basis for the development of this research.

3.0 RESEARCH TO SUPPORT THE DESIGN

The purpose of the project developed in this work was to propose a product that would provide suitable working conditions for employees performing remote work from home. Remote work, as mentioned in the literature review above, has increased in recent years and is currently being reinforced by the SARS-COV19 pandemic. This product had to be innovative in order to be used to perform remote work from home, regardless of the existence or not of events such as the SARS-COV19 pandemic. A set of research was then established, in order to support the design of such product.

3.1 RESEARCH QUESTION

The project in question aimed to create a product, capable of enabling home office employees to perform the work in a way that is suitable for their various needs. As a result, the following research question was defined: How can a product be designed to offer suitable conditions for the performance of remote work from home?

3.2 OBJECTIVES

Main Objective:

To develop a proposal for a product which has the appropriate characteristics for employees who are working remotely from home, to perform such work in a suitable manner (comfortable, healthy and productive).

Specific Objectives:

- Analyse how the products were approached from their design and how they were working in the past
- Understand how employees work from home due to the SARS-COV19 pandemic.
- Identify the needs that employees have when performing their work from home.

3.3 RESEARCH METHODS AND TECHNIQUES

This research, as mentioned above, got as main objective the creation of a product that has the appropriate characteristics for employees who are working remotely

from home. In order to have the necessary basis to help answer this objective, two different research methods were used: the multiple case study and the survey. The main reason why this choice of methods has been made is that in the first place it was considered important to gain knowledge from objects and environments created in the past that have been used to support desk work. This point was made possible through three case studies. From the realization of the survey, it was possible to know more precisely what the reality is nowadays for employees who are doing remote work, specifically from home. The combination of these two methods allowed us to have a more general vision of what existed previously and what was the situation of the employees who were working from home.

For the first research method, the multiple case study, a study of three cases was conducted in which the techniques of data collection and SWOT analysis have been used. The chosen cases were an office designed in 1998 and two products made in 2017 and 2019, the latter two can be used to work. The reason why these specific cases were chosen was that it would allow to have a perception of what existed previously with what exists today. Initially, a brief explanation of each product was presented with general information such as product name, product designer, year of manufacture and its main characteristics, then a table with the SWOT analysis in each case was presented. The main objective of this analysis was to explore and analyze the strengths, weaknesses, opportunities and threats of each case. This gave a better understanding of the essence and reason of each product, its morphology and functionality. In addition to the SWOT analysis of the three case studies, the differences and similarities found between the cases were discussed. According to Sartori and Morlino (1994), it is by being able to name the similarities or differences between the cases, easier to identify whether these similarities or differences are relevant to the phenomenon of interest, since there are moments in which the comparison emphasizes the similarities and moments in which the differences are emphasized. Very similar cases require verification of the differences and in very different cases, an attempt is made to find the analogies (Sartori & Morlino 1994). Using these techniques, the three cases were analyzed in the same way in order to make comparisons and abstract information that was used later for the creation of the product.

The second research method, the survey made use of the questionnaire technique, with the main objective of understanding the work environment in which employees

were working remotely from home, the activities they perform, the body position in which they work, as well as the advantages and disadvantages they consider when working from home. In order to meet this objective, the questionnaire had questions that outlined for example the activities they performed, the work equipment they used in their day-to-day work and the space where they worked at home. In order to use a questionnaire that would give as much useful information as possible. A questionnaire was created based on questionnaires already created and used by the University of Cincinnati, a questionnaire developed by the London company Hubble, and a questionnaire created by Ipsos, World Economic Forum, a multinational company of market research and consulting. In the case of the questionnaire created by the University of Cincinnati, teachers (N = 4,200) and employees (N = 4,300) were involved, the study consisted of sending the questionnaire which included an e-mail so that after completing the questionnaire all participants also sent images of their posture and workspaces. The objective of this was that the workspace at the home of teachers and employees was evaluated by experienced ergonomists (Kermit et al. 2020). In the case of the questionnaire developed by the company Hubble, its main objective was to know what the advantages and disadvantages were perceived by employees to be working from home in the sense of productivity of their activities, in addition to knowing what was the interest of employees given the future, to continue working under this methodology or not. The questionnaire created by Ipsos World Economic Forum involved 12,500 employees in 29 countries who were working from home, the objective of this was to show their opinions about the work after COVID-19.

In order to use in this study a questionnaire covering ergonomics, needs and activities of employees working from home. Some questions from the aforementioned sources were used, but new questions were also added in order to know more precisely how employees work at home and what their main needs were. In addition to answering the questions in the questionnaire, participants were asked to send by email photos of their workspace, and the posture in which they worked, as was done in the questionnaire conducted by the University of Cincinnati. The design of the questionnaire will be detailed later in the procedure chapter.

One of the best techniques to make the data obtained in an investigation comprehensible is the representation of numbers through images (Schulz, 2009). Representation through images can make it easier to appreciate a pattern or expose

certain patterns that might otherwise be hidden. According to Schulz (2009), data can be displayed in many different ways, from bar charts to more complex scatter plots, thematic maps and animated population pyramids. According to Tufte (2001), this way of transmitting the obtained data makes it possible to illustrate trends and relationships quickly and easily, effectively transmitting the information from the database to the reader's head. The results of the questionnaire are presented through descriptive statistics by means of bar graphs and pie charts according to each question, making them easier to read. For the analysis of the data obtained, according to the typology of the questions asked, a simple frequency analysis of responses was carried out. For the choice of the questions to be analyzed, the questions considered the most useful for the research were taken into account.

In addition, the images received from the participants of the questionnaire showing their work environment and their body position when working, were compared with an image showing how the correct position should be when performing computer work based on the Ovako Workplace Postural Analysis System (OWAS). This analysis system was developed in Finland to analyze work postures and was proposed by three Finnish researchers Karku, Kansi and Kuorinka in 1977 (Santos, 1999). The researchers defined seventy-two typical postures resulting in different combinations and performed more than thirty-six thousand observations in fifty-two activities to test the method (Paim et al., 2016). In order to implement this method, the authors of the method suggested that a minimum of 100 observations be made in order to make correct inferences about the analyzed task (Paim et al., 2016). For this research, it was not possible to perform this method in depth since prolonged periods of observation are required to verify the frequency and time spent in each posture. Finally, the analysis allowed a final discussion of the chapter, where important points to consider during the development of the research are mentioned, which were, respectively, discovered during the case study and the questionnaire. The case studies and the design and development of the questionnaire with their respective results and analysis are presented next.

3.4 CASE STUDIES

As mentioned above, in addition to the data collection, a table with a SWOT analysis was made for each of the three case studies respectively: identifying the strengths,

weaknesses, opportunities and threats. Subsequently, the differences and similarities between the presented cases were shown, which made it possible to identify the aspects considered important and that was taken into account when making the product proposal. For the three different cases, images and documentation were collected through the official websites, papers and design sites of each product, serving as a basis to obtain data on the functionality and needs that helped to solve this typology of products. The case studies chosen, as already mentioned, were an office designed in 1997 to be able to work remotely from home, a work module designed in 2017 and a desk designed in 2019.

The purpose of the selection of cases to gain knowledge know different products through design have responded to the need for the realization of work activities, in addition to have a perception of what existed previously with what exists today.

- **A HOME OFFICE FOR TELEWORK 1997**

Product name: Home office for telework

Designer: Per Erik Boivie

Manufacturer: Per Erik Boivie

Year: 1997

Price: Information not found

Features:

- A place for cooperative work and short meetings
- A place for writing and other computer-supported work at a flexible motor-driven
- A table that permits working both standing up and sitting down.
- Maple-wood for the tabletops.
- Storage for books and files on shelves.
- A small rolling pedestal for suspended pockets covered with a Plexiglas top.
- A rolling pedestal for storage of paper before recycling.

In 1997 Per-Erik Boivie - the founder of TCO computer certification changed his position within TCO. He renegotiated his working conditions and opened up the possibility to work from home a couple of days a week, so a home office had to be built. The design was carried out as a first case study within the activities of the

laboratory where he worked. At home he had a spare room, after his son moved out. The room had a window to the backyard with an approximate size of about 3.30 by 2.90 meters wide and 3 meters high (Junestrand & Leal, n.d.). This project was also to be carried out as a learning process. As it was not to be changed all in one moment, but over a longer period of time (Junestrand & Leal, n.d.). The home office was composed of elements such as a place for writing, computer work, a flexible and motorized table that allowed working both standing and sitting, a place for cooperative work and short meetings, an old but comfortable chair, a storage space for books and files on shelves, a small rolling pedestal for suspending bags and a rolling pedestal for storing paper before recycling. The tabletops were made of maple wood. Although the office designed by Per-Erik was the main space for activities, for example, he used the dining room for meetings and a sofa for reading (Junestrand & Leal, n.d.). The following figures show the architectural plan of the home office space designed by Per-Erik Boivie (Fig. 27) where all the elements that compose the home office space are shown, and the figure with the computer workplace (Fig. 28).

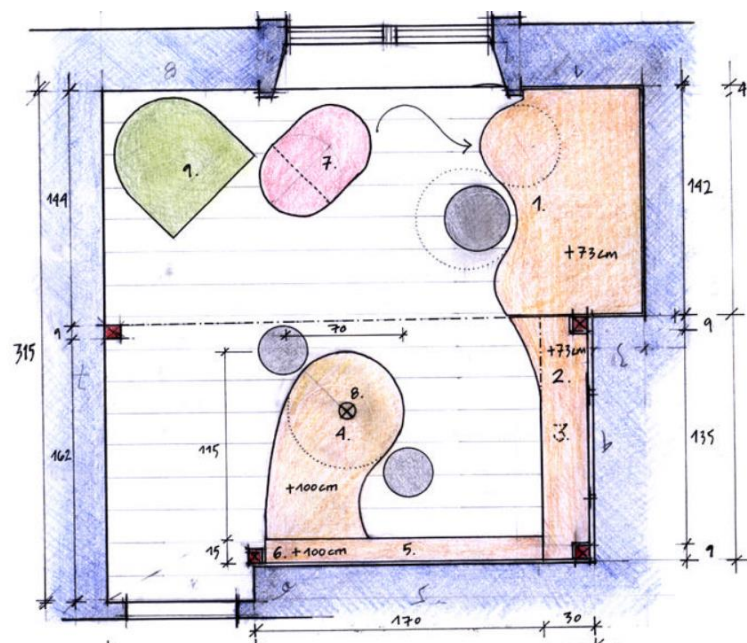


Fig. 27 Plan of the Home Office of Per-Erik Boivie. 1. Place for writing and other computer-supported work. 2. Place for printer etc. 3. Storage for books and files. 4. Place for cooperative work and short meetings. 5. Storage. 6. Folding function of the table. 7. Small rolling pedestal with a Plexiglas top. 9. Old comfortable chair for reading; Source: Boivie 1997



Fig. 28 The computer workplace in the home office of Per-Erik Boivie. The rounded forms of the table permits a position close to the table and good support for the arms. The colours are neutral and make no disturbing contrast; source Boivie 1997

SWOT Analysis

A HOMEOFFICE FOR TELEWORK 1997

STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
• The rounded edges, which allow smoothing the surface and reduce the effects on circulation • A place for writing • A flexible motor-driven table that permit working both standing up and sitting down • A place for cooperative work and short meetings, at a table for standing up or sitting at a high chair. • Storage for books and files at shelves • Storage of paper before recycling • Space for other useful items such as a printer • The remote workspace is located in an isolated space inside the home	• Does not include a chair in the design of the remote workspace. • It is a fixed piece of furniture that cannot be easily transported. • It is a fixed piece of furniture that cannot be easily assembled and disassembled.	• Demonstrate that through design in a small space effectively used can create a workspace that includes even an area for short meetings	• Not every house has enough space to create a workspace in an isolated area

Table 4 SWOT analysis Homeoffice for telework 1997; Source: Author

• PROSPECT SOLO SPACE

Product name: Prospect solo space

Designer: Richard Holbrook

Manufacturer: Herman Miller

Year: 2017

Price: depending on the product configuration, it can vary between 1606,72 EUR to 3211,59 EUR

Features:

- Single flat base
- Interior acoustic pads
- Marker cup
- Coat rack
- Cell phone holder
- Tacks

- Bag hook.

In 2017 the designer Richard Holbrook for Herman Miller designed a workspace by the name of Prospect Solo Space. According to Holbrook, people need time to focus on work and contemplation in order to bring their best ideas to their teams. Prospect Solo space spaces were ideal for individual creative work or just to settle in and get some quick tasks done (Holbrook, 2017). Prospect Solo space, is composed of freestanding semicircular furniture considered by Richard Holbrook to be an oasis for creativity with whiteboards. The round shape offers visual privacy and the soft, sound-absorbing materials create a quiet place to work or study (Holbrook, 2017) (Fig. 29).



Fig. 29 Prospect solo space with all elements; Source: Herman Miller 2021

In addition to the main semicircular component, Prospect Solo Space is composed of other elements that help to better plan the work area, such as a marker cup, tack cup (Fig. 30), coat rack, bag hook (Fig. 31), cell phone holder, and an interior acoustic pad that allows for sound isolation (Holbrook, 2017).

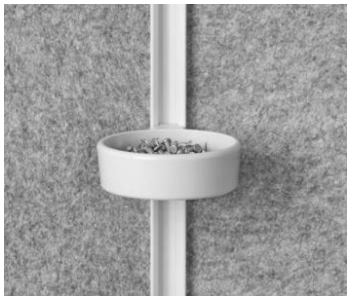


Fig. 30 Tack cup; Source: Herman Miller 2021



Fig. 31 Bag hook; Source: Herman Miller 2021

The following image shows two ways to use Prospect Solo space: As a small meeting room for teamwork, with the taller vertical structure, and as an individual work area. However, both have the same elements such as whiteboards and noise reduction panels (Fig. 32).



Fig. 32 Prospect solo, when it works as individual workspace and as a meeting table; source: Herman Miller 2021

SWOT Analysis

PROSPECT SOLO SPACE 2017

STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
• The rounded edges, which allow smoothing the surface and reduce the effects on circulation • Ideal for individual creative work or just to settle in and get some quick tasks done • Compose of freestanding semicircular furniture • The height and spacing between the round structure and the table struck a balance between intimacy and openness • The freestanding semicircular structure encouraged reducing visual and auditory distraction • With other elements like marker cup, tacks, coat rack, bag hook, cell phone holder, and an interior acoustic pad that allows for sound isolation • Can be in different types of finishes and colors.	• Not include a space to sit of the prospect solo space • The module did not have wheels, which makes it difficult to move easily. • It was a fixed piece of furniture that cannot be easily assembled and disassembled. • The height of the table was not adjustable • Did not include a lighting element	• This product could be used to work at home or in an office • For the purchase of a prospect solo an ergonomic chair for work could be included. • More than two modules could be put together to increase the work space and to be able to hold meetings when necessary. • This product can be the right answer when the employee works in spaces where there is also another function such as the living room, dining room, bedroom, giving a sense of isolation	• The cost of the product may not be affordable for all users (1606.72-3211.59 EUR) depending the configuration • Not every house has enough space to have this kind of product • the appearance it can have inside the house, like a office module

Table 5 SWOT Prospect Solo Space 2017; Source: Author

• STIR DESK

Product name: Stir Kinetic desk

Designer: JP Labrosse

Manufacturer: Stirworks

Year: 2019

Price: approximately 2777 EUR

Features:

- Single flat base
- Adjustable height
- Touchscreen
- Firmware
- Power

In 2019, the ex-Apple engineer JP Labrosse designed for the company Stirworks a desktop which they consider "the most advanced desktop in history" (Labrosse,

2019). Stir as the product is called, is a desk with a curvilinear shape, and a slim profile with a matte finish.

Among the digital elements that characterize Stir is that it allows storing data in the cloud, which enables synchronization with electronic devices, and allows automatic login and access to information that is available in the cloud. Facilitating the sharing of information, it has a set of proprietary algorithms and custom interfaces that allow the desktop to detect, learn and adapt to the needs of each user. The desktop has a touchscreen embedded in the surface, which also tracks usage and remembers data and preferences (Fig.33) (Labrosse, 2019).



Fig. 33 Stirdesk with black finishing; Source: Stirworks 2019

Underneath the touchscreen (Fig. 34) is what JP Labrosse considers the brain of the desktop. A tiny processor that can be removed and upgraded in the future. This device keeps track of preferences, users, height settings and habits. For example, when the Stir desktop is used in offices with shared desks, it is possible to do the registration via the screen or via Bluetooth with a Fitbit - a device that is used as a watch but where the main purpose is to track steps and track physical activities performed during the day. When there is a registration in this way the desktop automatically detects when the user approaches and turns on the screen. All the controls of the desk are operated through the touch screen. It is possible to manually switch from sitting to standing, check the time, see how long one has been standing or sitting and set a daily standing target, defined as the position the person adopts when standing (Fig. 35) (Labrosse, 2019).



Fig. 34 Stir desktop touch screen; source: Stirworks 2019



Fig. 35 Different heights of Stir desk; source Stirworks 2019

SWOT Analysis

STIR DESK 2019

STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
• The rounded edges, which allow smoothing the surface and reduce the effects on circulation • Can be in different types of finishes and colors. • The height this can be adjustable from approximately 76cm to 152cm with electric drive • The assembly is done in a simple way because only the legs must be fixed with bolts (at the time of shipment all the necessary tools for assembly are included) • the lifting mechanism is made of steel and the operation is ultra-quiet, and minimal or no surface vibration • Has a touchscreen embedded in the surface, which also tracks usage and remembers data and preferences • Allows storing data in the cloud, enables synchronization with electronic devices, allows automatic login and access to information that is available in the cloud, facilitating the sharing of information • It is possible to check the time, see how long one has been standing or sitting,	• Did not include a space to sit • The desk can not be easily assembled and disassembled. • To be able to use it is necessary to fix the desk to the floor • Did not include a lighting element • If the processor stops working, it is possible to lose all the information that is in the cloud • Does not have drawers to store documents, such as folders, pages, • Does not have an element that eliminates distractions that may be present in the environment	• This product could be used to work at home or in an office • The desk height should be manually adjustable in case the touchscreen doesn't work • This product may be the right answer when the employee likes to work standing and sitting • All the controls of the desk must be manageable through mobile devices such as cell phones, ipad, tablets and smart watches and not only with the touchscreen	• The cost of the product may not be affordable for all users (2777 euros approximately) • If the user, for example, lives in a rented house, may not be able to fix the desk on the floor to avoid damage • For a user who does not use a lot of technology, it could be a very sophisticated desk

Table 6 SWOT analysis Stir Desk 2019; Source: Author

Below is a table with the main differences and similarities between the cases: with the purpose of outlining some elements that could be considered important for the product proposal (table 7). This table synthesises the similarities and differences that were perceived between the three cases under study. It should be noted that despite having fewer similarities and more differences between the three cases, the differences help to perceive more the differentiating elements between each product, making their design unique.

SIMILARITIES

- The rounded edges, which allow smoothing the surface and reduce the effects on circulation
- The seat is not included in the proposal
- Lighting and ventilation are not included in the design of the product
- The products cannot be easily assembled and disassembled
- These products could be used either to work from home or in an office

DIFFERENCES

- The option to adjust the height of the work table is not available in all products
- In two of the three cases the product has the option of an area for small meetings
- The technology in one of the three products is the main component, since it allows to activate all the actions of the product, such as adjusting the height of the table or saving information in the cloud
- The morphology of the flat work surface is different among the three products
- The materiality and finishing is different among the three products
- The appearance is different among the three products
- Only one of the three products has an element that avoids distraction from the environment and noise reduction

Table 7 Similarities and Differences between the cases under study; Source: Author

The SWOT analysis and the table with the similarities and differences between the cases allowed to know in greater depth the morphology and the functionality that make up these products. Being products that were designed in different years, it is possible to perceive what the needs were according to the time in which they were created. However, there are elements that despite changing needs are maintained in the three products, such as the single flat base to work. To make the proposal of a product it is necessary to know the current needs of the employees, this will be possible from the questionnaire that is presented below.

3.5 SURVEY

The main objective to be achieved through this research as mentioned in chapter 3.2 is the creation of a product that is suitable for employees who working remotely from home. In order to respond to this objective, it is necessary to consider the current situation of the employees, the type of activities they perform, the space where they work, the work equipment they use on a daily basis, as well as to know the needs that employees have when performing their work. In order to answer all these questions, a specific questionnaire was designed for this research. The following is a description of how this questionnaire was carried out.

3.5.1 QUESTIONNAIRE DESIGN

As previously described in the chapter on research methods, a questionnaire was implemented to better understand the current situation of the employees, their body posture, daily activities, the furniture they use to work, the technological equipment, interests and tools needed to perform their work tasks, as well as the future expectations of the participants. This questionnaire was directed to employees in Portugal, Spain and El Salvador who were working remotely from home due to the SARS-COV2 pandemic. In order to design a questionnaire with the most useful information, a questionnaire was created based on questionnaires already created and used by the University of Cincinnati, a questionnaire developed by the company Hubble, and the questionnaire created by Ipsos, WorldEconomic. However, in order to use a questionnaire in this study covering ergonomics, needs and activities of employees to work from home, some questions from the above sources were used, but also new questions were created to learn more precisely how employees work at home and what their main needs were. In addition to answering the questions in the questionnaire, participants were asked to send by email photos of their workspace and the posture in which they worked as was done in the questionnaire conducted by the University of Cincinnati.

The questionnaire used in this research consisted of 31 questions: open and closed, collecting qualitative and quantitative data. The questions intended to discover aspects such as the equipment they work with, the main activities they perform on a daily basis, factors that affect their productivity, whether or not they have a specific

workspace at home, as well as how the experience of working from home has been and what their future expectations are. In the introductory part of the questionnaire, the objective of the research was mentioned, as well as the confidentiality with which the data and results would be treated, which would be used only for academic purposes. Also, the approximate time to complete the questionnaire was mentioned, as well as how they needed to complete the questions. The questionnaire was divided into two sections: The first section was composed of 28 selection questions, which were focused on knowing how the experience of working from home has been, as well as the needs and interests of the participants, and the second section was composed of demographic questions. The questionnaire was created on the Google forms platform and was distributed online to the participants, by using their computers and personal gadgets they gave answers. In addition to asking participants to answer the questionnaire, they were asked to send by email photos of their workspace and their body position while working. Non-probabilistic sampling was used to select the sample to which the questionnaire was addressed. This type of sample was considered for this study because it is the most accessible at the time of collecting the largest amount of data in a short period of time, this involves a non-random selection based on convenience or other criteria, which allows for easier data collection (Pimienta, 2020). According to Pimienta (2020) in these types of research, the goal is not to test a hypothesis on a large population, but to develop an initial understanding of a small or under-researched population.

For this case, this was intended to be 130 participants similarly distributed with 50% Women and 50% Men from different companies, in which their areas of work and the activities they perform were diverse. The expected age range of the sample was between 25-60 years in order to have a greater diversity of responses. Subsequently, in the chapter on the results of the questionnaire the obtained sample got presented, with the number of questionnaires completely answered and the data obtained. In the case of the data, these are presented through descriptive statistics by means of bar graphs and pie charts according to each question. According to the typology of the questions asked, for the analysis of the data obtained a frequency analysis of responses was carried out in which a choice was made of the questions considered the most important to be analyzed. For the selection of these questions, the ones considered most useful for the research were taken into account. Such as the equipment used by the employees when working, the activities they perform on a

daily basis, questions about the environment in which they currently work. In addition to the data obtained in the questionnaires, a comparison has been presented between the 7 images received from the participants in Portugal, Spain and El Salvador, in which the work environment is visible and where the body position got highlighted in red while they are working with their equipment. Respectively, this data was compared with an image obtained from the Ovako Workplace Postural Analysis System (OWAS) which show how the correct position should be when working with a computer. As a final point, from the images received from some of the participants of the questionnaire, a table was made with a scheme of the posture of the back, arms and legs of the participants, and this was compared with a scheme of the ideal posture condition, based on the Ovako work posture analysis system (OWAS). This table contributed to comparing both schemes and to determine if the body posture of the participants at the time of working is the correct one or not.

Below, all the questions that make up the questionnaire designed for this research are presented. Subsequently, in this chapter, the data obtained are presented with their respective analysis.

1. Which is your work field/area?

- ☐ General management
- ☐ Sales/Business development
- ☐ Marketing
- ☐ Finance
- ☐ Human resources
- ☐ Architecture or design
- ☐ Legal
- ☐ Customer support
- ☐ Research
- ☐ Administration
- ☐ Project Manager
- ☐ Do not know/ Do not answer

2. Did you ever work from home before the coronavirus outbreak?

- ☐ Never
- ☐ Rarely
- ☐ 1-2 times per week
- ☐ 3-4 times per week
- ☐ Daily
- ☐ Do not know/ Do not answer

3. What is about working from home that you do not like? (Select up to 3)

- Lack of social interaction
- Lack of work-life balance
- Increased distractions
- Uncomfortable work environment
- Poor team communication
- Internet/technology issues
- None of the above, everything was fine
- Other (please specify):
- Do not know/ Do not answer

4. What is about working from home that you do like? (Select up to 3)

- No travel to and from work
- Financial savings
- More time with loved ones
- Improved focus / productivity
- Environmental impact
- Impact on physical health
- Flexibility with childcare
- Impact on mental health
- Other (please specify):
- Do not know/ Do not answer

5. If your company allows it, how often would you like to work from home in the future?

- Never
- Rarely
- 1-2 times per week
- 3-4 times per week
- Daily
- Do not know/ Do not answer

6. Do you have your own work space at home?

- Yes
- No
- Do not know/ Do not answer

7. If your answer in question 6 was yes, where do you work?

- Home office
- Home library
- Other (please specify):
- Do not know/ Do not answer

8. If your answer in question 6 was no, where do you work?

- Kitchen
- Dining room
- Living room
- Bedroom

- Garden
- Other (please specify):
- Do not know/ Do not answer

9. Do you share that space with other family members?

- Yes
- No
- Do not know/ Do not answer

10. With how many people do you share the workspace?

- 0
- 1
- 2
- 3 or more
- Do not know/ Do not answer

11. What are your daily activities? (Select up to 3 if necessary)

- Design related work using softwares such as (Illustrator, In-Design, Photoshop, Revit, AutoCAD etc.)
- Management related work using softwares such as (Word, Excel, Power point etc.)
- Making and receiving calls
- Participating in videoconferences
- Visiting customers
- Receiving or presenting products
- Doing presentations
- Other (please specify):
- Do not know/ Do not answer

12. In your current home office situation what type of equipment do you use?

- Laptop
- A combination of laptop and external monitor
- Desktop
- Desktop with multiple monitors
- Ipad or tablet
- Other (please specify):
- Do not know/ Do not answer

13. If your company provides you with a desk, how would you like it to be?

- Sit down only
- Sit-stand
- Do not know/ Do not answer

14. In your current home office situation, where do you sit?

- Office chair
- Dining chair
- On the bed
- On the couch
- Other (please specify):
- Do not know/ Do not answer

15. If your work chair has armrests, how much do you use them? Scale 1 to 5

Never

Always

16. Check the elements you find necessary in a chair for working remotely?

- Footrest
- Wheels
- Adjustable seat
- Adjustable lumbar support to fit the lumbar region of the user's back seat
- Armrest
- Other (please specify):
- Do not know/ Do not answer

17. From the following elements a desk can have, which are essential for providing you a comfortable work environment? (Select up to 3).

- A flat base
- Document trays
- Drawers
- Power sockets
- USB ports
- Space for printers
- Space for additional technology: chargers, external drives, cameras, pen drives, etc.
- Drawing / writing area
- Desktop/ monitor area
- Other (please specify):
- Do not know/ Do not answer

18. Do you listen to music during work?

- Yes
- No
- Do not know/ Do not answer

19. If your answer above was yes, how do you listen to the music?

- Headphones

- Ambient music
- Don't know / Non-response
- 20. Do you find that ambient/neighbourhood noise interferes with your work?
- Yes
- No
- Do not know/ Do not answer

21. If your answer above was yes, what kind of measurements do you take in order to minimize the noise in your work space at home? (Please specify):

22. Do you find that you have appropriate lighting to develop your work in a comfortable manner?

- Yes
- No
- Do not know/ Do not answer

23. If your answer to question above was yes, how do you measure that you have appropriate lighting at home in your work space? (Select up to 2 if necessary)

- Natural lighting
- Indirect artificial lighting (Ambient lighting)
- Direct artificial lighting (Task lighting)
- Do not know/ Do not answer

24. If your answer to question 22 was no, what are you lacking to have the appropriate lighting conditions? (Select up to 2 if necessary)

- Natural lighting
- More indirect artificial lighting (Ambient lighting)
- More direct artificial lighting (Task lighting)
- Do not know/ Do not answer

25. When you were working from home, did you receive colleagues at home for work reasons?

- Yes
- No
- Do not know/ Do not answer

26. If your answer above is yes, where did those meetings took place?

- At your work space
- Kitchen
- Dining room
- Living room

- Anywhere else at home (Please specify)
- Do not know/ Do not answer

27. Thinking about your home, which space would you choose to work in?

- Kitchen
- Dining room
- Living room
- Bedroom
- Garden
- A specific work space
- Other (please specify):
- Do not know / Do not answer

28. During the confinement did you work there or are you working there?

- Yes
- No
- Does not apply. (If not, please explain why):

29. What's your gender?

- Female
- Male

30. How old are you?

- <26
- 26-30
- 31-40
- 41-50
- 51-50
- 60+

31. Who are you currently living with?

- I live on my own
- Partner/spouse
- Children (under 4)
- Children (age 4-18)
- Friends
- Parents
- Flatmates
- Family members
- Don't know/ Non-response

3.5.2 SAMPLE

For this investigation, 130 questionnaires were sent out. Of these 130 questionnaires only 127 participants responded to all 31 questions in their entirety, so only these 127 were considered valid. The participants were employees who had to work from home because of the health measures imposed due to the SARS-COV2 pandemic. The professional area of the participants as well as the field of activity in which they worked was diverse. The main professional areas in the sample included Sales/Business Development, Marketing, Finance, Architecture or design, Customer support (10.8%) and Research (10%). The participants residing in El Salvador, Portugal and Spain were 130, 53.5% women and 46.5% men with an average age of 32 years.

3.5.3 RESULTS

The results of the bar charts and pie charts of the questions considered the most useful for abstracting data specifically intended for the project are presented below. The descriptive statistics of the complete questionnaire can be found in the appendix.

1. Which is your work field/area?

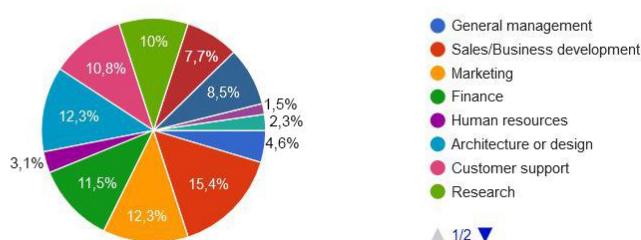


Figure 36; question 1 of the questionnaire

1. Which is your work field/area?

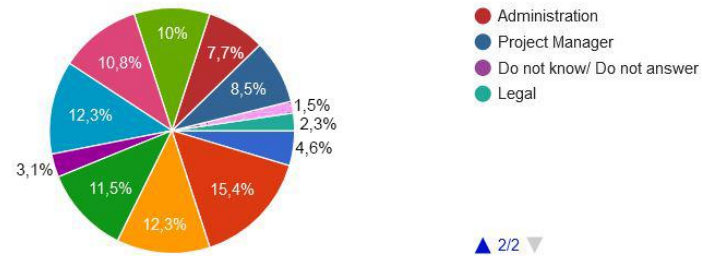


Figure 37; question 1 part II of the questionnaire

2. Did you ever work from home before the coronavirus outbreak?

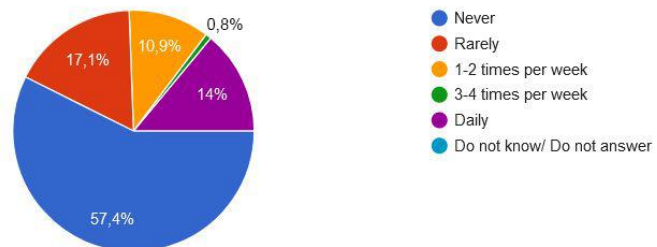


Figure 38; question 2 of the questionnaire

4. What is it about working from home that you do like? (Select up to 3)

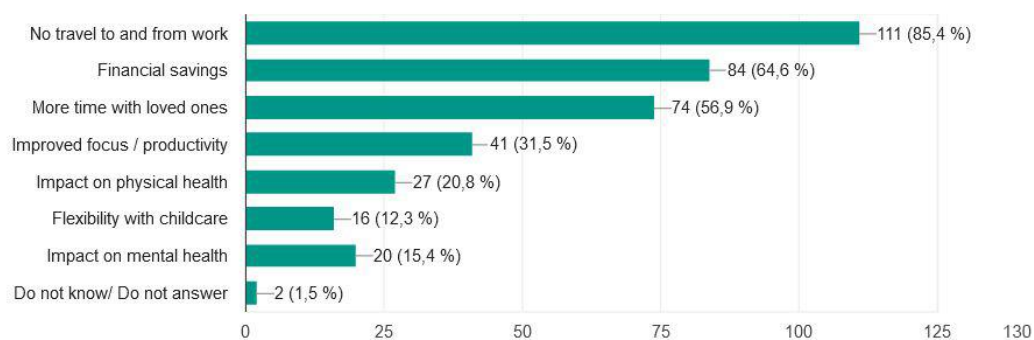


Figure 39; question 4 of the questionnaire

5. If your company allows it, how often would you like to work from home in the future?

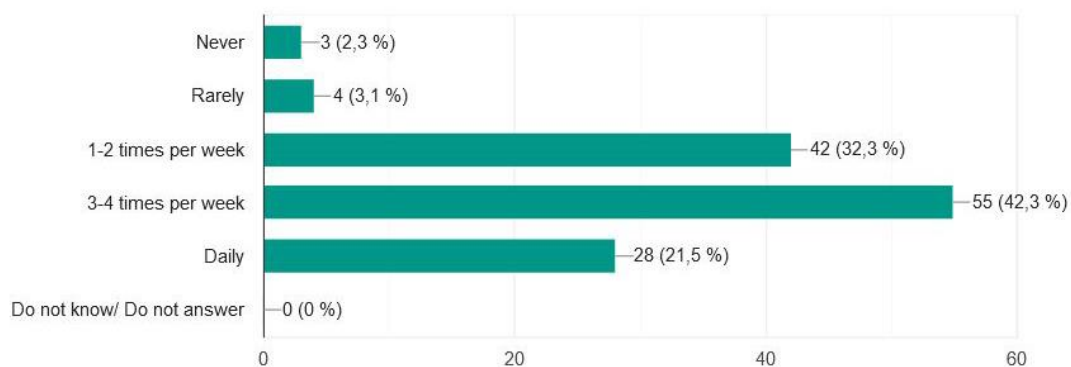


Figure 40; question 5 of the questionnaire

6. Do you have your own work space at home?

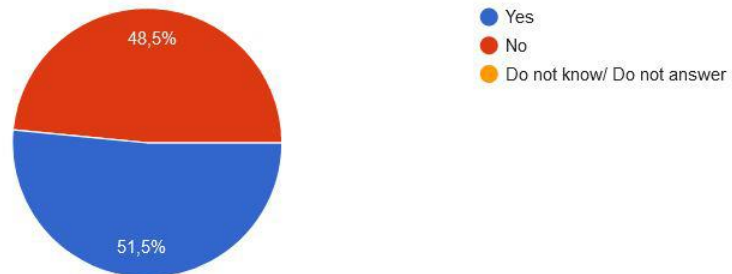


Figure 41; question 6 of the questionnaire

8. If your answer in question 6 was no, where do you work?

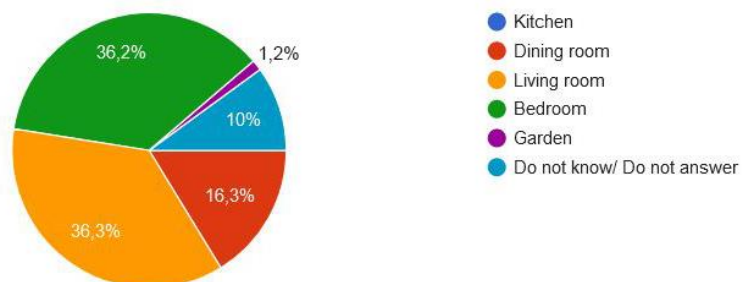


Figure 42; question 8 of the questionnaire

9. Do you share that space with other people?

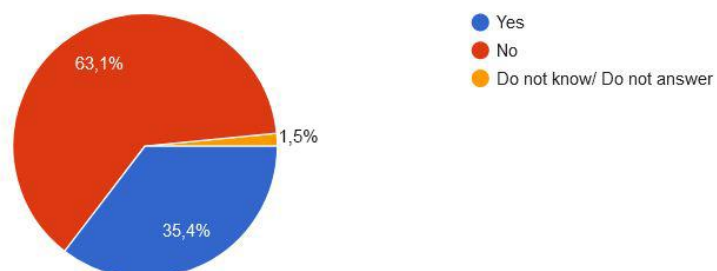


Figure 43; question 9 of the questionnaire

10. With how many people do you share the workspace?

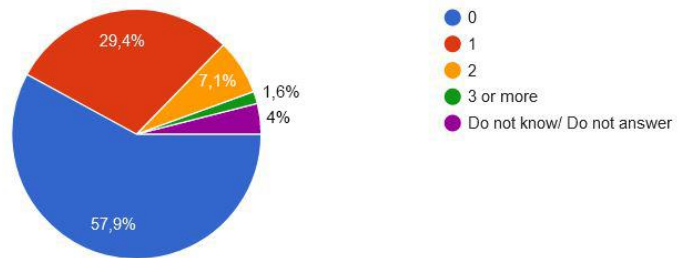


Figure 44; question 10 of the questionnaire

11. What are your daily activities? (Select up to 3 if necessary)

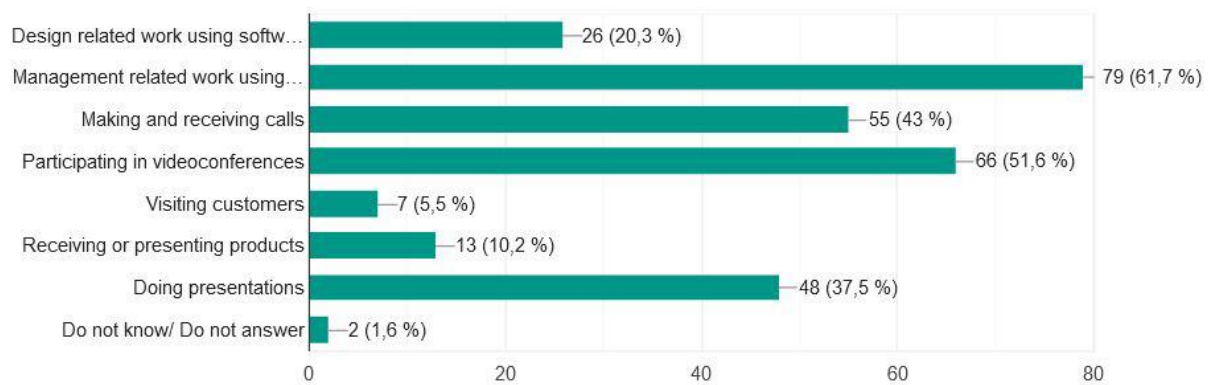


Figure 45; question 11 of the questionnaire

12. In your current home office situation what type of equipment do you use?

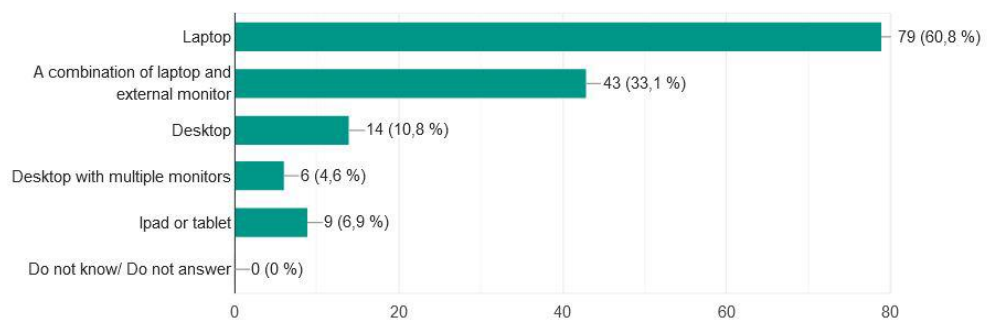


Figure 46; question 12 of the questionnaire

13. If your company provides you with a desk, how would you like it to be?

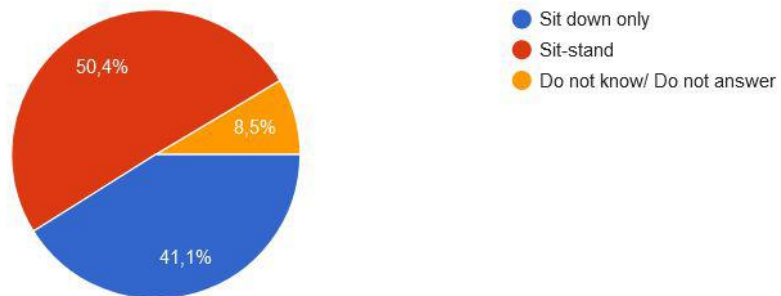


Figure 47; question 13 of the questionnaire

14. In your current home office situation, where do you sit?

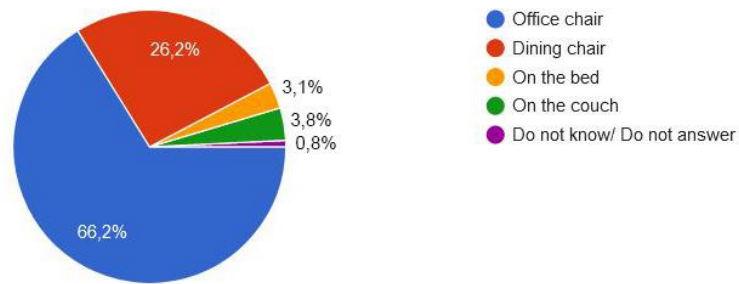


Figure 48; question 14 of the questionnaire

17. From the following elements a desk can have, which are essential for providing you a comfortable work environment? (Select up to 3)

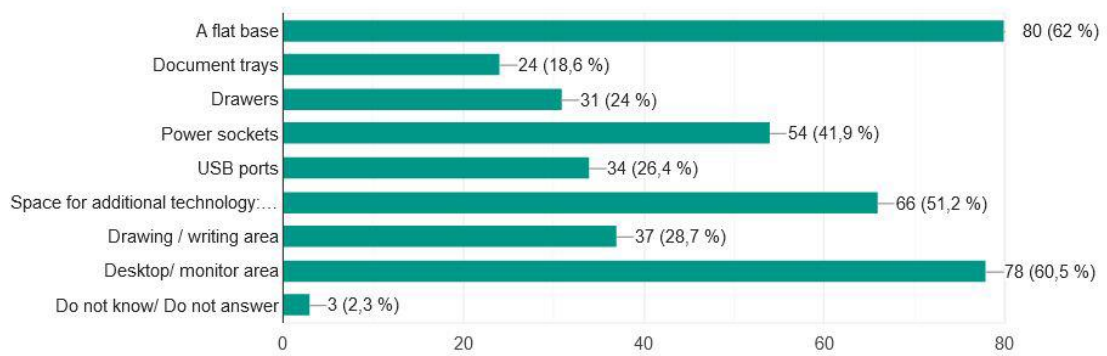


Figure 49; question 17 of the questionnaire

18. Do you listen to music during work?

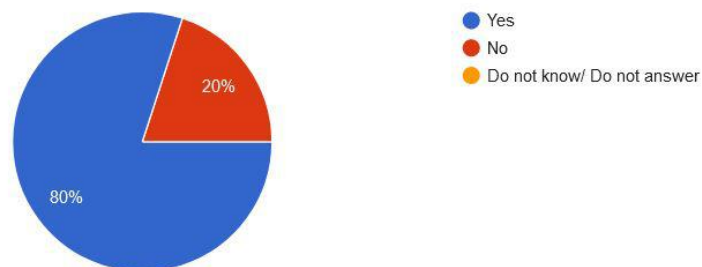


Figure 50; question 18 of the questionnaire

20. Do you find that ambient/neighbourhood noise interferes with your work?

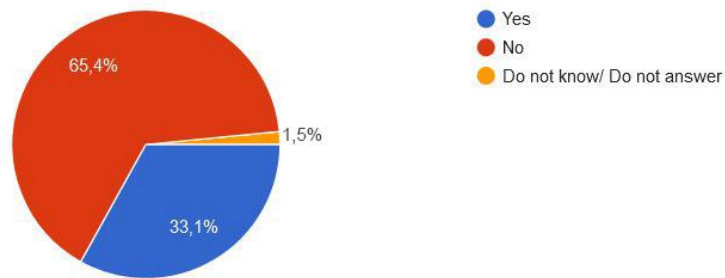


Figure 51; question 20 of the questionnaire

22. Do you find that you have appropriate lighting to develop your work in a comfortable manner?

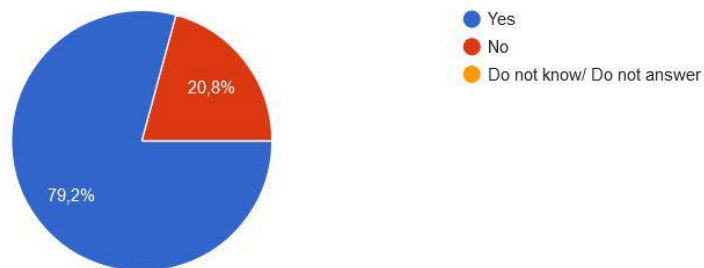


Figure 52; question 22 of the questionnaire

23. If your answer to question above was yes, how do you measure that you have appropriate lighting at home in your work space? (Select up to 2 if necessary)

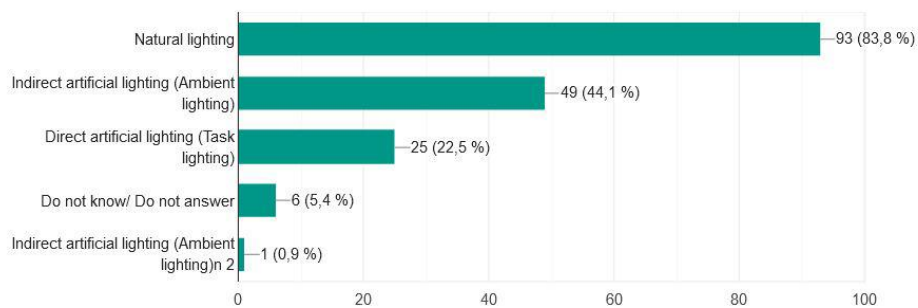


Figure 53; question 23 of the questionnaire

25. When you were working from home, did you receive colleagues at home for work reasons?

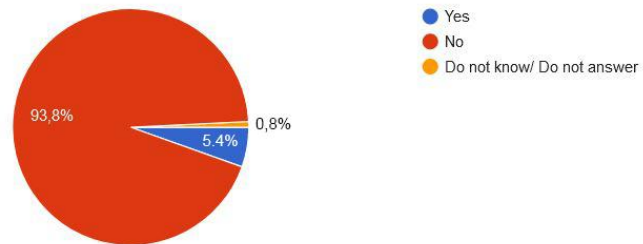


Figure 54; question 25 of the questionnaire

27. Thinking about your home, which space would you choose to work in?

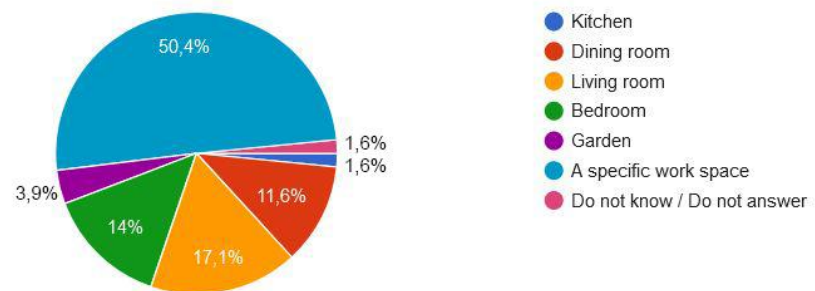


Figure 55; question 27 of the questionnaire

In addition to completing the questionnaire, the 7 images received from the participants are shown below. (Fig, 56)



Fig.56 Images received from survey participants

3.5.4 ANALYSIS, AND INTERPRETATION OF DATA

In the previous chapter, the results of the questions considered the most useful for this research were presented in graphic form. For the analysis and interpretation of these data, a frequency analysis of responses was performed. The frequency analysis was performed using the "inverted pyramid" method, which consists of presenting the most important facts first, followed by the secondary points in decreasing order of importance (Jorge, 2008). In this case, all the data are considered important. The order of analysis showed first that most of the participants working remotely from home for the first time, that not all employees had a dedicated space to work, and it also showed the interest that employees had in continuing to work from home in the future if their companies would allow it. In addition, it showed the activities they performed, the equipment they currently used, and the guidelines that should be taken into account in how their ideal product would be to work.

The questionnaire identified at the time the survey took place, it is not current anymore situation of employees who were working remotely from home; 57.4% of the participants had never worked prior to the outbreak of the SARS-COV2 pandemic under this methodology compared to 17.1% who had experienced this way of working at some point in the past. Upon having experienced working remotely, 21.5% of the respondents stated that they would like to work from home on a daily basis, 42.3% would like to work at least 3-4 times per week and 32.3% would like to work at least 1-2 times per week under this methodology if their company would allow it in the future (as opposed to 2.3% who would never want to work from home). This shows that although many companies at the moment have the possibility of opting for employees to return to work in the office, employees are interested in continuing to use this work method, although not on a daily basis. This shows that the project at hand, for the design of a product which allows working comfortably at home is a pertinent one.

Most of the participants showed that the bedroom (36.2%) and living room 36.3% were the most common places at home where they work. By not having a space dedicated solely to work, 22.5% identified an uncomfortable work environment, considering it one of the problems of doing remote work, and 32.6% mentioned as a problem that they experienced an increase in distractions. In that sense, 50.4% of the

participants would like to have a place specifically dedicated to working at home and they don't want to work in spaces shared with other activities such as the bedroom, dining room, kitchen or living room because they experience more distraction.

For 61.7% of the participants the main work activities involved the use of software such as Word, Excel, and PowerPoint, confirming that in order to carry out their activities, 60.8% used a laptop as their main equipment, 33.1% used a laptop with an external monitor and in the minority with 6.9% they made use of an iPad or Tablet.

All of the participants in the questionnaire used computer equipment such as laptops, monitors or iPad/tablets to work. And 62% of these participants valued it as necessary to have a smooth base to place their equipment. Also, 51.2% wanted a designated space to place technological gadgets such as cameras, USB ports and chargers, with a minority of 18.6% saying they consider document trays to be essential. If the companies to which they belong would offer a desk for working from home, 50.4% said that they would prefer a sit-stand desk, compared to 41.1% who prefer it to have just a sit down desk for working from home.

Concerning seating, it was shown that 66.2% of the participants used an office chair to work at home, with 26.2% employees using a dining room chair and a minority (3.1%) of employees working from bed. This data showed that two thirds of the participants in terms of seating, had a chair with some ergonomic features.

The majority (80%) of the participants confirmed that they listened to music while working. When answering whether the noise of the environment/neighborhood interfered with their work, 65.4% said it did not compared to 33.1% who said that it did. This may show that most of the participants listened to music not because they tried to avoid noise of the surroundings, but because they actually enjoyed listening to music while working.

In the case of lighting, 79.2% of the participants considered that they had good lighting while working and 20.8% mentioned that they need more natural lighting. From the employees who answered that they had a good lighting source, 83.8% answered that it consisted of natural lighting. For the product proposal, it was important to take into account that 93.8% of the participants did not receive colleagues at home for work reasons, so they do not need a place for meetings, only a space to work individually.

As mentioned in the chapter sub-related to research methods, the participants were also asked to send photographs of their posture at the time of work and of their workspace. At this request only 7 participants send photographs. These were used to make a comparison of how the employees were working, compared to the ideal body posture based on the Ovako Work Postural Analysis System (OWAS). Which considers the postures of the back, arms, legs, use of force and activity phase (Paim et al., 2016). (Fig. 57)



Fig. 57 Example of an ideal posture condition; source: istockphoto

The set of photographs received from 7 of the participants in the questionnaire are presented below. The images show the work environment, the equipment they use and the body posture. Over the images an analysis was done, by examining the posture of the Legs, posture of the arms and posture of the back. (Fig. 58)



Fig.58 Legs, arms and back posture and workspace status of survey participants

From the set of images received, the following observations were drawn. Most of the participants did not use the backrest of the chair, so their body posture in most cases is a posture with the lumbar back curved and away from the backrest chair. Regarding the posture of the arms, the participants hold their arms in the air, and they were not supported on the work table. Although in some cases the participants had a chair with armrests, they did not use them. In the case of the legs, there is more diversity of positions, however, it can be observed that they did not have them in a straight position resting on the floor and in some cases, they had their legs crossed on the seat.

Based on the above photographs received and as a summary of the observation made, a comparative table was created to show a scheme of the current body condition of the participants, compared with a scheme of the ideal body condition at the time of working with a computer. The scheme used as a basis for the comparative scheme is

the scheme used by OWAS (Fig 59). The table with the comparative scheme is composed of three categories, the posture of the back, the posture of the arms and the posture of the legs. The middle column of the table shows the scheme that has been made according to the photographs received, and the right column shows how the ideal posture should be according to the scheme used by OWAS (Table 8).

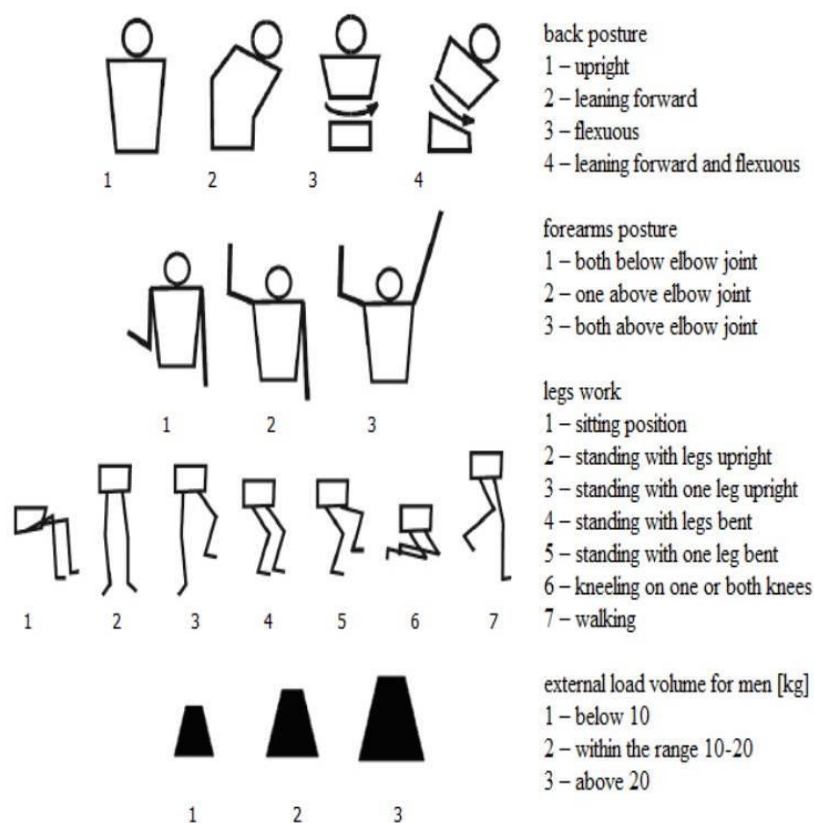


Fig. 59 Body position code with OWAS method; Source: Keyserling W.M., Postural analysis of the trunk and shoulders in simulated real time, Human Factors, Ergonomics 29, 1986.

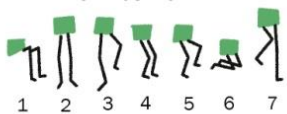
CATEGORY	CURRENT WORKING CONDITION	IDEAL WORKING CONDITION
1. BACK POSTURE  1 2 3 4	 1	 1
2. FOREARMS POSTURE  1 2 3	 1	 1
3. LEGS WORK  1 2 3 4 5 6 7	 4	 1

Table 8 Ovako Working posture analysis system (OWAS) between current and ideal working condition of home office employees; Adapted from Reyes 2021

3. 6 SUMMARY

The information obtained from the case studies shows that remote work is a reality today but that it also existed before, therefore, through product design it has been possible to respond to this work methodology at different times. Despite the fact that new technologies and the equipment with which we work are changing over time, simplifying in its form more and more. It was possible through the case studies, to observe an essential part when proposing a product to work. In the 3 case studies, a smooth work surface was the main component that they all had in common, which was an important point to consider when making the product proposal.

In the case of the questionnaire, it was found that most of those working from home, did not have a specific workspace suitable for their work activities. One of the main reasons was that they had never worked from home before the SARS-COV19 pandemic, so they had not given importance to this activity at home. However, if they would have had the possibility of having a dedicated space to work, most of the employees would have preferred it. The fact that the employees did not have adequate space and equipment for working purposes increased incorrect body positions. This was perceived through the photographs received from the participants of the

questionnaire. Through the photographs, it was also noticeable what kind of main equipment employees were using. This matched with the three case studies, in which employees considered as the main element a smooth base to place their work equipment. Despite not having all the appropriate conditions to work, the employees were satisfied working under this method and did not mind doing so as long as it is allowed. As seen in the literature review, working remotely from home is increasing. The SARS-COV19 pandemic showed that employees were able to respond satisfactorily to their obligations. Therefore, companies have chosen to maintain this work method; which justifies the objective of this research and the subsequent project developed: The design of a product that is suitable for workers who perform remote work from home.

4.0 THE PROJECT: DESIGN FOR THE HOME OFFICE WORKSTATION

4.1 USER

The target user group of the product is dedicated to users who are working in administrative and marketing areas, as well as the majority of the participants in the questionnaire, these are the users who currently state that they are still working under the hybrid work methodology. According to the questionnaire conducted for this research, 15.4% of the participants are involved in sales/business development, 12.3% in marketing, and 11.5% in finance. Furthermore, according to the study conducted by Adobe in 2021, Forbes magazine reports that the most digitally mature organisations that are currently using their processes digitally to work from home are in the areas of sales (65%), marketing (57%), and human resources (28%).

Main characteristics of the user:

- 25 - 45 Years old
- Do not live alone
- Work on hybrid form, 2-3 days per week from home
- Work position in marketing or administrative areas

4.2 PRELIMINARY PROGRAMME

The product did not focus on a design for a seat, because in the results of the questionnaire 66.2% of the users showed that they use an office chair for working, therefore it was not taken into account as the main need.

- Smooth surface , minimum depth of 65cm. To allow for a monitor to be placed depending on the user, more to the front or more to the back. (It is recommended to place it at the approximate distance of the arm length of each user to have a better posture). The rounded front and back edges allow to smooth the surface and reduce the effect on circulation when resting on the desk surface. Surface with a semi-matte finish to avoid reflections.

- Base with intelligent connections (USB) and power sockets; powered through a cable that connects to a standard power socket
- Base that allows adjustment to 3 different heights 7-11-15cm for the laptop screen or the monitor of a desktop computer
- With swivel casters and brakes on the base for easy mobility
- Adjustable desk height (hydraulic mechanism) between 73 and 120cm
- Switch for raising and lowering the surface
- Elements to enable visual privacy and noise reduction
- Elements which can be used to place notes, and pictures, or to hang headphones and other small objects
- Secondary elements for producing a neutral background set and extra privacy
- Hooks for bags or garment
- Task lamp, removable and with flexible shape/orientation
- With multipurpose components or element which allow optimization of space versus functionality

4.3 CONTEXT DEFINITION

The environment for which the product is intended for any home. Inside the home, the users may use the product in a specific studio to work or in spaces with dual functionality such as bedrooms, social room, dining room or kitchen. In the exterior, the garden, patio or balcony with flat and levelled pavement was considered a suitable setting. The environment should have natural light or artificial light and have at least one electrical outlet. In addition to lighting, the environment should be ventilated and in case of use in the exterior should be a dry area.

4.4 CONCEPT

The product aimed at practicality, ease, intuitive use, versatility, and adaptability. Furthermore, so that the product could adapt to different types of environments, simplicity and straightforwardness of design were a goal. Figure 60 summarizes the concept. Based on the information gathered from the questionnaires, the product should also respond to the 4 activities that most users stated to carry out when working:

1. Management-related work using software such as (Word, Excel, PowerPoint, etc.)

2. Participating in videoconferences

3. Making and receiving calls

4. Doing presentations using PowerPoint, Prezi, google slides, canva , etc.

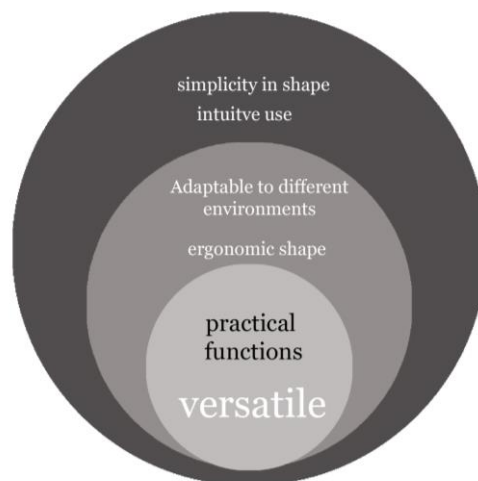
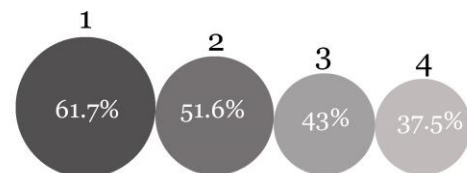


Fig. 60 Product concept summary; source: Author

4.5 IDEATION AND PROTOTYPING

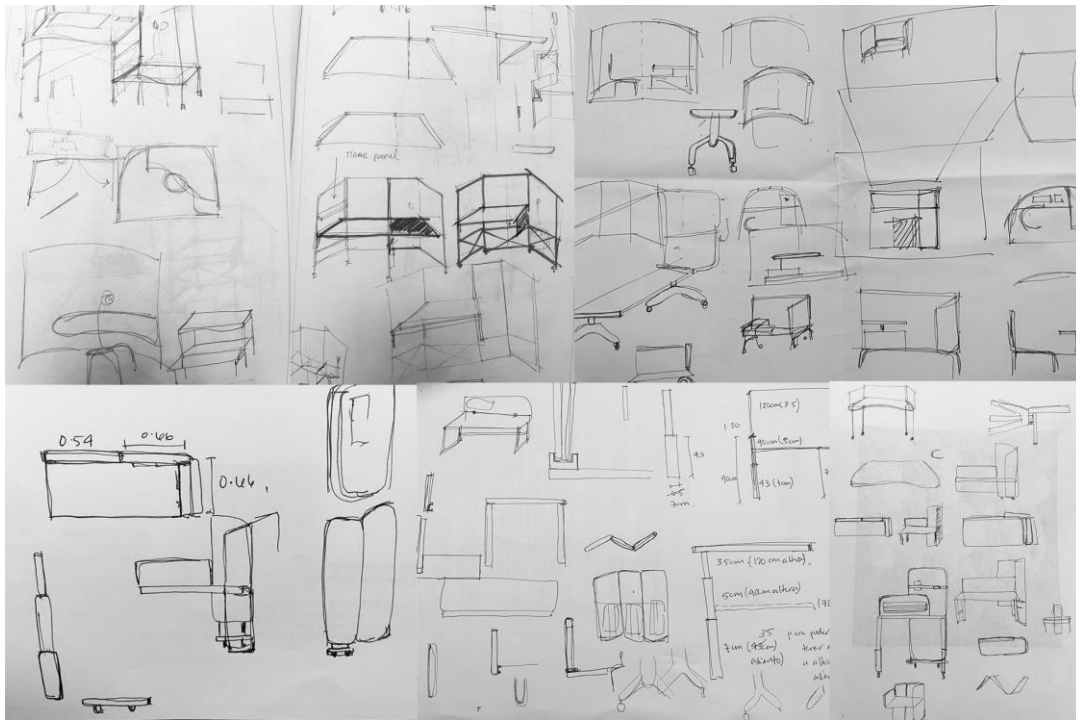


Fig. 61 Sketching process

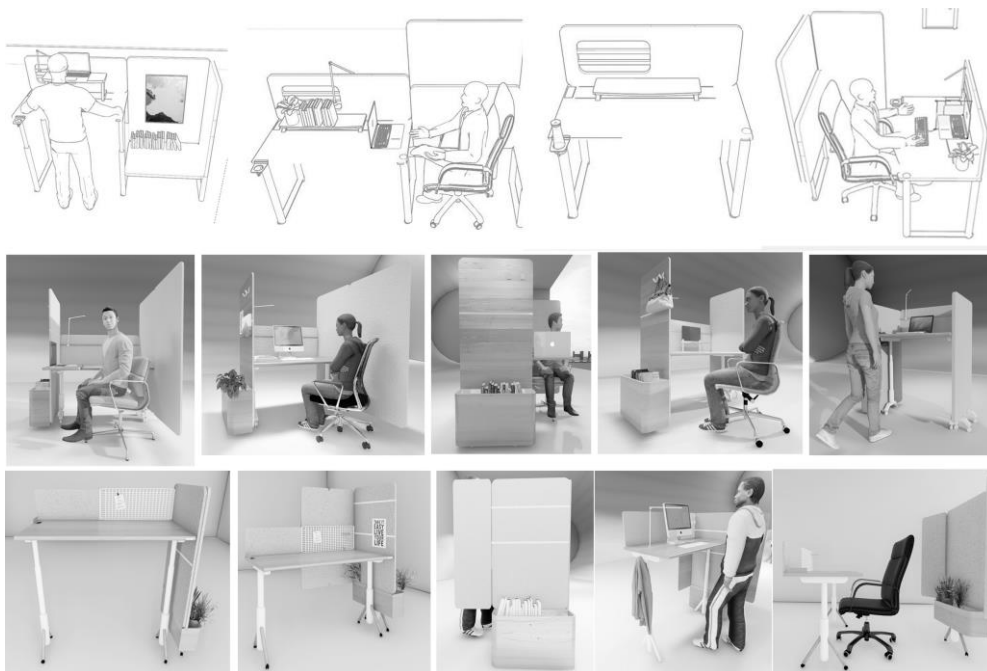


Fig. 62 prototyping process

4.6 PRODUCT DESCRIPTION

When designing the product, the aim was to find a well-thought-out and targeted solution to the need to work from home, but with the main focus on the concept of an activity-based workspace. The main objective was to create a product which supported working at home; one that improves the conditions of the users' work equipment, positively contributing to productivity, creativity, and comfort when performing all work activities, but that also supports different dynamics and daily activities which arise while at home. This is how the Multesk proposal was born. The design of Multesk is simple. Allows for adaptability to different forms of use, according to the activities and needs of the users.

- **Main Idea:**

- To increase the user's comfort through a product that supports, facilitates, and improves the conditions for carrying out day-to-day work activities.
- Create the configuration of a work table in which, different elements allow the product to adapt to the different needs and activities at home; adaptability in the environment, versatility in use, easy transport, and multifunctional; but also meet the appropriate characteristics of a desk to be able to work. To design a suitable solution for the growing demand for working from home.

- **Shape:**

Inspired by the rectangular shape of a conventional desk but with attention to materials and details; such as the curved edges on the main base and the vertical panels that can be opened or kept closed depending on the user's need, when working or the situation of the work environment. The simplicity in form allows the user a clear and intuitive use of the product.

- **Function:**

The product explains by itself its main function, to allow the user to do his work: to use a laptop or desktop, to receive and make calls, to make presentations, and to make video conferences. However, Multesk leaves room for user self-expression. This

works mainly thanks to its simple design approach, which makes the product easy to understand allowing users to benefit from its desktop or coffee table features.

- **Differentiation:**

- The versatility in the design of Multesk, allows it to be used as a desk with adjustable heights but also as a coffee table; multesk allows the panels to be used as room dividers at home when open and closed; these can also be used as creative panels for sticking notes, images, photos, etc, responding to the style of each user and also has the base to be able to store different objects. This multifunctionality in its use favours and supports the different dynamics that may exist within the home.

- Although other desks may have much more risky shapes, they do not take into account elements such as: room dividing panels; nowadays, as we have seen in the theoretical framing, when working at home many different dynamics can be carried out at the same time during the working day, therefore, an element that provides privacy and absorption of sounds that may affect concentration.

- Other desks do not take into account in their design the height at which the laptop or desktop is held, and therefore their design does not include any element that allows the adjustment of these, causing bad postures.

- Other desks generally do not take into account the task lamp, as in the case of multesk.

Multesk is composed of two main elements: A desk station and the vertical panels.

- **A desk station:** composed of a smooth main base with waterproof MDF veneered in walnut or oak with dimensions of 120x65x4cm; the main base has rounded front and back edges to reduce the contact effects on circulation. This base is supported by a coated aluminium structure, which can be hydraulically adjusted in height with a switch on the right side with buttons for raising and lowering. The height of Multesk can be adapted according to the user's need, if the user wants to work sitting down or if the user wants to take a rest break and work standing up. Multesk can be adjusted from a standard work table height of 73cm up to a height of 120cm which is the ideal work table height for a person with a height of 185cm. In addition to the ability to adapt to the height of the user, Multesk can be adapted as a coffee table with a height of 37cm, this versatility

allows to use multesk for example when the user needs a coffee table for a meeting with friends or family, or simply a table to place objects. Thanks to its morphology and materiality, it can be adapted to different environments (Fig. 63).

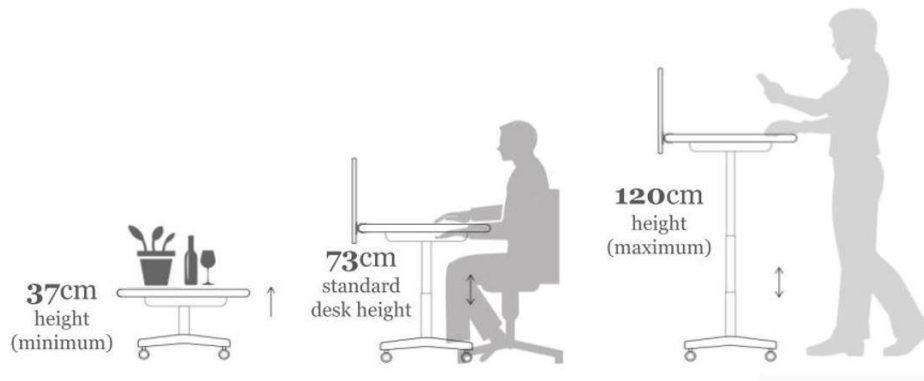


Fig. 63 Multesk height adjustment

The structure that allows height adjustment and that which supports the smooth base is composed of a structure formed by an aluminium tube in vertical position and a horizontal structure of 45 cm in length, which works to give the supporting structure more stability. The horizontal element has rounded edges to avoid bumps; this structure is supported by swivel casters and brakes, which allows easy handling and mobility. The braked castors allow the product to be parked and prevent movement when working; however, it is suggested not to use it in spaces with grass or stone pavements to avoid wear and tear. The vertical structure has a hook for bags or garment and is located on the left side at the bottom.

To the smooth surface three different elements can be attached:

- A detachable panel composed of two elements at the front of the base, serves as sound absorbing element, but also serves as a dividing panel to give more privacy. This left element is composed of a 2cm thick sound-insulating material element with absorption class C, fire protection class B according to EN-13501-1. On the right side is the second element, an aluminium grid with a semi-gloss finish in black or white that allows placing the headphones, paste notes and give greater visual lightness by not being a completely closed panel

in its entirety. The complete panel format with the 2 elements is 120x41x2cm (Fig.64).

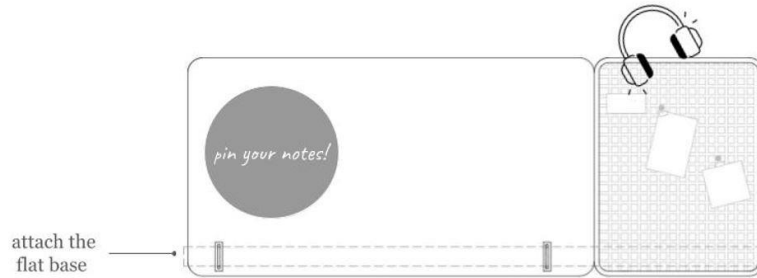


Fig. 64 Detachable front panel

- A structure that allows to adjust in three different heights (7-11-15 cm) the monitor or a laptop; allowing to keep the position of the head and neck straight. This structure can slide through the double groove on the surface of the desk, allowing the computer to be placed in the center of the desk or on the sides depending on the activity and comfort of the user. For example, if the user needs more or less free space for the computer, or to write notes, put a book or documents. This structure is composed of two L-shaped elements, which are kept rigid and joined by a piece in the horizontal. The structure is in black or white semi-gloss aluminium, and the base that serves as a support for the laptop or monitor is in MDF veneered in oak or walnut semi-matt 1.5 cm thick. To the left of the structure smart plugs and USB sockets area located (Fig. 65).

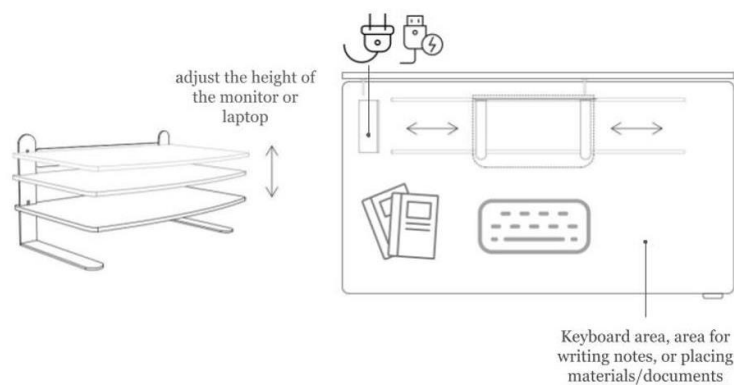


Fig. 65 Components of the flat base

- A Flex lamp, this can be in black or white aluminium with a semi-gloss finish. This flex lamp can be directed to provide task lighting in the case of insufficient ambient lighting. Its flexible shape allows it to be opened or closed and positioned according to the user's needs.

The vertical structure, the smooth surface, the structure to adjust the height of the screen and the task lamp can be chosen in different finishes: the wooden elements can be in waterproof MDF veneered in oak or walnut and semi-matt finish avoiding the creation of reflections and easy maintenance. The aluminium parts can be chosen in black or white aluminium with semi-gloss finish. This allows to make several combinations and to adapt it to the different environments in which the users live.

- **Vertical panels:** composed of 3 vertical elements that can be opened and closed (Joining mechanism by means of hidden hinges on the sides of the structure, giving a greater lightness and visual cleanliness). Its main function besides absorbing sound is that they serve as a neutral background when videoconferences are held. The three panels when open, serve as a dividing wall of 130x160cm in height, serving as a partition inside the house. These panels are made of sound-absorbing material, absorption class C, and fire protection class B according to EN 13501-1. Dimensions of the central panel are 65x125cm high, side panels 32.5x125cm high with a thickness of 2 cm, and a walnut or oak wood border to give the product more warmth. The central panel contains an elastic at the top that allows you to place images or notes on the panel. This structure has in the lower part an element that works as a storage compartment and that allows it to store materials or documents necessary at the moment of working or belongings that the users have in general; like umbrellas, books, bags, or also serves as a base to put plants. This structure has pivoting wheels with brakes hidden in the lower part, making it easy to place it anywhere. This lower element with curved edges is made of waterproof MDF veneered in oak or walnut and semi-matt finish, with dimensions 65x30x35cm in height. Like the other elements that make up Multesk, these panels can be chosen in different finishes; it is recommended to use a neutral tone. The material of these sound absorbing panels can also be

used to pin ideas, paste quick notes, photographs, posters or whatever the user wishes to personalise the space (Fig. 66).

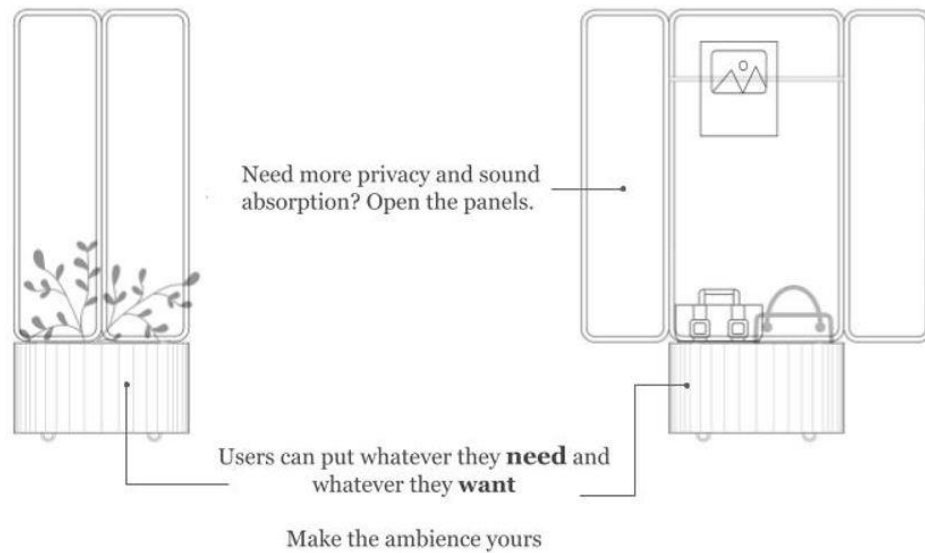


Fig. 66 Vertical panels

The technical drawings of the entire product with the respective dimensions, materials and finishes can be found in appendix 2.0.

- **Materials**

Sound absorption panels



Fig. 67 possible panel colours

-2 cm thick felt acoustic absorption panel. The material is made from recycled PET - bottles.

-It absorbs and reduces disturbing noise, providing a pleasant, better quality room acoustics. Absorption class C, highly absorbent, fire protection class B according to EN 13501

-The easy-care felt surface can also be used as a pinboard

- For the different shades of the acoustic panels 6 colours were chosen: a neutral colour palette, if the space where it will be used is very small or dark the user can use the lighter shades. The objective of having this variety of shades is that the user can choose the tone that most benefits them according to the characteristics of the user's home environment and that gives more personality to the workspace.

Aluminium



Fig. 68 possible colour finishes for aluminium

For the rigid structure that supports the smooth base to work as well as the task lamp and the grid to place notes or hold the headphones, aluminium has been chosen for its various characteristics and properties (Djukanovic, 2016): Waterproof and odourless, corrosion-resistant, ductile and malleable, easy to manufacture, high weight/strength ratio and finishing possibilities. For Multesk, the two finishes chosen are black or white.

Waterproof MDF



Fig. 69 possible MDF colours

-It is excellent support for wood veneers, which gives the appearance of solid wood.

-It is ideal, especially where there is a risk of occasional exposure to moisture, being a product to be used at home, being waterproof is the best option for the durability of the product.

-One of the great advantages of MDF over solid wood is its price, much more competitive.

For Multesk options are oak or walnut wood veneer with a semi-matt finish for the desk surface, the curved edges of the panels, and for the base used to store objects.

Multesk is not only a sit-stand desk, in which the height can be adjusted from 37cm to serve as a support table to a work table with a height of 120cm for standing work but it is also characterized by its other functions. All in all, Multesk allows users to perform their activities more easily and conveniently and is characterized by its simplicity and adaptability due to its morphology and materiality. Multesk has a distinctive design and brings a sense of lightness due to its curved shapes and the contrast of materials and colours. Figure 70 shows all the elements that make up Multesk.



Fig. 70 Multesk elements

1. flat base with rounded edges
2. Smart USB plugs and sockets
3. Sound-absorbing front panel and grid for headphones or pin quick notes
4. Task Lamp
5. Structure for monitor or laptop height adjustment
6. Hook for bags or clothing
7. Vertical structure
8. Horizontal structure
9. Swivel casters with brakes
10. Sound-absorbing side panel and ambience divider panel
11. Storage compartment with curved edges
12. Swivel casters with brakes
13. Elastic for hanging notes, posters, pictures.
14. Switch for height adjustment

All the features that make up Multesk, make it a unique and differentiating product to work from home. Facilitating the work activities that the user has in their day to day, but also has the ability to adapt to the different dynamics that may arise at home.

4.7 3D PRODUCT RENDERS



Fig. 71 Multesk perspective when it is a desk with standard height



Fig. 72 Multesk perspective when is a stand desk



Fig. 73 Frontal perspective of Multesk



Fig. 74 Side perspective of Multesk



Fig. 75 Multesk perspective when panels are opened to perform as a neutral background for videoconferences



Fig. 76 Perspective of Multesk when it works as coffee tables and in different finishes

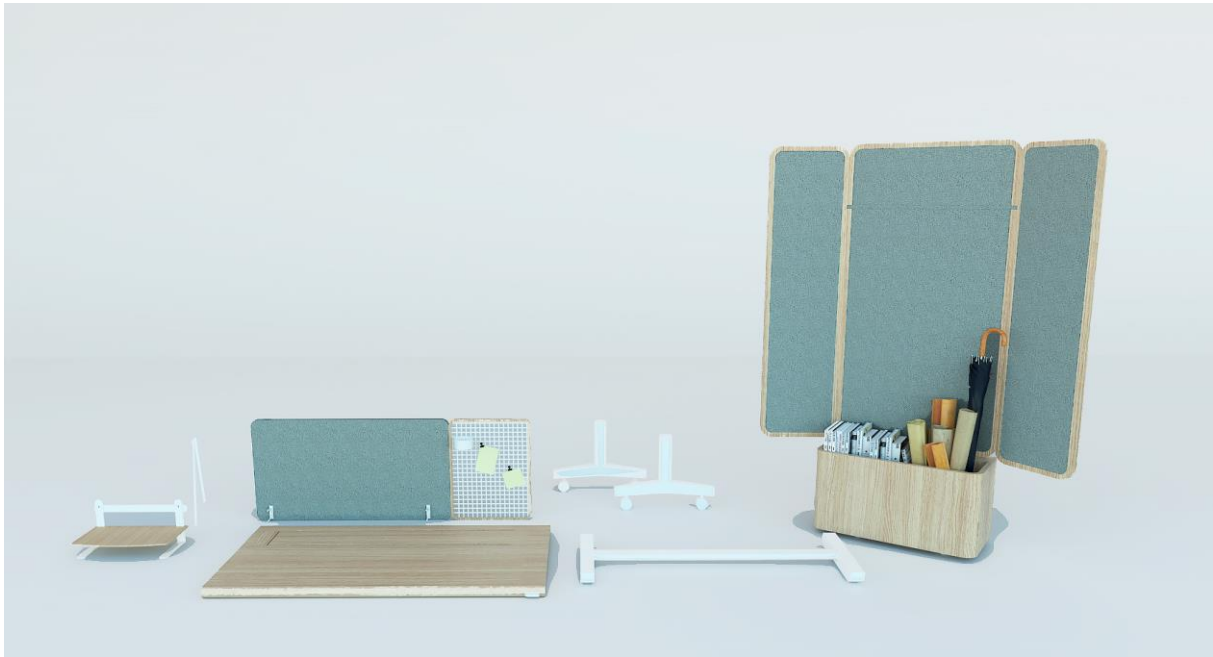


Fig. 77 All the Multesk components



Fig. 78 Multesk in a home environment



Fig. 79 Multesk in a home environment next to the kitchen



Fig. 80 Multesk in a home environment inside the bedroom

FINAL CONSIDERATIONS

Through this research it has been possible to address the issue of workspaces in a comprehensive manner, starting from the origins to the present day of hybrid work. The topic of the home office was the main focus throughout the research. The studies presented in the theoretical framework showed that the reality of the home office is a change in work dynamics, that has become adopted and widely accepted as normal. Although working remotely got accepted by many employees, the aforementioned studies and this research proved that the conditions in which the work was performed, did not meet the recommended workstation characteristics and therefore, could result in health - concentration problems or even affect productivity in the tasks.

Because working remotely suddenly increased by the SARS-COV2 pandemic, employees did not have the possibility to create adequate work environments. This underlined the importance of this research: to fulfil the needs of employees and improve conditions in which the activities were performed, by the creation of a product that meets all the necessary characteristics to create a “home office”. The theoretical framework that was used served as a research basis to support and propose the design of the product, including the materiality, the characteristics of the elements, the morphology and the function. The completion of the questionnaire was important in order to truly understand the different situations that users experience when working from home. This part of the research also provided the necessary guidelines to find out what activities the employees carried out most at home, as well as the equipment they used. From this information, the needs to which the product should respond were listed. To respond to all these needs, a desk station was created which, in addition to being a surface for working while sitting or standing, can also be used as a coffee table due to its adjustable height. This desk is also complemented by a vertical element composed of 3 panels that function as a sound insulator but also as a partition inside the house, to provide better privacy in the spaces. The main objective of this research, - to create a product proposal for working from home-, has been achieved.

For future studies, when conducting a study of this type, ideally an observation of the postures that employees have while performing their tasks should be carried out. However, due to the pandemic, this observation could not be carried out for this investigation. Similarly, for future studies, a prototype could be made on a human scale, where only an evaluation by the users would make possible the collection of adequate data on the effectiveness of the project.

Hopefully, this research will be used in the furniture design industry for developing a product. More value should be given to the creation of products that allow work to be done from home in an adequate manner, but that also integrates into the changing dynamics that arise in the day-to-day life of the home. The research wants to make designers aware that they should pay as much attention to ergonomics, as to the aesthetics of the products that they design. This would ensure that products are not only innovative but are also comfortable for the user.

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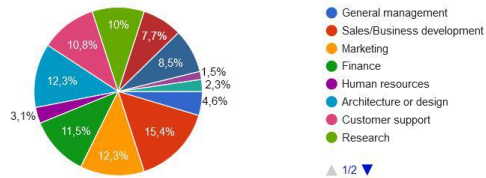
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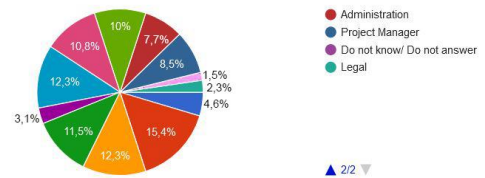
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APPENDIX 1: Questionnaire results

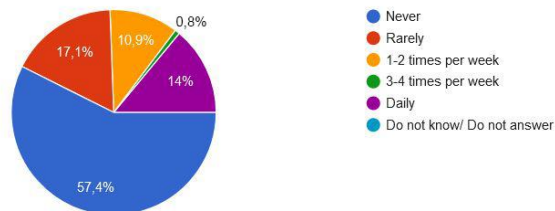
1. Which is your work field/area?



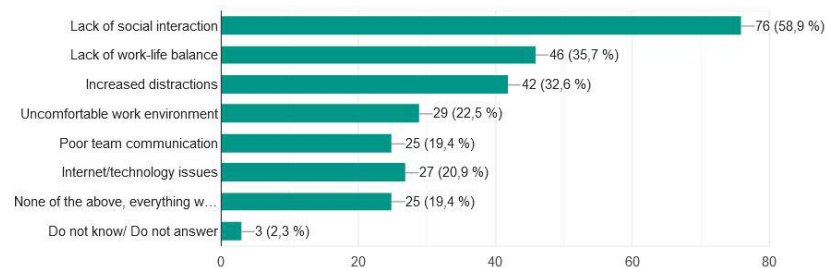
1. Which is your work field/area?



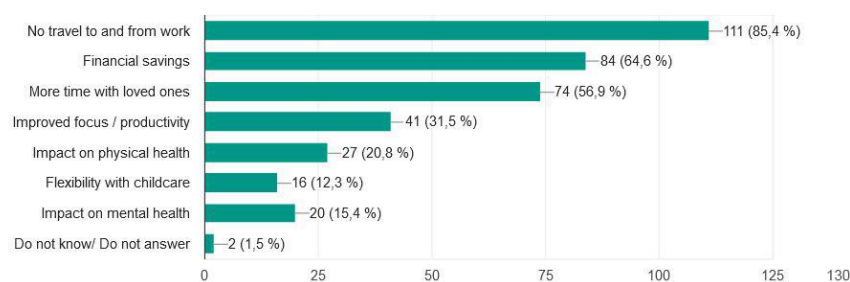
2. Did you ever work from home before the coronavirus outbreak?



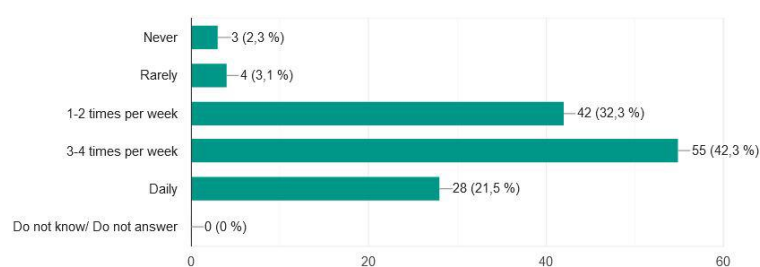
3. What is it about working from home that you do not like? (Select up to 3)



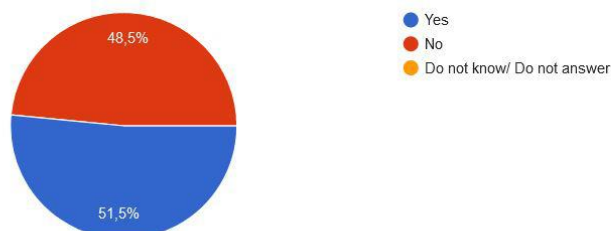
4. What is it about working from home that you do like? (Select up to 3)



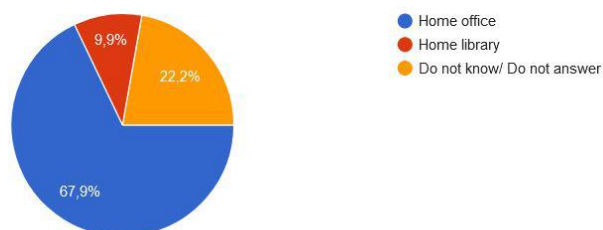
5. If your company allows it, how often would you like to work from home in the future?



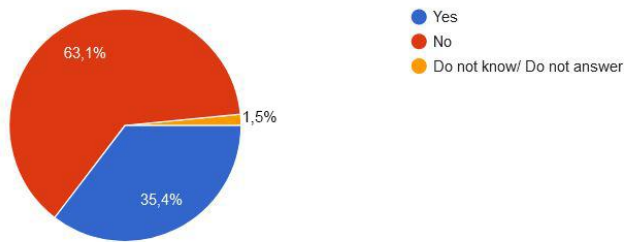
6. Do you have your own work space at home?



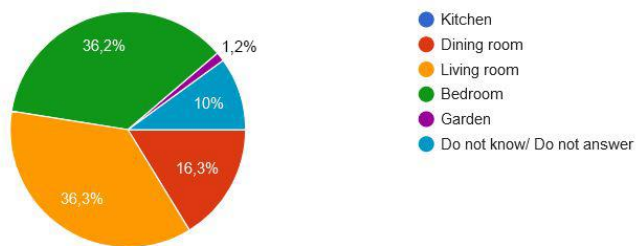
7. If your answer in question 6 was yes, where do you work?



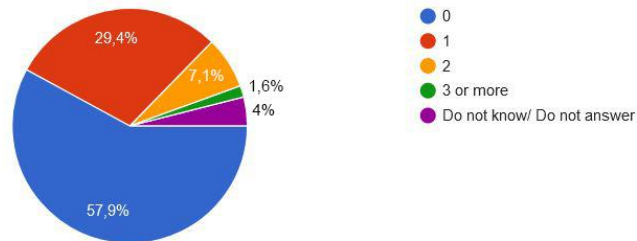
9. Do you share that space with other people?



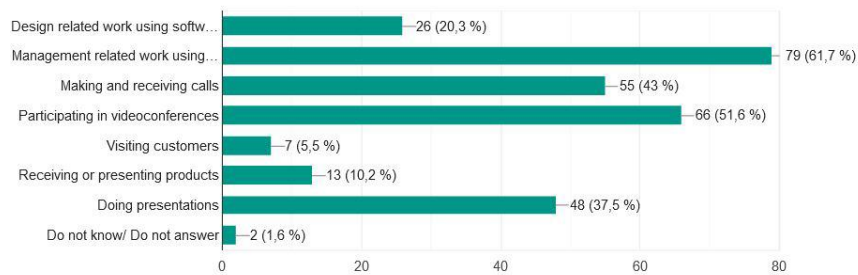
8. If your answer in question 6 was no, where do you work?



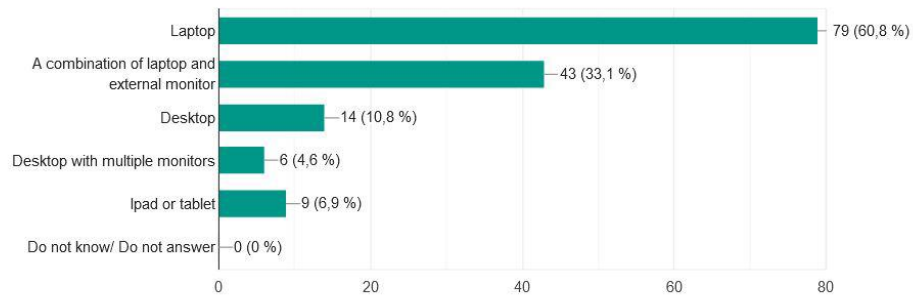
10. With how many people do you share the workspace?



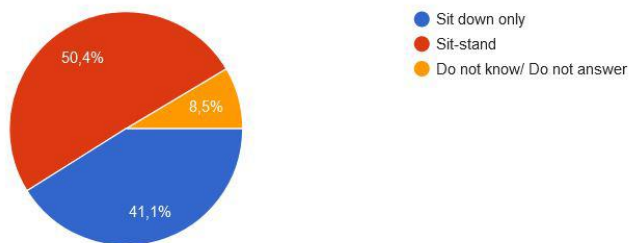
11. What are your daily activities? (Select up to 3 if necessary)



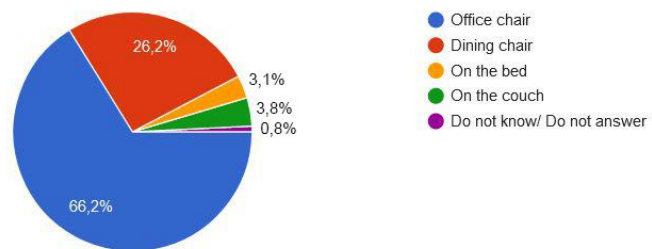
12. In your current home office situation what type of equipment do you use?



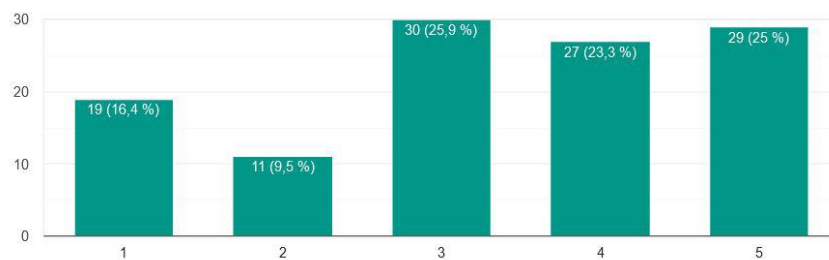
13. If your company provides you with a desk, how would you like it to be?



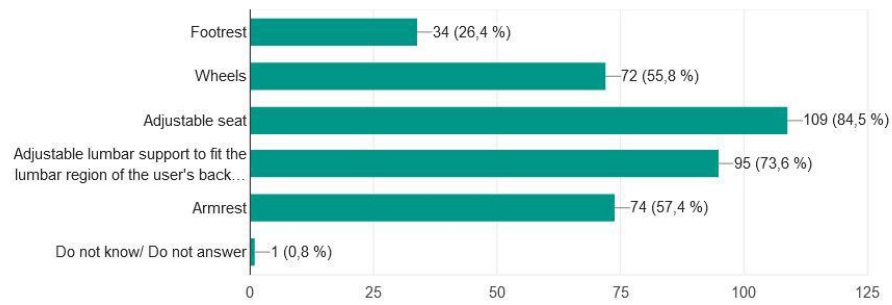
14. In your current home office situation, where do you sit?



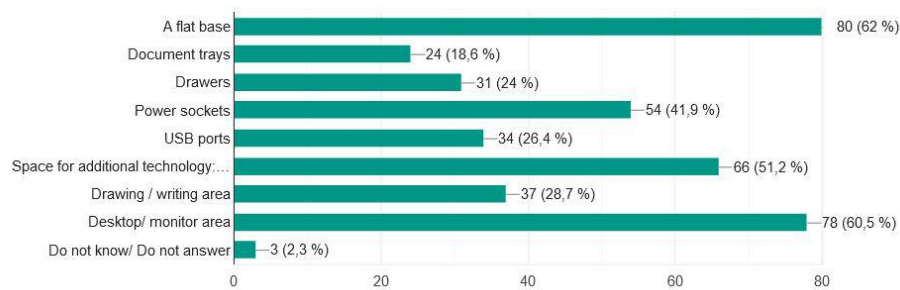
15. If your work chair has armrests, how much do you use them? Scale 1 to 5



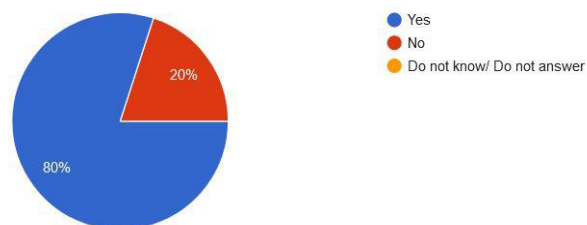
16. Check the elements you find necessary in a chair for working remotely



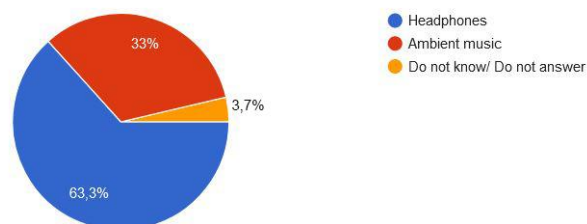
17. From the following elements a desk can have, which are essential for providing you a comfortable work environment? (Select up to 3)



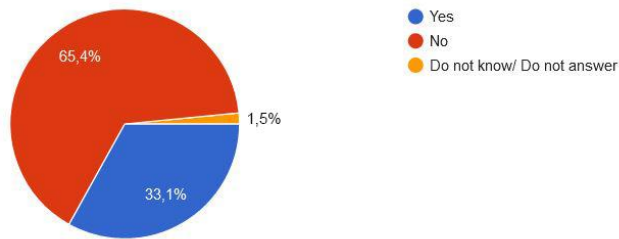
18. Do you listen to music during work?



19. If your answer above was yes, how do you listen the music?



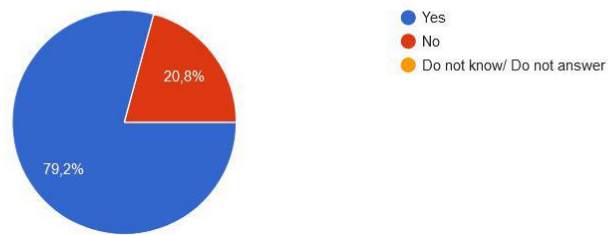
20. Do you find that ambient/neighbourhood noise interferes with your work?



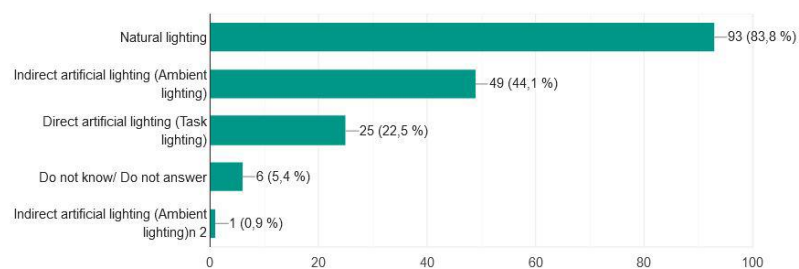
21. If your answer above was yes, what kind of measurements do you take in order to minimize the noise in your work space at home? (Please specify)

- I just close my bathroom's door
- Close all windows and doors
- A good pair of headphones and closing the windows.
- Nothing
- Close all windows, mite mic
- Listen to music, close the window
- I close the window and put my headphones.
- Headphones
- Wear headplugs during meetings or turn off the radio.
- Estar más aislado en una habitación más lejana a la entrada principal
- I have to close the windows
- Lock my windows and use the air conditioner
- close the windows, use headphones
- Close doors
- Closing window
- Music with headphones
- My neighbours have had construction work for the last year but otherwise, the area is very quiet
- None
- Just change of the place when i need in a call
- Not much I can do about it
- Using headphones
- Close the office door
- Close windows and doors, use headphones
- I have to mantain the window closed at all times due to construction (noise reducing windows)
- closing windows and listening to music
- People talking outside
- wearing Headphones
- I use headphones to control surrounding sounds while I work
- Listen to music
- Move to different room
- Close the window and doors
- I used to work at the living room, and moved to the bedroom to minimize the ourdoor noise. I bought noise canceling headphones.
- Using more times headphones
- I close everything
- Work with closed windows

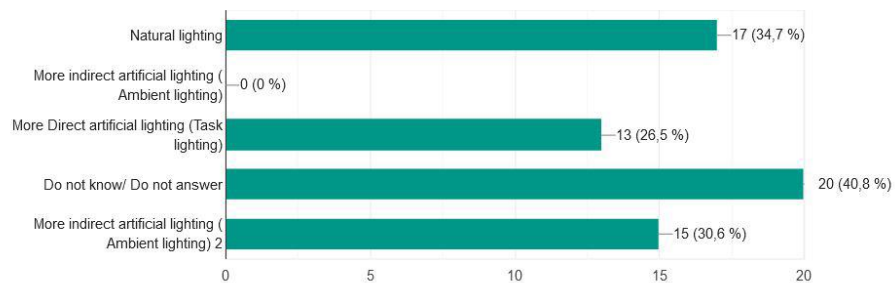
22. Do you find that you have appropriate lighting to develop your work in a comfortable manner?



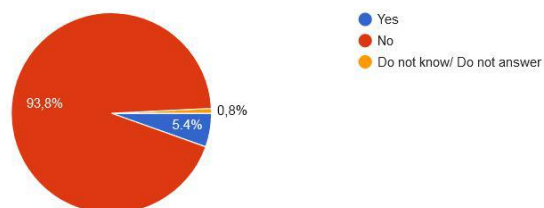
23. If your answer to question above was yes, how do you measure that you have appropriate lighting at home in your work space? (Select up to 2 if necessary)



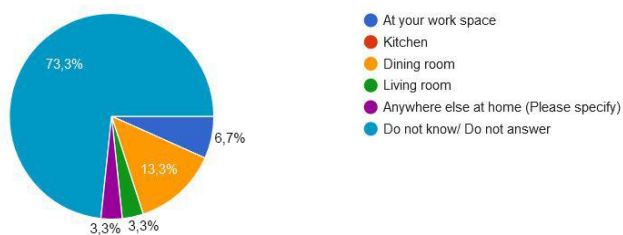
24. If your answer to question 22 was no, what are you lacking to have the appropriate lighting conditions? (Select up to 2 if necessary)



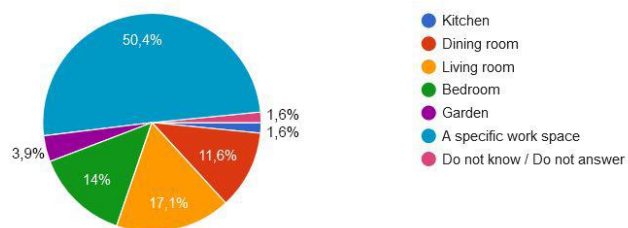
25. When you were working from home, did you receive colleagues at home for work reasons?



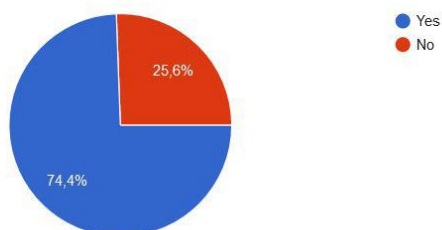
26. If your answer above is yes, where did those meetings took place?



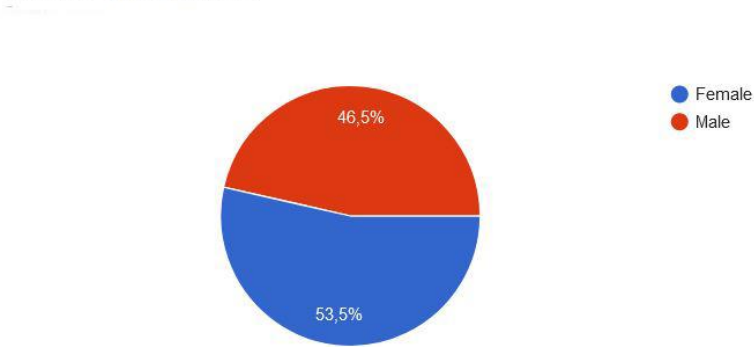
27. Thinking about your home, which space would you choose to work in?



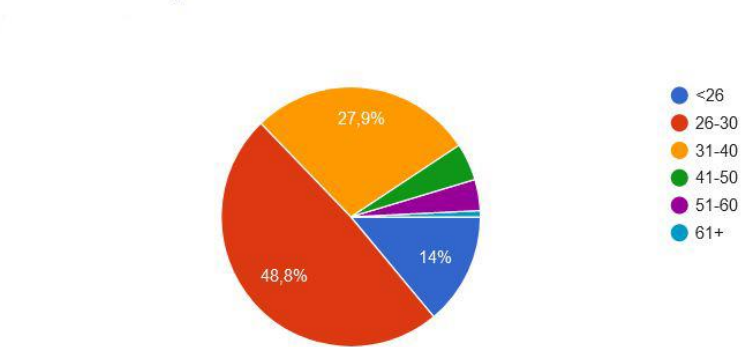
28. During the confinement did you work there or are you working there?



29. What 's your gender?



30. How old are you?



31. Who are you currently living with?

