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WORKPLACE DESIGN FROM A SUSTAINABLE LIFELONG PERSPECTIVE

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Abstract: *This paper explores ways in which ergonomics increase the sustainability workplace by creating a multifunctional workspace. The analysis of the remote-working and workplace was done according to the variable factors on which the ergonomic design depends on. Ergonomic aspects and the construction of green workspaces receive attention from both the employer and employee, depending on where the work is carried out, representing an essential condition of well-being and implicitly and performance. This study shows us that the teamwork is important for development human resources using the observation and focus group. Also, presents the results obtained from the study the variables of the ergonomic design in the three ways arrange the workplace, using the least squares method for classic job and remote work.*

Key words: *Ergonomics, sustainability, future workplace, design, green workplace.*

1. INTRODUCTION

Between ergonomics and sustainability there is a common point of view of the well-being of human resources. This link provides the premises for the creation of new working conditions and urges organizations to develop the workplace, either at home or in a common space created by the employer.

We will follow the importance of ergonomic design in both workspaces and determine the level of comparative design of the two work environments.

This link provides the premises for the creation of new working conditions and urges organizations to develop the workplace, either at home or in a common space created by the employer [1].

Ergonomic principles refer to furniture in the case of an office and follow the optimum between employee – medium. [2].

The furniture must be properly placed, functional and aesthetic. It is also taken into account that the arrangement of the furniture is not fixed in time, which is why we prefer modular furniture, consisting of small bodies, removable and easy to move. The physical and mental health of the employee depends on this arrangement. The office chair plays an important role for any employee who works predominantly in the office [3].

For work from home, it is recommended to use the 5S technique, built on Japanese principles: Seiri sort, Seiton establishes an order, Seiso shine consists in cleaning the workplace, Seiketsu standardization, Shitsuke supports change.

Flexibility is needed in the practice of work to reduce the risks posed by safety and health. The relationship between the employee and the work environment has physical repercussions, but also mental, based on stress, effects with direct termination in affecting performance and productivity. A reorganization of the workspace, of the means used, the introduction of teamwork has become essential for an increase in quality and efficiency in work. Good management will focus on these ergonomic directions that are proven to lead to sustainable development [4].

Sustainable design refers to the balance between what is built from an ecological point of view and the combination of resources and innovations. Sustainable design brings clean materials, elements that can be modified over time, with lower energy requirements and the possibility of recycling [5].

The concept of sustainable development was released as it turns out from [6], when by the Brundtland Commission focused on environmental sustainability: the survival of the planet but also paid significant attention to social sustainability, as well as the need for a new era of economic growth that is socially and ecologically sustainable, as well as socially responsible.

The EU adopted its first Sustainable Development Strategy at the Gothenburg European Council in 2001, followed in June 2006 by the renewed Sustainable Development Strategy for the enlarged EU. The document defines sustainable development as follows: "Sustainable development means that the needs of the present generation should be met without compromising the ability of future generations to meet their own needs"".

Ergonomics refers to understanding the relationships between people, machines and the environment, designed to optimize performance and human well-being.

Ergonomic design is essential for human resource development. Green design is the reflection of greening to improve human well-being without negative influences on the environment. It involves the use and arrangement of furniture in an ecological, natural way. Another term used is sustainable construction which implies a high performance, qualitatively built-in terms of energy, safety, functionality and cost-benefit ratio [7] as in Figure 1.

Fig. 1. Sustainable Development Goals [8].

The aim of the Objective is Decent Work and Growth is to promote inclusive and sustainable growth, decent work and employment, social protection for families, so that all women and men have equal opportunities at work [9].

Moreover, in November 2017, the European Pillar of Social Rights was launched at an EU summit in Sweden. The vision of the pillar was to find the best solutions to achieve economic development and growth, good working conditions and social protection.

"The aim of the European Pillar of Social Rights is to serve as a guide for effective employment and social outcomes when addressing current and future challenges, which are directly aimed at meeting people's basic needs and ensuring better implementation and implementation of social rights" [10].

Ergonomic office interventions on how to arrange and purchase furniture do not require costs as high as the costs of health care, which affects the entire organization [11].

Ergonomic conditions must be investigated and included in the approach to sustainable development. "Integrating sustainability with ergonomics could create important opportunities for researchers and practitioners to capture attention and promote new working conditions. Thus, companies are increasingly involved in social responsibility projects related to well-being at work or sustainable development jobs.

A well-organized office, tailored to the employees, can bring efficiency in the work. Noise, light, personal space and climate must be considered. Each workspace is unique, and ergonomic design must be maximized on this uniqueness. This information can be obtained through observation, questionnaires and other discussions with employees. Because a small organization with a large staff requires creative design solutions. These solutions contribute to changing the organizational culture. Ergonomic desk increases efficiency through satisfaction [12].

Over the decades, the concept of sustainable work has been developed. In the context of the labor market, the sustainable labor force provides good conditions for those who enter jobs, promoting the conditions of people at work, health, well-being, good working conditions, learning, productivity, growth.

As Docherty et al. (2009, p.7) presented the principles of sustainable work at work as follows [13]:

„The opportunity to develop as a person, professional and member of a society through work experience is a fundamental human right:

- Sustainability of human and social resources is one of the foundations of economic sustainability.
- Sustainability in the workplace is one of the foundations of social development and the sustainability of society as a whole [13];
- The sustainability of human and social resources is necessary to ensure ecological sustainability, "because only people and groups that operate sustainably are able to understand, prioritize and work for ecological sustainability" [14].

Ergonomics has a direct connection with human resource management. Ergonomic principles relate to all working conditions provided to employees. The advantages brought by achieving the ergonomic objectives refer to the motivation of the employees, the development of their social and psychological realities and implicitly to the increase of the productivity. The purpose of ergonomics is to obtain the well-being of the personnel involved in the work. "Work is the key to connecting people and creating a better world. By increasing productivity, creativity and human connectivity, we can develop sustainable solutions to global challenges" [15].

The relevance of office work has been questioned, and distance work is encouraged nowadays with the rapid spread of the pandemic. This was a trend just before Covid-19, which is why functional solutions made it possible to work efficiently, high technology offset face-to-face communications. In addition to high work efficiency, distance work has limited socialization and sometimes affected mental health. What is the future of work and how has Covid-19 changed the design of future jobs? How can we set up a job for future needs? Does Agile Work / Hybrid Work Help Organizations Achieve Maximum Potential and
Increase People's Happiness and Productivity?

2. RESEARCH HYPOTHESES

From the beginning of the 20th century, spacious open offices were common. The office activity was controlled by the manager who worked in front of the employees [16].

We want to show how this method is old and deprecated and now, the trend is teamwork. Even if it was proved that the teamwork leads to development of human resources, we have proposed to prove this starting from the five variables which influenced the ergonomic design in three mode arrangement workplaces. The aim of the research is to demonstrate that teamwork in a correct ergonomic arrangement of the workspace leads to a pleasant climate, good results and implicitly obtaining performance.

Knowing that remote working can be designed as the person wants to work, we thought, according to those studied to propose a design consisting of an office, with lamp, laptop and smartphone, an ergonomic office chair, placed at the window to respect the indication to rest at 20 minutes of work by directing the gaze to a space as far away as possible. Next to the window, we thought of a rocking chair, which will be used for recreation and meditation, facing the window, also for a more pleasant mental climate. In the corner next to the door, we placed a sofa to relax for lunch and stretch my back and limbs as needed. Near the desk, a potted plant will bring extra oxygen and aesthetics [14].

The relationship between the job and the perception of it can lead to changes in the perception of resources human. Based on the literature on workplace design, it is expected that ergonomic improvements in workspaces should be related to changes in perceptions of workplace ergonomics. The paper presented here expands the specialized literature and proposes certain arrangements of the furniture for the ergonomic redesign of the position, as a means of improving the health of employees and obtaining performance through optimal development (Figure 2).

Fig. 2. Designing the workspace for online work.

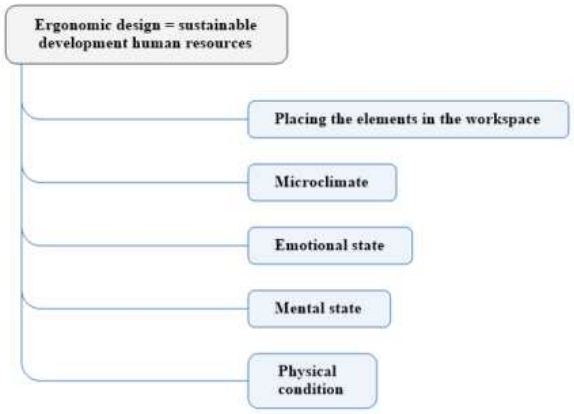

Fig. 3. Variable elements of ergonomic design.

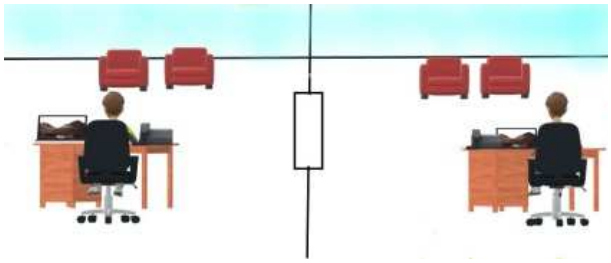

Fig. 4. Arranging individual furniture in the workspace.

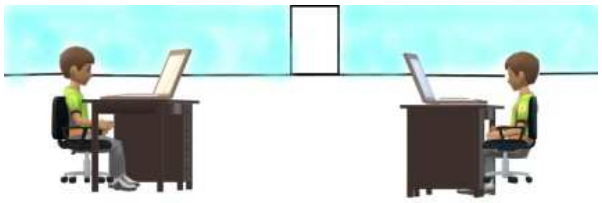

Fig. 5. Arranging the furniture in a binomial way in the workspace.

Fig. 6. Arranging the furniture in teams of four.

The employees were forced to think about their living space so as not to disturb too much the standard organization of the house, but also to find an optimal way to carry out their work tasks. This helps organize telework without putting pressure on your personal life. The trend is towards coworking, a hybrid system, as a prediction of the future.

Research into ways in which ergonomics increases the sustainability of human resources started from the premise that this design is dependent on five variables, namely: physical condition (*a)*, mental state *(b),* emotional state *(c)*, microclimate *(d)* and placement of elements in the workspace *(e)* represented in Figure 3.

These variables are individual factors, with certain singular percentages, which lead, in sum, to the maximum percentage of ergonomic design *(PE)*, with direct implications on the development of sustainable human resources (*DDRU)* as we show in the equation (1).

$$a+b+c+d+e=PE=DDRU\,. \qquad (1)$$

We aim to investigate whether this hypothesis is valid in three ways of arranging the furniture and whether the ergonomic design is more important at home than at work to obtain DDRU.

3. RESEARCH METHODOLOGY

In the first stage of the research, we saw of three different ways of arranging the furniture and based on the discussions in the focus group of experts we established points from 1 to 10 for each variant, where score 1 is the weakest and score 10 is the best.

The same team was subjected to three different ways of arranging the furniture in the workroom, for three months, one month for each variant and it was observed how people behave. During this time, the five variables that can influence the result were followed, i.e., the increase of performance through sustainable development of human resources.

In the first hypothesis, the furniture was arranged individually as in Figure 4 and each person worked individually. In the second hypothesis, the furniture was arranged as in Figure 5 and employees worked in pairs; and in the third hypothesis, the arrangement was as in Figure 6 on working groups. Ergonomic design was discussed in focus groups of 10 people in total and based on the method of least squares, we will make predictions of the level of ergonomic design (PE) in the two workspaces for sustainable development of work (DDRU).

In the first disposition, the individual one, the scores are lower, the activity not being one of development, but rather of stagnation, capping, through physical, mental and emotional states at the level of subsistence. In the second disposition, we noticed an increase of the variables, which leads to a slow but improved progress.

However, the variant of arranging the furniture compatible with teamwork is superior to the other two in all the variables pursued. In particular, the variable of the placement of the elements in the workspace is noticeable, an aspect that interests us particularly in this research. The way furniture is arranged can bring people closer and further away, who will work and have results depending on how they feel, how they cooperate, how they relate and find solutions to the organization's problems.

Teamwork has once again proved to be beneficial, conducive to human resource development. This way of arranging the furniture leads people to a unitary whole, to mutual complement and lasting results as it looks as shown by the scores given by the focus group in Table 1.

In the second stage, we analyzed work at home, where the workspace is strictly arranged individually and according to personal preferences and the workplace arranged by the employer and we found common and different points between these workspaces. This stage is an auxiliary of the basic research because remote work is compared with the singular work from the first arrangement proposed by us in the study. This step is necessary to emphasize the importance of ergonomics regardless of the workspace and for the research results where we have outlined the importance the ergonomic design for development of work in the two workspaces different – remote- work and job classic.

As a research method, in addition to observing the different arrangement experiment, we also used the Venn-Euler diagram, through which we looked for common points in remote-working and the classic job.

The workplace environment changes through mobility and movability of a virtual and sustainable Lab.

Table 1

Observation of ergonomic design variables

Variables	**Arranging the furniture for individual activity**	**Arranging the furniture for the activity in binomial mode**	**Arranging the furniture for activity on teams of four**
Physical condition	7	8	8
Mental state	5	7	9
Emotional state	6	7	9
Microclimate	7	8	8
Placing the elements in the workspace	6	8	10

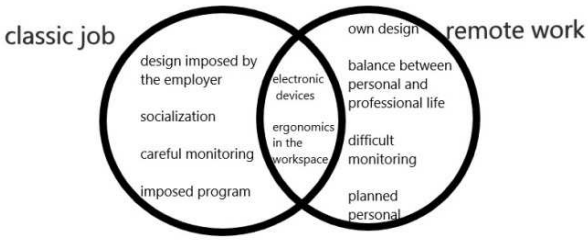

Fig. 7 Chart Venn-Euler remote-work and classic job.

The New Bauhaus initiative connects the European Green Deal to our living spaces**,** it challenges us to imagine, build together an inclusive and sustainable future inspired by art and culture, in harmony with nature to encourage free dialogue between genders, cultures, disciplines in a healthy, productive work environment. The place to connect people from all fields of culture, education, science, administration, sharing a common place that is open to innovations and changes. The ergonomic digital lab is addressing to all three

core values of the New European Bauhaus sustainability, aesthetics, inclusiveness.

4. RESEARCH RESULTS

Following the studies, we found that remote-work and classic job have in common the use of electronic devices; they do not cease to be used unless the nature of the work is different and the importance of ergonomics in the workspace. As different points, we noticed after a focus group carried out in education and public administration, as remote work, brought the possibility of a proper design of the workspace, after the possibilities, of course, created a certain balance between professional and personal life and allowed employee involvement in work time planning. Monitoring by superiors was more difficult, and could not be permanent, but not impossible, but rather random and after the results obtained. In the case of the classic job, the difference is the socialization, the ergonomic arrangement according to the wishes of the employer, the work being carried out according to a fixed schedule, carefully monitored.

Applying the least squares method and according to the ergonomic design predictions in Table 2, we will calculate the amounts per column denoted by S1, 2, 3, 4 for the classic job and for remote-working and we get the results from equation (2).

$$\begin{matrix} S1=80; S2=81; S3=660; S4=661 \\ S1=88; S2=86; S3=784; S4=762 \end{matrix}. \quad (2)$$

For the analysis of the ergonomic design from the classic job, the regression equation is:

$$DDRU = a + b \times PE. \quad (3)$$

We will calculate a and b as a system of equations with the data in table 2 and we will obtain the equation (4):

$$\begin{matrix} 10a + 80b = 81 \\ 80a + 660b = 661 \end{matrix}. \quad (4)$$

The calculation will result a= 2,9 and b=0,65. The regression equation obtained is:

$$DDRU = 2.9 + 0.65 \times PE. \quad (5)$$

We will continue to make predictions of the level of ergonomic design starting from this equation in situations where it would be 9, respectively 10 and we obtain DDRU=8.75 respectively 9.4. We can see that between the estimated and the real values, there are some differences (8.75 estimated compared to 9 obtained, respectively 9.4 compared to 9). These differences represent estimation errors.

For the analysis of the ergonomic design from remote work, we have the following system of equation:

$$\begin{matrix} 10a + 88b = 86 \\ 88a + 784b = 762 \end{matrix}. \quad (6)$$

The calculation will result a= 3.84 si b=0.54.

The regression equation obtained is calculated, again wih the date from table 2 in equation (7).

$$DDRU = 3.84 + 0.54 \times PE. \quad (7)$$

We will continue to make predictions of the level of ergonomic design starting from this equation in situations where it would be 9, respectively 10 and we obtain DDRU=8,7 with estimation error of 0.3 respectively 9.24 with estimation error of 0.24. The development of human resources increases, respecting a certain function compared to the variable of ergonomic design of the workspace. We notice that ergonomic design tends to be more important for the employee to work from home, the comfort demands being higher, but not enough for sustainable development, due to other factors, such as ability, skills, motivation.

Table 2

PE predictions for obtaining DDRU

#	PE (x) Classic job	DDRU (y) Classic job	PE^2 Classic job	PE×DDRU Job classic	PE Remote work	DDRU Remote work	PE^2 Remote work	PE×DDRU Remote work
1	10	9	100	90	9	9	81	81
2	8	9	64	72	8	10	64	80
3	7	8	49	56	7	8	49	56
4	9	9	81	81	10	9	100	90
5	6	5	36	30	9	9	81	81
6	7	7	49	49	10	10	100	100
7	8	10	64	80	8	7	64	56
8	10	8	100	80	9	8	81	72
9	6	7	36	42	10	9	100	90

10	9	9	81	81	8	7	64	56

With the help of the least squares method, the statistical method, we had the opportunity to make predictions from the focus group and even if we do not find perfection of a relationship in the real world, we can make estimates of one variable according to another, in our case, predictions of human development according to ergonomic design.

5. CONCLUSION

Ergonomic design is a key factor in obtaining good, efficient work results, referring in essence to the well-being of the employee, who is at the center of successful activities. In a favorable environment, with furniture arranged according to the employee's needs, with a pleasant climate, with a physical, mental and emotional state, the human resource develops sustainably. Remote work brings a comfort in addition to the classic job, but also higher demands and needs from the employee, who no longer blames the employer for their creation, but belongs to him quite directly.

Following the research of this aspect, we find that the level of ergonomic design in the case of remote work tends to be higher compared to the level of ergonomic design from the classic job.

As research limitations, it is considered that ergonomic design can be designed in other ways, in which the study of variables has not been performed. Also, the focus group was limited and the predictions varied according to the current moment.

As future directions, we intend to investigate the reasons for this finding, for the time being assuming, from discussions and personal experience that it can be a substitute for socialization that is missing in the case of work from home or lack of motivation.

At the classic job, the interaction between the employees makes them more practical, which, in fact, we have shown in the table with the three types of furniture arrangements, where it is observed that teamwork with physical interaction is beneficial for human resources development.

Future studies should be focused on musculoskeletal disorders evaluation in relation with the workplace design [17-19] due to the changes occurred during the pandemic period and considering occupational health and safety issues from the practical perspective [20]. In addition, the new methods and tools for the ergonomics intervention and optimizations could be better acquired using knowledge and innovation transfer from the international communities of ergonomists (as suggested by [21]).

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Designul locului de muncă dintr-o perspectivă durabilă pe termen lung

Aceast articol explorează modalitățile prin care ergonomia crește locul de muncă durabil prin crearea unui spațiu de lucru multifuncțional. Analiza postului de lucru la distanță și a locului de muncă s-a făcut în funcție de factorii variabili de care depinde designul ergonomic. Aspectele ergonomice și construcția spațiilor verzi de lucru primesc atenție atât din partea angajatorului, cât și a angajatului, în funcție de locul în care se desfășoară munca, reprezentând o condiție esențială de bunăstare și implicit și de performanță. Acest studiu ne arată că munca în echipă este importantă pentru dezvoltarea resurselor umane folosind observația și focus grupul. De asemenea, sunt prezentate rezultatele obținute în urma studiului variabilele designului ergonomic în cele trei moduri de aranjare a locului de muncă, folosind metoda celor mai mici pătrate pentru munca clasică și lucrul la distanță.

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