

Article

Digitization in the Design and Construction Industry—Remote Work in the Context of Sustainability: A Study from Poland

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Abstract: The article presents the results of research on the digitization of services provided by the design industry in the context of the implementation of sustainable development goals, especially environmental sustainability. First, a literature review has been done. These research goals were established in the publication: investigating the impact of remote work on the implementation of sustainable development goals (in particular, environmental), examining the essence of better perception of remote work and digitization of the design process by employees of the design and construction industry, and examining barriers and factors favoring the digitization of the design and construction industry in Poland. Both a survey and interviews were carried out. To analyze data obtained from the interviews, the Colaizzi's methodology was performed. The data obtained as a result of the survey were subjected to a statistical analysis using a cluster analysis (Ward's method). Groups (clusters) of strong and weak barriers, supporting factors, and sustainability factors were defined. The COVID-19 pandemic has perpetuated the digitization trend in this industry. Employees and owners of project offices prefer remote work due to the flexibility of working time, time savings, work comfort, safety, and savings. Industry employees recognize the advantages and benefits of remote work in terms of environmental sustainability. The environmental impact in the form in the reduction of electricity consumption by large office buildings and reduction of the emission of harmful substances contained in car exhaust fumes are the most frequently mentioned environmental advantages. The biggest barriers are legal aspects, and sometimes difficult cooperation with a client. The research results presented in this publication, as well as the methodology adopted, are a contribution to the literature on the perception and comfort of remote work, the social effects of the COVID-19 pandemic, and environmental sustainability.

Keywords: achieving sustainable goals; remote work sustainability; digitization of designing services; Industry 4.0; digitization and sustainability; designing and building sector remote work



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1. Introduction

In recent years, the process of digitizing services has become increasingly common, affecting, to varying degrees, all industries. The pandemic has undoubtedly accelerated the trend towards leveraging the potential of technology for a variety of purposes, including that of improving business sustainability. The focus of this study is on the design and construction industry to explore the possibility of leveraging remote collaboration between designers, architects, suppliers, and clients to reduce, at least in part, the environmental damages produced by an industry that is highly exploitative of natural resources. Progressive automation of industrial processes also applies to the design and construction industry. The speed of information flow, innovation in the supply chain, automation of many elements of the design process, and cooperation between members of the project team, as well as direct electronic communication, fit in with the idea of Industry 4.0. [1]. It becomes justified and important to conduct research not only on its development and the

impact of a pandemic on the speed of its development, but also on how employees and people who use these tools perceive work with its usage.

A very important aspect with respect to digitization in this industry is the fact that the construction industry itself is very polluting to the environment. Due to the high level of natural resource usage, there is a need to find solutions that can reduce the harmful impact of this industry, even by affecting its other aspects and processes that are connected to construction. It is also worth paying attention to the plan of the new generation of the European Union. It provides for the allocation of significant funds to the energy efficiency of buildings. Interfering with elements related to the implementation of the design process itself, including the introduction of a remote work model or the provision of design services, may prove to be an effective way to reduce the harmful impact of this industry on the natural environment and a step toward environmental sustainability.

A research gap was found based on an analysis of the existing literature [2–9]. A lack of results related to employee preferences and remote work environmental sustainability's influence on the design and construction industry was found. Taking into account the aforementioned literature that has been analyzed and the methods that have been usually used to study aspects related to remote work management, as well as employee satisfaction with this form of work, the use of the phenomenological approach in the article, and the data analysis obtained in interviews is an innovative approach. This article finds its place in the literature on the digitization of services in business, in particular on issues combining aspects of environmental sustainability and employee welfare, as well as barriers and implications of the digitization process of the industry in Poland.

We think that the construction industry differs from other industries because it involves many stakeholders and agencies in its functioning [10]. Due to that, there is a very extensive need in the case of information management and knowledge management, with a good basis for the digitization of this industry. The construction industry also depends heavily on its contractors, and is dependent on seasonal labor force [11]. Those linkages to other organizations also need an extensive information management system. A very important problem related to this industry is its productivity and the way of its measurement, as well as the hazards [12].

We think that due to the specifics of the construction industry, an analysis of its functioning in the pandemic time may be a very interesting case from a cultural point of view. In particular, the aspects connected with remote work and its advantages and barriers are a very interesting topic from a cultural point of view.

The aim of the research was to determine the opinions of employees in the design and construction industry about remote work, then to select employees who prefer remote work and to determine the reasons why they consider it more efficient and comfortable in the context of sustainability. The following research questions were posed:

1. What are the reasons why remote work is preferred by employees in the design and construction industry?
2. How is the impact of remote work on the natural environment and sustainable development perceived?
3. What are the barriers and obstacles to digitization of the design process?
4. What are the factors that contribute to the digitization of the design process?
5. What are the most relevant environmental factors in terms of sustainability of a digitized design process?

The paper is articulated in order to first present the literature on digitization in the design and construction industry (enablers and barriers), with a focus on remote working (remote workers' preferences in terms of, for example, efficiency and quality of work, relationships with the business environment, and technological tools for remote work). The second part of the literature review raises issues connected to environmental sustainability in the design and construction industry, as well as other industries, with a focus on the role of remote working in reducing the environmental impact of this industry. It also highlights the context of sustainability in the various areas affected by the pandemic and

digitization of industry. The work covers three current areas. The first is the comfort with and perception of remote work by employees. The second area is the social and occupational effects of the COVID-19 pandemic. The third is environmental sustainability in the design and construction industry. The research results presented in the paper contribute to the literature on the three above-mentioned aspects. The research results provide reasons for the preference for remote work and show accelerated digital transformation regarding the example of the discussed industry and the approach to remote work as a social result of the COVID-19 pandemic. Another aspect is the contribution of the publication to the literature on environmental sustainability using the example of the design and construction industry, in which the desire to balance it can be achieved on the basis of compensation, which was mentioned at the beginning of the article. It is worth mentioning the aspect related to the care and environmental awareness of employees and business owners operating in the industry in question.

Our research had two stages, according to phenomenological analysis method. The first stage was the questionnaire, and on the basis of this questionnaire, we selected people for the second part of the research, the interview. In our research, we send a questionnaire to 50 employees in the design and construction industry. On the basis of the phenomenological approach, we selected 40 that were interleaved using the Collaizzi method.

2. Literature Review

The digitization of services in various fields is a trend that can be observed over the past decade. The COVID-19 pandemic has dramatically accelerated this trend [13–16]. Many industries that previously offered services that previously seemed impossible to provide digitally had to try to transform their activities and adapt them to the conditions of the pandemic. Many industries that previously offered services that seemed impossible to provide digitally had try to transform their activities and adapt them to the conditions of the pandemic [13]. However, a question should be asked: “How does the digitization of services affect both the comfort of work of employees and the quality of these services, as well as the implementation of the sustainable development goals?”

2.1. Digitization in the Design and Construction Industry

In an effort to stay in the market despite the need to temporarily stop providing fixed-line services, companies have been forced to use electronic means of transmission and communication. Some services and business processes had their equivalents in the form of digital goods before the pandemic. This trend is present in design and construction industry. There are also threats that are related to the services and processes in the construction industry. The design and construction industry is a special example of ongoing digitization and the opportunities that arise from it. There are both benefits and difficulties that can affect project offices, their employees, and also owners of these enterprises. This industry is a special case of not so much total transformation, but as the evolution of digital business. Apart from the standard difficulties encountered by many industries and enterprises, it is worth paying attention to the benefits and facilities. This industry is already partially digitized, and the use of information technology makes the design process susceptible to digitization of more and more of its aspects.

The benefits and difficulties with barriers accompanying the digitization of design services are presented in Table 1 [16–19].

Table 1. Benefits and difficulties in design industry digitization.

Benefits	Difficulties and Barriers
Accessibility digital strategy	Too many tasks in time to change the structure of enterprise without affecting the usual operation of the enterprise
Flexibility and easier adaptation	Lack of ability to change strategy and adapt to new conditions
Strong leadership	Lack of personnel's digital skills
Building skills to adapt to new conditions and implementation of changing strategy	Workers of different ages
Decentralization of digitizing process	Lack of abilities and willingness to learn new digital skills
	Lack of technical skills to create new infrastructure inside a company
	Integration of the organizational structure between the new digital and old traditional models in the moment of transitioning
	Reengineer existing business models

Source: authors' own work based on [16–22].

The literature on the preferences of engineering students in the field of design is interesting. Research has shown that the teamwork of these students is rated 4 on a scale of 1–5 (1 = bad, 5 = very good). Students assessed satisfaction with their projects in the same way, and aspects such as team support, adequate work time, and clarity of instructions given by instructors were highly rated [22]. The great advantage of the remote work model for private entrepreneurs, including small companies such as design offices, is that there is no need to buy real estate for offices or rent premises. This becomes very important in an era of a pandemic [23]. There is also a theory that the future of remote work has already started, and will concern future generations, the young, and those already working [23]. Remote work itself has so far been shown in the literature as contributing to greater employee satisfaction due to offering them a flexible work model, giving them trust, etc. Most empirical studies confirm this hypothesis and indicate a higher degree of effectiveness of employees working remotely. There is, however, a study that contradicts it, pointing to a slight decrease in effectiveness in relation to stationary work [23]. It should also point to research that shows certain barriers to the digitization of the design process. Despite the old age of this publication, aspects such as “information being lost” when shared by project team members still seem relevant. Another aspect is the maintenance of “double documentation”, a hybrid form of document circulation, despite digital equivalents. Such behavior can be encountered in many companies operating in the markets of different countries. This is due, among other things, to barriers caused by legal regulations [24]. The design and construction industry itself, in the cited publication, suffered at that time from a lack of coherent systems that supported the entire process, from design, to information exchange and contact with contractors, to construction, and finally, to acceptance of the finished building [24]. In the mid-1900s, research was conducted on the remote work model. The publication [25] presents a simple and still-used model of remote work, in which people who participate in the process and have access to the Internet to exchange information also have access to a user interface consisting of modules such as [25,26]:

- Project management planning;
- Design management;
- Procurement;
- Cooperation area;
- Managing the project team.

The information exchanged by team members and contractors, as well as the management, is transferred to the database [25].

2.2. Environmental Sustainability in the Design and Construction Industry, as Well as Other Industries

Digitization of services and broadly understood digital transformation are often perceived as an effective and efficient way to achieve some of the goals of sustainable development. The transformation process has a different entry threshold for companies operating in different sectors. Depending on the sector and business profile of the companies, different sustainability goals can be achieved [27–30]. In the design and construction industry analyzed in the publications, it is hard to directly reduce the consumption of natural resources. Therefore, it is possible to influence other elements of the process by trying to compensate for the harmful activity to the environment.

Digital marketing fits in with the idea of achieving sustainable development goals, in particular in environmental aspects. Research using the example of companies operating in the tourism industry has shown that digital marketing is beneficial for sustainability. The hypothesis of the positive impact of digital marketing on the use of natural resources, including the benefits for the local population (employment and development of crafts and handicrafts), has been confirmed [31,32]. The COVID-19 pandemic has caused enormous havoc in industries and economies around the world. However, some studies show the massive use of digital resources and the digitization of services, processes, etc., have led to improvement in some environmental issues [33–35]. The COVID-19 pandemic, despite its negative effects, has resulted in [36]:

- Many countries uniting in the fight against the pandemic;
- New sustainable development plans being established that take into account threats and crises;
- Communication and drawing solutions inspired by other countries, both in terms of combating the pandemic and in terms of sustainable development.

Other aspects in the context of sustainable development related to global impacts after almost 2 years of the pandemic consider climate change. Opportunities and threats in building and designing resilience in the context of COVID-19, as well as finding a balance between health and social, economic, and environmental aspects, should also be considered and described [37]. Digitally offering goods that were previously available in a physical manner allows us to realize numerous sustainable development plans and ambitions, as well as the overall maintenance of community functioning [38,39]. Taking into account the aspects of sustainable development in the context of the design and construction industry, the digitization of the design process, including relations and activities between members of the project team, contacts with contractors, etc., is a participation in the pursuit of environmental sustainability through: “healthy built environment through resource efficient and ecologically sound processes, preservation of ecosystems, and maintenance of natural balance between development and carrying capacity of this planet” [40].

During pandemics, a lot of attention in science is paid to environmental issues [41–43]. Most studies related to the implementation of the sustainable development goals in the context of COVID-19 have been published in disciplines related to environmental science. There are numerous studies on the following aspects: work environment, hospitality, recreation, sports, tourism, education, and health policy [43].

Similarly to the design and construction industry, education is another sector that was quite easy to digitally transform from an organizational point of view [44,45].

Considering the issues related to the exploitation of marine resources, interference with the natural world, and nature, one can easily notice a change in the approach to tourism described in scientific publications.

COVID-19 has become a kind of catalyst that allowed for a greater understanding of how contradictory tourism can be in terms of achieving the goals of sustainable development. On the one hand is economic growth, and on the other is the absolute need to acquire valuable and limited resources of land and the natural environment [46,47]. The influence of the COVID-19 pandemic on industry and technological development is causing a huge economic crisis, and is leading to change in industries around the world. The situation in

these sectors is similar to that of the design and construction industry. On the other hand, the pandemic can be considered the beginning of a large-scale digital transformation in industries (and various areas of life). Nevertheless, serious problems affect the entire global supply chain and value system. [48–53]. However, this situation led to an extremely rapid digital transformation of the various industry sectors. The need to omit the risk factors related to direct contact with other people is the main motivator in the development of digitization among enterprises. It can maintain the continuity of its services with partial or complete digitization of the services provided so far [54]. Factors accelerating digitization in industry due to both the cause of pandemic and Industry 4.0 strive to include [55–57]:

- Promoting remote work and striving to reduce the paper form of documentation for environmental reasons;
- Tendency to completely abandon paper in favor of electronic procedures, processes, and daily duties;
- Restrictions related to movement within and outside countries;
- Quarantines, home isolation, and the business impacts are partially mitigated by platforms for remote communication, filling, and signing documents, etc.;
- A global trend lasting for years consisting of offering more and more goods in digital or hybrid forms;
- Industry 4.0 assumptions of digitization and automation of production processes.

The pandemic-related crisis has created supply chain problems in the renewable energy sector. Another problem is difficulties in the stock markets regarding the risk of not being able to take advantage of government incentives that end at the end of the year. The behavior of investors is unstable due to uncertainty in the industry [57]. We need a constant analysis of the energy demand while maintaining the balance of the savings application. This also applies to industries and innovative solutions. In the context of the digitization trend and its use, it is worth paying attention to the balance of energy use. Improving energy efficiency in digitization is an engine of economic growth. Unfortunately, it is a source of an increasing demand for energy. One of the major remote work consequences in the construction and design industry is a reduction of energy consumption due to the lack of use of huge office spaces both during the day and in the afternoon. However, a study in India showed that as lockdowns were lifted and social freedom was restored, energy consumption began to increase after a temporary drop due to lockdowns [58]. Electricity will be crucial in the near and long terms to maintain progress and technological development [59,60]. This shows how important it is to take care of the environmental aspects, even in an industry that by its nature is harmful to the environment. It is worth making various attempts to compensate for industrial activities harmful to the environment. The role of the economy and legislative and governing bodies in managing design processes in such a way that they can give optimal results in the context of the allocation of economic resources becomes important as well in connection with rational management of natural resource management [61].

An important issue related to digitization is noise reduction in city centers. The impact of the pandemic on noise reduction is shown by research conducted in Stockholm, Madrid, and Dublin [62–64].

The next issue related to pandemic changes in an industry context is waste management. There is an increase in the amount of medical waste as another important area affected by the COVID-19 pandemic. However, there is a decrease in the amount of domestic and industrial waste [65]. Despite a small change in greenhouse gas reduction, it cannot be considered as satisfactory. Unfortunately, serious problems have occurred in renewable energy sector [65–67]. In terms of waste management, there is a need to develop and manufacture biodegradable and environmentally friendly disposable personal protective equipment (masks, gloves, and coveralls) so that we can continue to achieve sustainable production while reducing environmental costs [68,69]. The examples given in the literature review should be combined and refer to the design and construction industry, which is characterized by a high consumption of natural resources. By using remote work,

it is possible to at least partially reduce its negative effects; e.g., in the fields of natural energy consumption and waste management, and the impact on utilities consumption. This can be achieved on the basis of the aforementioned compensation by influencing one another in the industry. The issues presented in this review of the literature, related to remote work and environmental sustainability not only in the design and construction industry discussed, but also in other sectors that influence and interact with each other, show the importance of the research carried out and the potential contribution to the literature of the presented article. The issues discussed concern both remote work as perceived by employees and its effects and perception. These posts have a background in environmental sustainability. It shows the complexity of the topic and the value of the literature contribution of the presented publication.

3. Materials and Methods

During the COVID-19 pandemic in Poland, it is estimated that approximately 8.9% of the employees worked remotely [70]. The research was carried out among 50 employees in the design and construction industry. The research was carried out in different regions of Poland. Each employee was interviewed and asked to complete the questionnaire. The interview was partially categorized. Topics related to the provision of design and construction services in a digital manner were discussed. The issues raised were classified as follows:

- Comfort of work;
- Efficiency and quality of work;
- Contact with the business environment;
- Tools for digitization and their use.

The interviews were related to the experiences and perceptions of remote work by employees and the complete digitization of the design process. Their statements have been carefully analyzed. The analysis of the interviews focused in particular on the personal experiences of each employee with respect to remote work.

All the statements that were carefully written down during the conversation were subjected to a thorough analysis based on Colaizzi's method. This is a method of qualitative research, the essence of which is to discover (define) the basis of the phenomenon under consideration. This is done through rigorous data analysis [71]. In this method, the study begins with writing descriptions of the experiences of the respondents in the field of the studied subject, and ends with an accurate and precise formulation to answer the research question. Colaizzi's method was developed in 1978. It is used primarily in psychiatry and medical sciences, including nursing [72,73]. In this publication, due to the research question posed and the subject of research, it was adapted in an innovative way to conduct research in the field of management. In particular, the focus was on the perception by designers, architects, and engineers in the design and construction industry. They were asked about the comfort of remote work, the sense of security, and the possibility of focusing on work (based on the experiences that accompanied employees during lockdowns). The questionnaire that the employees were asked to complete concerned the implementation of the sustainable development goals by the companies in which they work (or are owners) in the context of using tools for digitizing the design process. The data obtained from the questionnaires were subjected to statistical analysis based on the Ward method. Using this method, aspects that are problematic in digitization, aspects that are beneficial (favoring digitization), and aspects related to sustainability were identified. Electronic means of communication were also identified by frequency of usage by employees for communication and cooperation with the business environment.

The first qualitative research conducted was to examine how employees of the design and construction industry in Poland perceive remote work. The authors of this article asked 50 employees in the design and construction industry from various regions of Poland to participate in the survey. The survey and analysis were conducted in the last quarter of 2021. In the case of further interviews, a partially categorized interview

was used that was conducted in the form of a casual conversation. The interview was conducted through electronic tools: Skype, Zoom.us, or Microsoft Teams. A total of 20 designers (20%), 18 architects (36%), and 12 full-time employees (24%) working in the design and construction industry first participated in the survey, which was conducted before the interview and had a questionnaire form. All survey participants worked remotely during the pandemic. These are private architecture studies, full-time employees, and commissioned designers. A total of 19 questions were asked during the interview.

3.1. Preparing an Experiment

The questions were divided into areas related to remote work. The interview plan is presented below (Table 2), including the questions asked and the areas to which they were assigned.

The answers collected during the interviews were placed in an MS Excel spreadsheet. The rows represented the respondents and the columns represented the questions asked. The result was a worksheet with 50 answers to each question asked. Work-related comfort was first taken into account.

The questions were sorted in the order presented in Table 3. The following methodology was adopted for the analysis of answers to questions 1–3, 5–12, 15–17, and 19.

- (1) The responses were coded for each response assigned to a given respondent. Code 0 was a negative answer, and 1 was an affirmative/positive answer.
- (2) All “0” and “1” responses were counted, knowing the ratio of the amounts of one group to the other.
- (3) The result was the next list of participants for the final interview.

Table 2. Questions assigned to the categories.

Question	Category
1. How do you rate the comfort of work during the COVID-19 pandemic? Has remote work changed working conditions for better or worse during the pandemic?	Comfort of work
2. Has working at home made you feel more secure?	Comfort of work
3. Was the remote work model more or less comfortable for you than stationary work in a design office/workplace?	Comfort of work
4. What are the advantages and disadvantages of working remotely during lockdowns?	Comfort of work
5. How do you evaluate the contact with the project team, cooperation with people involved in the project during the pandemic? Were there any cases where contact during cooperation turned out to be easier or more difficult?	Contact with business environment
6. How do you evaluate the contact with the client during the design process, have the working conditions changed in this regard due to the pandemic?	Contact with business environment
7. How do you rate the ease of cooperation with clients during the COVID-19 pandemic (remote work)?	Contact with business environment
8. Do you think the COVID-19 pandemic has affected the demand in the design and construction industry? (was it a negative or a positive effect)	Contact with business environment

Table 2. *Cont.*

Question	Category
9. Has the COVID-19 pandemic affected the efficiency of your work?	Effectiveness and quality of work
10. How do you rate the overall quality of work as a designer/architect during lockdowns? Has the job turned out to be easier/more difficult?	Effectiveness and quality of work
11. How, in your opinion, did the lack of direct contact with a client/colleagues affect the quality of work.	Effectiveness and quality of work
12. Have digital means of communication made your work more efficient?	Effectiveness and quality of work
13. What are your thoughts on the digitization of the design process? It is about all organizational and customer cooperation aspects? Is it possible in terms of labor productivity? Does this have a positive or negative effect on customer satisfaction?	Effectiveness and quality of work
14. What was, in your opinion, the average time working remotely during the pandemic? Please estimate as a percentage.	Effectiveness and quality of work
15. Were the remote methods of communication with the client used due to the pandemic used by you and the company you work for before the pandemic?	Tools for digitization and their use
16. Did you also work remotely or in a hybrid manner prior to the COVID-19 pandemic?	Tools for digitization and their use
17. Despite the return to stationary work (in most companies), have some of the solutions used during remote work remained?	Tools for digitization and their use
18. What are the IT tools enabling remote work and remote contact with the client that were used by you at work?	Tools for digitization and their use
19. Does digitization of services in the design and construction industry have a positive impact on sustainable development?	Sustainability influence

Source: authors' own work.

Table 3. Thematic areas from the responses to the question, “What makes remote working via electronic means better and more sustainable?”.

Theme	Description
Safety, a sense of peace at work	The respondents declared a high sense of security at work and a sense of peace.
Less electricity use	Respondents declared awareness of the consumption of (slightly) more electricity by their households, but a smaller amount by much larger buildings and entire industrial zones practically excluded from use during the lockdowns.
Comfort and freedom of work, the ability to balance working time and its rational division	Respondents declared a sense of freedom and the ability to control their lives and professional and private time. They did not feel like “incapacitated cogs in the machine”.

Table 3. Cont.

Theme	Description
Do more	Respondents declared receiving more orders while working remotely.
Higher productivity	Respondents declared the possibility of doing more work remotely.
Reducing fuel consumption	Respondents declared lower fuel consumption due to the lack of the need to travel to their design office/company/own office.
Lower fossil fuel consumption	As a result of reducing the electricity consumption of office buildings and industrial zones, respondents declared their belief in lower consumption of nonrenewable resources.
Lower utility consumption in enterprises	Respondents declared that due to their absence and of other employees in enterprises/design offices, there was a lower consumption of utilities (water, gas, electricity).
Reduction of harmful substances emitted into the environment	Respondents declared that in their opinion, as a result of remote work, fewer harmful substances were released into the environment (car exhaust fumes, exhaust fumes of heating boilers, and heating industrial premises).
Private financial savings	As a result of the lack of the need to commute, the need to order and buy food at work, and constant trips from the workplace, respondents declared financial savings in their private finances.
Savings in your design office (designers–entrepreneurs)	Due to the lack of their own presence and their employees, respondents who owned their design offices declared lower consumption of utilities in their companies.
Lower stress	Respondents declared that working from home was less stressful for them.
Quality of work	Respondents declared a higher quality of projects performed during remote work.
Decision making	Respondents declared better efficiency in making decisions.
Contact with customers	Respondents declared faster contact with customers.
Contact with the project team	The respondents declared better contact and cooperation with the project team.
Contact with the contractors	Respondents declared better contact with contractors.
Remote work tools	The respondents declared that it was easy to use remote working tools, and that they were familiar with them due to their partial use before switching to a totally remote working model.
Customer satisfaction in the opinion of designers	The respondents declared greater satisfaction of their clients due to the flexibility of their working times and the ability to devote more time to them.
Demand in the industry when working remotely	Employees declared a higher demand for design and construction services while working remotely during the pandemic.
Digitization and remote work after the pandemic	Respondents declared their willingness to work remotely with the use of digital tools (and the transition to this model of providing services by the industry) regardless of the pandemic and existing lockdowns.

Source: authors' own work.

3.2. Colaizzi's Phenomenology Descriptive Method

The next step was the selection of candidates for the final question. People who positively answered the following questions were selected: 1, 3, 5, 6, 7, 12, 13, and 19.

Of all the interviewees, 40 people positively answered the questions (numbers listed below). These people were asked to answer one more question: "What makes remote working via electronic means better and more sustainable?" The analysis was started in accordance with the assumptions of the descriptive method of Colaizzi's phenomenology. The essence of phenomenology is the discovery of the "essence", or "essential structure" of the studied phenomenon. It is a method used in psychology and medicine [74]. Due to the social nature of management sciences and the subject of the study; i.e., remote work in COVID-19 conditions, it was adopted in order to discover the reasons why the overwhelming majority of respondents considered remote work with the use of electronic communication techniques. The following are the analysis steps [74–76]:

1. Acquaintance with the data by reading all the statements of the participants that were written down;
2. Verify all significant statements that were directly related to the phrase "What makes remote work using electronic means of communication better and more sustainable?";
3. Formulating meanings that were significant and refer to the studied phenomenon;
4. Grouping themes—identifying meanings in themes that were common to all statements, and avoiding the influence of suppositions and theories;
5. A comprehensive description of the phenomenon under study in the context of the themes obtained in the previous step;
6. Condensing a long description to a short statement that encapsulated the essence of the phenomenon under study;
7. Obtaining feedback—after the examination, the test group should be consulted to verify whether the statement describing the phenomenon captured their experiences and feelings.

After the interview, they were asked to fill out a questionnaire sheet. Designers, architects, and full-time employees were asked about the degree of impact of digitization and digitization of services provided by their industry in supporting sustainable development. The next question concerned the degree of implementation of the 17 individual sustainable development goals. A total of 50 responses to these questions were given on a 5-point scale (for the degree of impact of digitization on sustainable development and the degree of its impact on each of the goals of sustainable development separately). The survey (in the same form, using a 5-point scale) also asked questions about the impact of remote work on efficiency, aspects of remote work that make work easier and more difficult, aspects of remote work affecting the quality of work, difficulties generated by remote work for the design and construction industry, and electronic communication tools and the degree of satisfaction with their use.

3.3. Cluster Analysis

A cluster analysis was performed using the Ward method (Euclidean distance method). The part based on statistical analysis was designed to define clusters grouping factors that responded to the opinion of respondents about the advantage of digitization of services in the design and construction industry and its positive impact on sustainable development.

The cluster analysis was used to determine the relationships between the variables studied. This method is otherwise known as the "unsupervised learning method". The basis of the cluster analysis method is to find similarities between elements and combine similar elements into homogeneous groups [76–79]. The analysis performed was based on the use of Euclidean distances between the numerical results characterizing the variables studied. Euclidean distances are expressed by the formula:

$$d(x, y) = \sqrt{\sum_{i=1}^p (x_i - y_i)^2} \quad (1)$$

where: $x = (x_1, \dots, x_p)$ and $y = (y_1, \dots, y_p)$.

An important assumption is that the assumption of linearity and normality of the variables studied variables does not have to be met in the cluster analysis. The Ward method was selected for the conducted analysis because the nature of the studied variables allowed its application. The condition about the lack of collinearity between the variables was also met. Ward's method chosen to minimize the sum of the deviations of the squares of any two clusters that may be formed at any stage [80,81]. To perform statistical analysis, STATISTICA 12 software was used. Attention was also drawn to the other side by repeating the study on a group of factors related to obstacles related to digitization. The compilation of the results of these two analyses aimed to identify the following groups of factors: favoring the digitization of design services in the principles of context of the principles of sustainable development principles, and obstacles to digitization services in the design and building industry sector.

A total of 12 variables were defined and included in the cluster analysis. Six of them dealt with aspects favoring the digitization of services in the design and construction industry, and six dealt with obstacles to digitization in this industry.

Barrier variables:

V1: Many aspects are impossible to discuss remotely.

V2: Difficulty motivating customers to explain certain aspects electronically.

V3: Formation of ambiguities and misunderstandings during electronic consultation with the client/investor.

V4: Legal problems (procedures that require signatures and original documents).

V5: Problems related to the place of activities (periodic presence required at the investment site).

V6: Problems with access to documentation and technical data during a design service provided remotely.

Favorable aspect variables:

V1: Better and more flexible contact with the client/investor via electronic means.

V2: Facilitated contact with the project team due to the use of electronic communication.

V3: Facilitated cooperation with representatives of external companies via electronic means.

V4: Higher efficiency at work.

V5: Greater comfort at work.

V6: Using more effective, faster, and productive methods of communication

4. Results

The following section presents the results of Colaizzi's method and the cluster analysis, in order.

4.1. Results of Colaizzi's Phenomenology Method Approach

People operating in the industrial and construction industry gave quite abundant answers to the question, "What makes remote working via electronic means better and more sustainable?". Each of the respondents provided at least some answers. All answers were grouped into "topics", coded with the name, and described. As a result, 20 thematic areas were created. The results are presented in Table 3.

The respondents referred to aspects related to work comfort, flexibility, efficiency, contact with the business environment, savings, and issues related to sustainable development. With regard to the comfort of work, statements included: "Working at home, no one bothers me, I can focus on my own work"; "Nobody controls me, I work at my own pace, carrying out the same number of orders"; and "Working in a design office means sitting at the computer all the time; at home I can step away from my computer, have a cup of coffee, and

go back to work.” In relation to efficiency: “I carry out the same number of orders, and even there are more of them” and “I do not waste time on commuting and chatting, I finish my work at the same time with more orders or I have time off before”. Regarding savings and care for the environment: “I know that I use more electricity at home, but it is still less than 4 office buildings use”; “We carry out all orders remotely, we certainly do not use as much utilities and electricity as before—I save on the maintenance of my company’s buildings”; “I save on commuting, I do not use my car so often for business purposes”; “I do not have to heat the offices in my company as before, almost zero energy and water consumption, the same number of orders”; and “We do not focus on environmental protection in our activities, but the consumption of electricity and water is much lower than when working in an office”. Regarding contact with business recession: “We worked remotely with clients even before the pandemic; what cannot be remotely dealt with are sporadic situations, we work remotely all the time” and “I contact my employees and share work using a network drive we contact electronically. That is enough, and if you need to have physical contact with the client, it is very rare. There is no need to go to the office every day.” The number of answers that were related to the topics described in Table 3 is presented below (Table 4).

Table 4. Number of answers related to topics described in Table 3.

Answers	Numbers of Answers
Comfort and freedom of work, the ability to balance working time and its rational division	40
Private financial savings	40
Contact with customers	40
Contact with the project team	40
Remote work tools	40
Digitization and remote work after the pandemic	40
Contact with the contractors	39
Safety, a sense of peace at work	38
Decision making	37
Higher productivity	36
Savings in your design office (designers–entrepreneurs)	35
Customer satisfaction in the opinion of designers	35
Reducing fuel consumption	34
Lower utility consumption in enterprises	32
Lower stress	32
Reduction of harmful substances emitted into the environment	30
Quality of work	30
Less electricity use	29
Lower fossil fuel consumption	20
Do more	15
Demand in the industry when working remotely	10

Source: authors’ own work.

Based on the formulated subject areas, a note was made, with an extensive description of the explanations of the respondents in relation to the statement “What makes remote working via electronic means better and more sustainable?”. Once again, the pronunciation of the thematic areas that were created was justified with their use. Finally, the following statement was formulated and evaluated in the form of feedback:

“The sense of comfort, freedom and economy as well as better efficiency with minimal impact of the design process on the environment made designers and architects prefer working remotely using electronic means of communication.”

4.2. Analysis of Clusters of Barriers and Contributing Factors to the Digitization of Services Provided by the Design and Construction Industry

The calculations were made on the basis of data obtained from a survey conducted among 50 people (designers, architects, and employees participating in the design process).

An indicator was developed to illustrate the extent to which difficulties hindered the digitization of the design process. The formula is presented below:

$$\text{significance index} = \frac{\text{averaged value of all votes cast for each of the points from 1 – 5 (where 1 – barrier does not bother you; 5 – barrier bothers a lot)}}{\text{average value of all votes cast for points 1 and 2 (a slightly disturbing barrier level)}} \quad (2)$$

The table below presents the average level and standard deviation for each of the barriers to digitization of services in the design and construction industry (Table 5).

Table 5. Barriers in digitization of the design process.

Barrier (Variable)	Indicator Value	Std. Dev.
V1: Many aspects impossible to discuss remotely	1.53	5.95
V2: Difficulties in motivating customers to explain certain aspects electronically	3.33	11.24
V3: Formation of ambiguities and misunderstandings during electronic consultation with the client/investor.	2.00	7.90
V4: Legal problems (procedures requiring signatures and original documents)	5.40	8.35
V5: Problems related to the place of activities (presence at the investment site)	2.22	8.17
V6: Problems with access to documentation and data	1.00	7.46

Source: authors' own work.

The grades at which barriers hindered digitization are graphically presented below (Figure 1).

From the collected information, it can be seen that the biggest obstacle in the provision of remote services was legal problems—problems in situations in which it was necessary to sign documents, direct contact with lawyers, etc. Another barrier was often motivating clients to take action in the field of electronic contact during design consultations. The smallest problem was access to documentation and data. The same was done for factors that favored the transfer of the design process. Table 6 shows the indicators for the conditions that favored the digitization of design services.

Table 6. Factors contributing to digitization of the design process.

Factors Contributing to Digitization in the Design Process (Variables)	Indicator Value	Std. Dev.
V1: Better and more flexible contact with the client/investor due to the use of electronic communication	2.00	5.93
V2: Facilitated contact with the project team due to the use of electronic communication	2.00	6.32
V3: Facilitated cooperation with representatives of external companies via electronic means	2.50	7.80
V4: Higher work-at-home efficiency	3.33	13.81
V5: Higher working comfort at home	4.00	14.10
V6: Using more effective, faster, and productive methods of communication	2.86	8.60

Source: authors' own work.

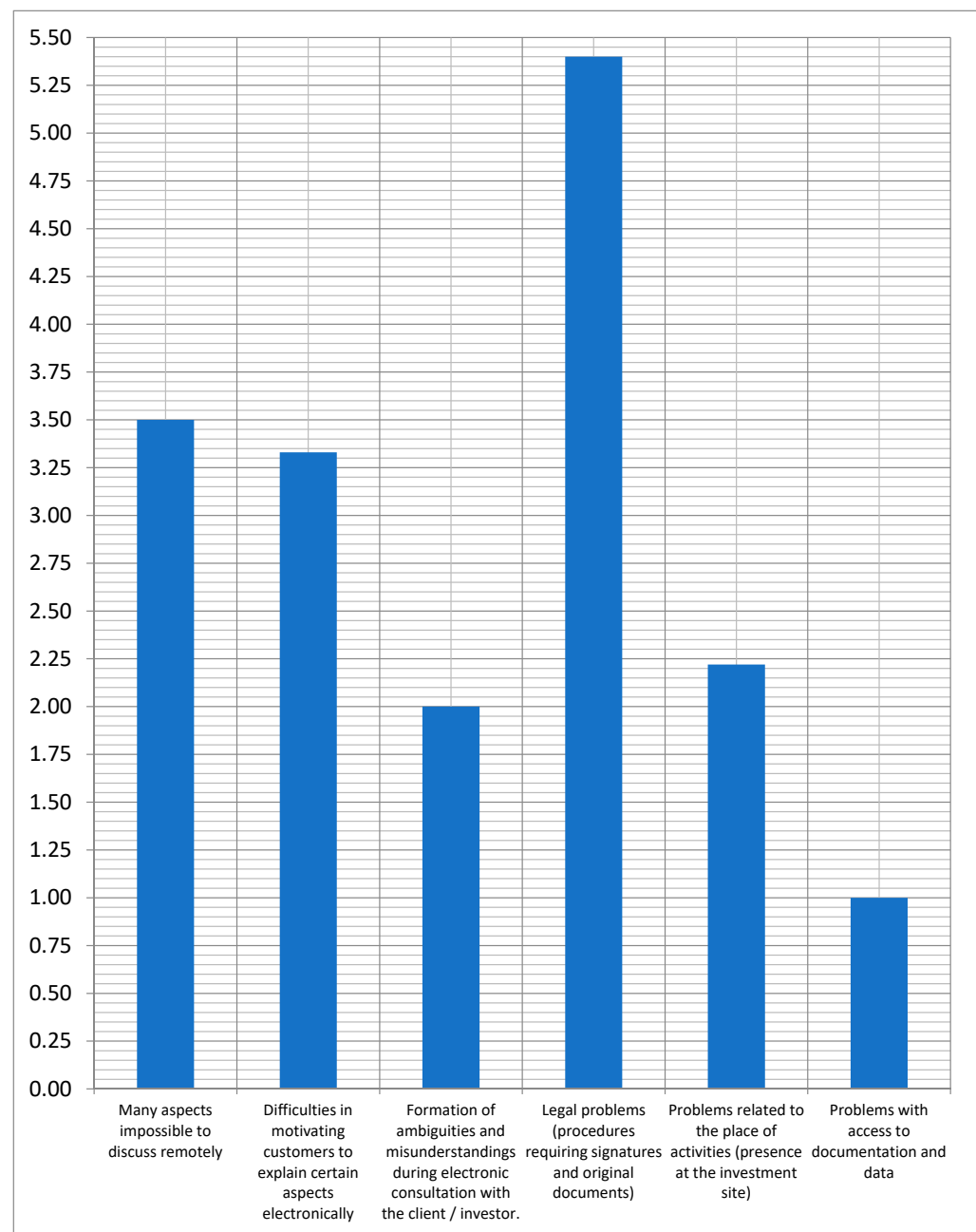


Figure 1. Barriers to service digitization in the design process. Source: authors' own work.

As in the previous case, the factors favoring digitization in the design process based on the calculated index are graphically presented below (Figure 2).

Based on the calculations, it was found that the flexibility of electronic means of communication was the basic factor contributing to the digitization of the design process. Then, there was the greater comfort with working at home, and finally, the use of more effective, faster means of communication. The cluster analysis was then performed. The first cluster analysis was performed for barriers. A tree diagram (Figure 3) that presents the variables grouped into clusters is presented below.

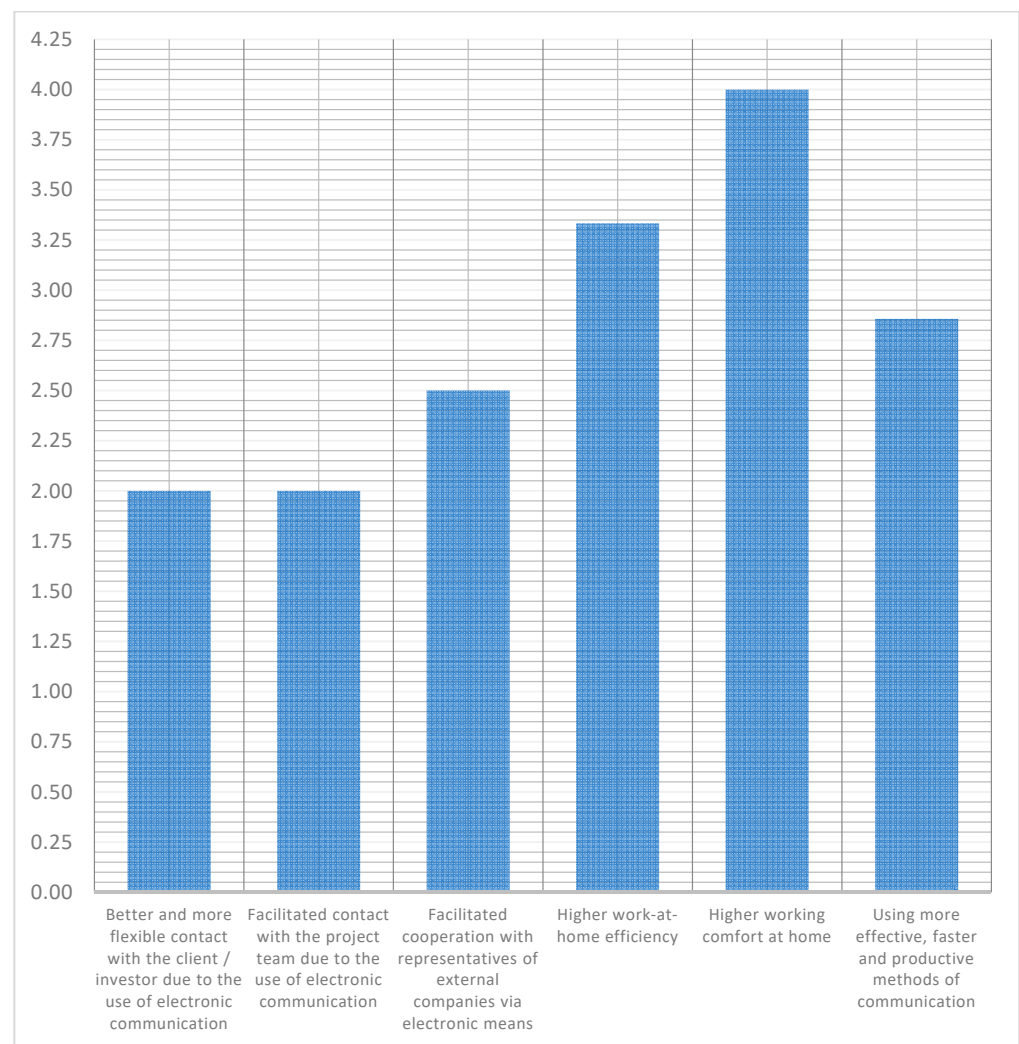


Figure 2. Contributing factors to service digitization in the design process. Source: authors' own work.

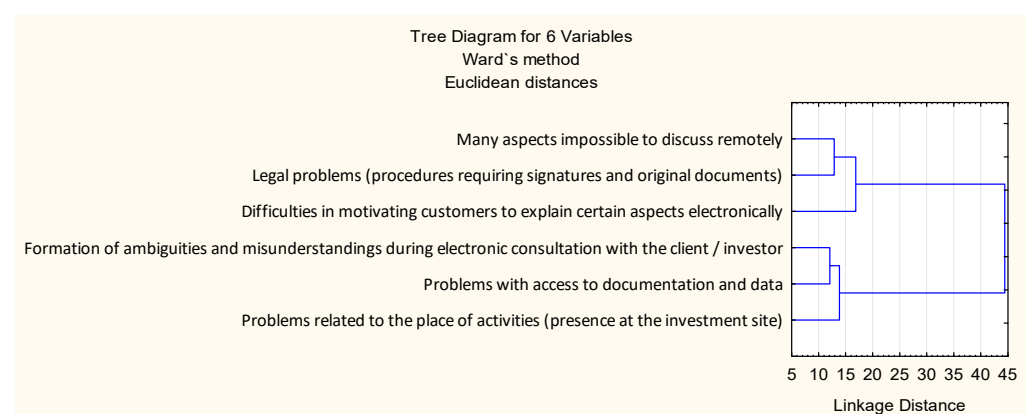


Figure 3. The tree diagram for barriers to service digitization.

The cluster analysis carried out allowed for the identification of two clusters in which there were barriers to digitization. The distinguished groups of barriers were the following:

- Cluster 1 (was titled: “Weak barriers”): “Formation of ambiguities and misunderstandings during electronic consultation with clients”, “Problems with access to data”, “Problems related to the place of activities (presence at the investment site)”.

- Cluster 2 (was titled: “Major barriers”): “Many aspects impossible to discuss remotely”, “Legal problems”, “Difficulties in motivating customers to explain certain aspects electronically”.

The same was done for the variables that described the significance of factors contributing to the digitization of the design process. The results are shown below (Figure 4).

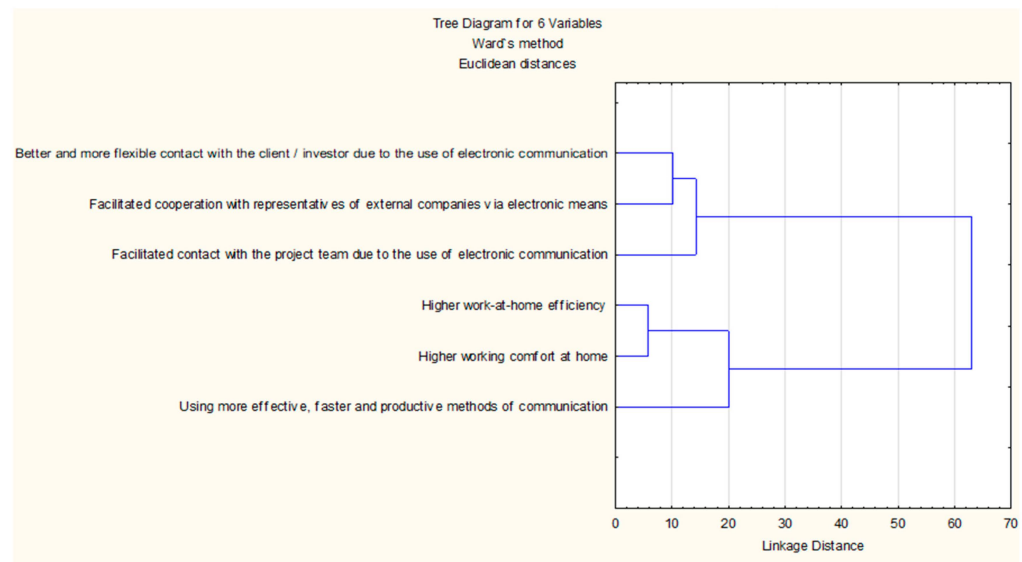


Figure 4. The tree diagram for factors contributing to digitization.

Two clusters were created, in which there were the following factors:

- Cluster 1 (was titled: “Weaker factors”): “Better and more flexible contact with client/investor due to the use of electronic communication means”, “Facilitated cooperation with representatives of external companies through electronic communication means”, “Facilitated contact with the project team due to the use of electronic communication”.
- Cluster 2 (was titled: “Major factors”): “Higher efficiency at work”, “Higher comfort at work”, “Use of more effective, faster, and productive communication methods.”

Using the same indicators and the same principle, the significance of sustainability and savings motivators was calculated, which the respondents considered the most important in relation to the digitization of the design process (Table 7).

Table 7. Sustainable development aspects.

Environmental and Financial Aspects	Indicator Value	Std. Dev.
V1: Reducing fuel consumption	3.20	13.55
V2: Lower fossil fuel consumption	1.78	3.29
V3: Lower utility consumption in enterprises	5.33	11.08
V4: Reduction of harmful substances emitted into the environment	1.60	5.10
V5: Private financial savings	4.00	12.07
V6: Savings in your design office	5.33	12.12

Source: Authors’ own work.

Below, the significance of individual aspects of environmental sustainability and financial motivators in the design process are presented graphically (Figure 5).

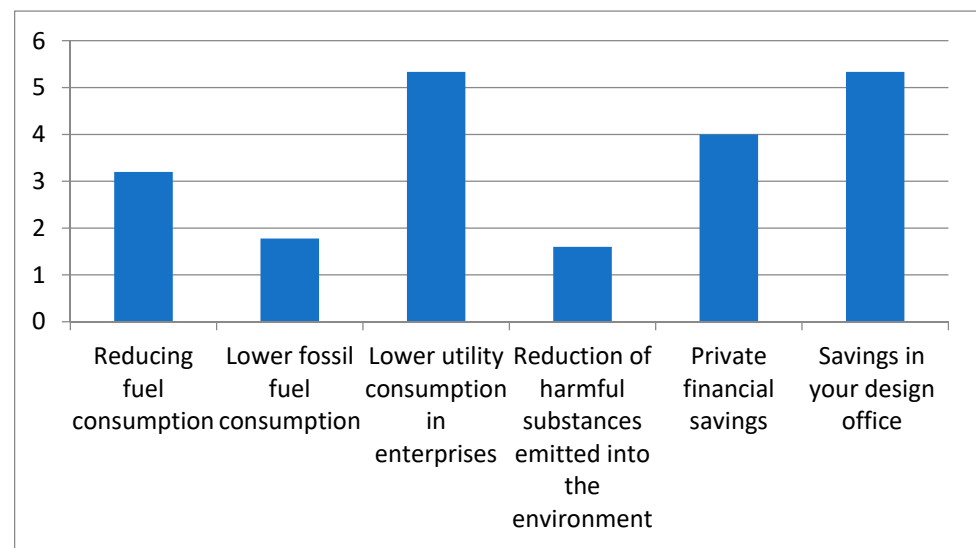


Figure 5. Significance of sustainability aspects' importance for designers.

Comparing the variables with each other, it appeared that “Lower utility consumption in enterprises”, “Savings in your design office”, and “Reducing fuel consumption” were the main aspects of sustainability perceived by designers and architects in the context of working remotely or providing remote design services.

A tree diagram was created for the variables describing the importance (according to designers and architects) of individual aspects of the sustainability of the design process (Figure 6).

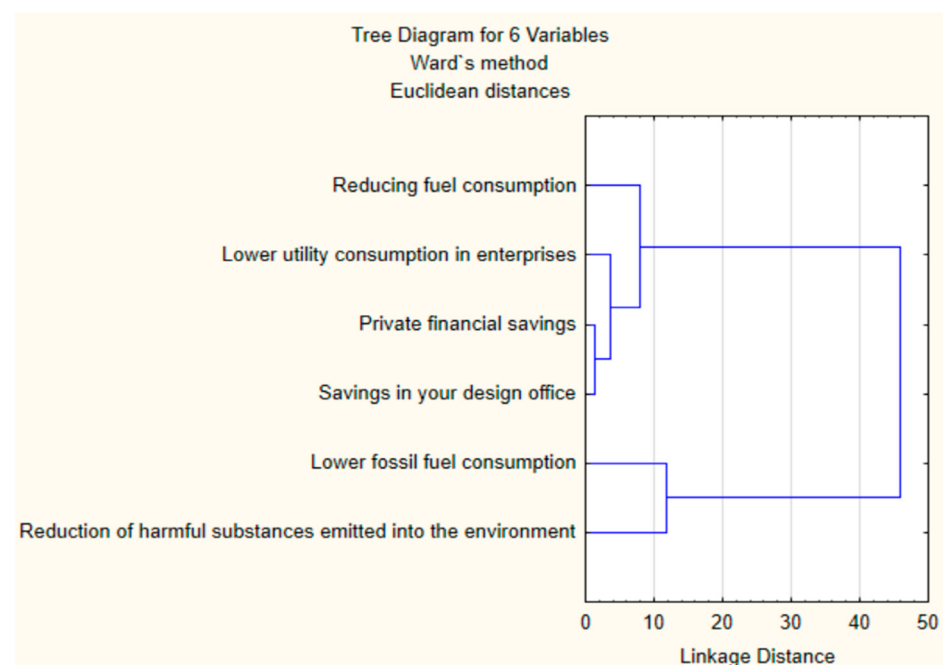


Figure 6. The tree diagram for sustainable development aspects.

The following clusters were defined:

- Cluster 1 (was titled: “sustainable savings”): “Reducing fuel consumption”, “Lower utility consumption in enterprises”, “Private financial savings”, “Savings in your design office”.

- Cluster 2 (was titled: “environmental incentives”): “Lower fossil fuel consumption”, Reduction of harmful substances emitted into the environment”.

From the survey, a few other results were found. Most of the respondents believed that remote work was not the problem during the pandemic. Issues related to infrastructure, gender equality, and climate were the most frequently mentioned goals in the survey. Zoom.us and Microsoft Teams were the most frequently used IT tools for remote work.

5. Discussion

By analyzing the changes taking place in many areas of industry, the progressive trend in digitization could be easily observed. The design and construction industry is a special example of the use of digital tools in the work of designers and architects, due to their use to a greater or lesser extent before the COVID-19 pandemic. It should be noted that the research and the results described in this publication were conducted on a specific group of people who supported remote work in their industry and considered such a model of work or business activity to be the most beneficial both in terms of comfort, efficiency, and care.

This approach should not be treated as a direct research limitation, but rather as a search for an answer to the question, “Why do some designers and architects prefer remote work, considering it to be more sustainable?”. Considering that 40 out of 50 respondents expressed strong preferences regarding remote work, it can be assumed that the majority of designers and architects considered remote work to be the most beneficial model for providing services. The limitation of the research was a small research sample. It would be worthwhile to conduct a survey among a larger number of people. Then, it could be precisely determined whether remote work was really preferred by the majority.

When referring to the results and methodology of the conducted research, it is worth comparing them with the results presented in [82]. This publication aptly describes that the psychological well-being and preferences of employees in the IT sector (whose nature of work is similar to design and gives similar opportunities and imposes similar limitations on remote work) also depend on independent factors such as: role ambiguity, organizational culture, atmosphere in work, and colleagues. These are additional variables that should be taken into account when building a statement about the superiority of the remote work model over the traditional one. Taking into account the results of these studies, it can be concluded that the most important factor that can affect the mental well-being of employees is stress. This publication focused only on the essence from design office positive feelings of employees and owners of design offices dealing with remote work. Contrary to the publication that was quoted, the stressors were not taken into account. Focusing on the essence of positive perceptions and impressions about remote work is a different point of view. As cited, most publications have focused on the strengths and weaknesses of providing comfort to remote workers. However, it did not happen that a given point of view was studied so thoroughly. Therefore, discovering the essence of positive impressions and preferences for remote work is important and is part of research on the trend of digitization of industry and services. From the second point of view, it may also limit the research application of phenomenology. However, it should be taken into account that the key research goal was to examine the essence of better remote work perception and digitization of the design process by design and construction industry employees. It is also worth taking a look at the results of research carried out at the request of the European Parliament. In [83], 83.3% of the men and 74.1 women surveyed declared that remote work had a positive impact on the balance of their lives.

Statements about work comfort and autonomy were confirmed. The publication mentioned that 81.8% of the respondents believed that remote work provided more autonomy to take actions and responsibilities related to the work performed.

This publication also touched on a different point of view. The problems related to isolation and blurring the difference between the time devoted to professional and family life were highlighted. However, the positive aspects were confirmed in the context of the results of quantitative research. The biggest advantages were flexibility of working time

for remote workers, no time wasted on commuting, savings, etc. However, this and the previous article used quantitative research, and focused only on some aspects related to the advantages and disadvantages of remote work. Contrary to the method presented, the focus was not on the essence that caused a positive approach of employees and employers to remote work. Another issue worth paying attention to is environmental savings and the carbon footprint. It should be noted that environmental problems in Poland are mainly with mining industry [84–86]. Architects and designers rightly expressed their opinions on the savings related to fuel consumption and the impact on the natural environment. According to a study carried out in France, around 3 days of working remotely a week would reduce the environmental impact of car transport by around 30%. This translates into greenhouse gas emissions by about 0.5% globally.

The additional environmental savings mentioned by the interviewees was confirmed in the report under discussion. It has been shown that reducing the carbon footprint can be achieved by reducing office space, energy consumption, water consumption, road renovation, paper consumption, district heating, etc. [83]. The aspect of remote work to reduce emissions of harmful substances and pollution of the environment was also highlighted in [83], which indicated the compatibility of remote work with the “path of sustainable development in the field of environmental health” [83]. When talking about the quality of remote work and the quality of life with remote work, it is impossible not to refer to studies and evidence that indicate the harmfulness and nuisance of such a solution.

Among the most frequently mentioned disadvantages of remote work were “loneliness” and “isolation” [87–89]. However, it should be remembered that these studies talk about working only remotely (they did not take into account hybrid operation in nonpandemic conditions). It should be taken into account that working remotely during a lockdown may be associated with loneliness and a lack of social relationships, but under normal conditions, working remotely itself could not have such an impact on the opinion of employees. It is also worth paying attention to several studies that dealt with the topic of employees’ preferences regarding remote work. Predictions of an upward trend in remote work were described and published in 1999 and 2002 [90,91]. In their research, the authors of the publications already drew attention to the fear of employees working remotely regarding the possibility of their professional advancement and relationships with the business environment and superiors. Employees expressed these concerns about the perception of their colleagues working stationary in offices. Another extremely important aspect is the organizational culture of companies, in particular the place of employees who work remotely in the organization, as well as their visibility and the possibility of cooperation with them [91,92]. Another aspect is the well-being of employees and the sense of comfort when working remotely. Research already carried out during the pandemic has shown that it was not enough to provide employees with an ICT infrastructure to allow them to work remotely. Employees also needed organizations to provide them with technology-related support; that is, the abilities and resources to learn new technologies, deal with multitasking, and deal with constant connectivity and availability to supervisors and colleagues [93].

The approach presented in the article used both qualitative and quantitative data analysis. The use of a quite rare method (Colaizzi’s phenomenology approach) turned out to be an effective way to define the essence of the phenomenon of willingness to work remotely by employees of the analyzed industry. An interesting and similar case of using this method outside of medical sciences (psychiatry and nursing) may be the article on the implementation of Lean Six Sigma (LSS) [87]. As in this publication, Colaizzi’s approach was used to conduct a qualitative study. Taking into account the context of sustainable development, one can also refer to the distribution of digital goods and the development trend of Industry 4.0. The distribution of digital goods, as well as the digitization and automation of production and service processes and the digitization of human work, fit into the context of sustainability [94–96]. In addition, the trend of remote work and the direction in which remote work is evolving in the era after the COVID-19 pandemic should be taken

into account. It should be considered that during the pandemic, remote work was partially forced due to epidemic conditions, but even in the prepandemic times, it was becoming more and more popular in countries where access to Internet infrastructure and technical resources was developed. However, irrespective of the COVID-19 pandemic, remote work in the design and construction industry can be recognized as a driver of environmental sustainability and as contributing to the compensation of environmental damage caused by the construction industry [1]. Referring to the results of the research presented in the article, it can also be concluded that remote work after the pandemic may evolve into “intelligent work”. This is a situation in which designers decide whether they want to work stationary or in a virtual environment. The role of coworking spaces and smart work centers can also be considered in these directions, assuming a workspace design consistent with these remote work arrangements [97,98].

6. Conclusions

Based on research, it can be concluded that remote work for employees in the design and construction industry in Poland is not new (some of the methods were used before the pandemic). Opinions on both savings and environmental impact are reflected in the literature and reports. They were presented in the Discussion section. The COVID-19 pandemic and the compulsion to work remotely have made digitization in the design and construction industry permanent. Many companies, as well as individual architects, designers, and employees, will use this model much more often than traditional work. It is conditioned by higher work efficiency, a sense of comfort, and ordinary savings in the household budget, as in the case of entrepreneurs. Savings on fuel or public transport, as well as time that is not “wasted” on commuting, are in line with the idea of sustainable savings. Polish architects and designers pay attention to the goals of sustainable development and understand the benefits of implementing them, even if they are dictated by savings. Situations in which remote work makes it impossible to perform work are so rare that they do not require abandoning the model of remote provision of design services. The most important barriers to digitization are aspects related to legal barriers and contact with the client himself. The main drivers for this model of design services delivery are: Higher efficiency at work, greater comfort at home, and the use of faster and more productive methods of communication. The most significant aspects related to resource use and sustainability are: media use in the enterprises in which respondents work/own, private savings, and savings for the design office (for self-employed designers/architects) (e.g., office supplies, rental costs). The strengths, weaknesses, and benefits of remote work in the design and construction industry in Poland have been classified in terms of environmental sustainability benefits, challenges, and organizational and individual benefits, and are presented and listed below (Table 8).

Taking into account the results of the conducted research, it is worth pointing out the theoretical implications. The method used allowed us to discover the essence of the positive feelings regarding remote work of employees. From a management point of view, it is worth pointing out the implications of how to outsource work to employees and human resource management not just during a pandemic. The research presented in this publication and its results showed the constant development of the trend of digitization of service provision in the design and construction industry. This trend is present not only in Poland, but also throughout the world, and was initiated even before the pandemic, as shown by the research in the quoted and analyzed publications. This publication complements the literature and brings freshness to research on remote work’s perception by employees and business owners in the field of industry digitization research, deals with the social consequences of the COVID-19 pandemic, and also connects these areas and relates to environmental sustainability.

Table 8. Sustainable development aspects.

Environmental Sustainability Benefits	Challenges	Organizational Benefits	Individual Benefits
Reducing fuel consumption	Contact with customers	Contact with the project team	Comfort and freedom of work, ability to balance working time and its rational division
Lower utility consumption in enterprises	Contact with contractors	Digitization development and remote work after pandemic	Private financial savings, safety, a sense of peace in work
Reduction in harmful substances emitted into the environment		Better workers satisfaction level	Savings in design office (private businesses owners)
Less electricity use		Higher workers productivity	Lower stress
Lower fossil fuel consumption			

Source: authors' own work.

Despite the fact that the research was carried out in Poland, the trend of industry digitization of industry can be treated globally. In Poland, it is worth mentioning the cultural implications of remote work. The major factor is the development of an organizational culture and increasing trust in employees.

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