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What to look for to increase work added value? Remote work and perceived productivity: A study in Poland, Hungary and the Czech Republic

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Abstract: In the era of digitisation, the role of remote work is growing. The digitisation of work has brought new opportunities and threats to the economic function of labour. This function, pointing to the fundamental role of employment, which is to provide added value for the employer and remuneration for the employee, has acquired a new meaning. Therefore, in the era of digitisation, it seems justified to assess the impact of remote work on labour productivity (in terms of organizational factors, cost factors and work quality). The subject of the study is to analyse the productivity factors of remote work (based on work performed under permanent and short-term employment, including various work models and irregular work patterns). The main objective of the research is to identify factors determining perceived productivity of individual workers who perform their job remotely and to measure the importance of factors determining labour productivity. The methodology used in the study is based on the analysis of the literature and conclusions drawn from a survey conducted in Poland, the Czech Republic and Hungary (a total sample of 450 units). Logistic regression and the k-means method were used in the statistical analysis. They allow measuring the relationship between the strength of a stimulus represented by the percentage of cases showing a specific response on how productivity is verified by the stimulus. Moreover, they bring the possibility to group factors in clusters representing workers with different sets of productivity factors.

Results show that across the study sample, high stress, low employee control, and limited communication with managers minimise the growth of remote work productivity, since social relationships at work are correlated with productivity. Nonetheless,

work organisation traits such as proper work environment, travel cost savings, technical assistance access, and a fast Internet connection remain positively related to remote work productivity.

Keywords: remote work, productivity, work digitisation, labour mobility, organisation.

Introduction

The spread of new forms of employment is facilitated by the widespread use of the Internet and algorithms supporting communication. As part of the new solutions in the area of employment, in addition to the classic form of full-time employment, we can find solutions that involve sharing a job between several employees or sharing an employee by several non-competing employers. In addition, there is voucher work, i.e. a situation when an employee buys a job with an employer from an intermediary organization. However, the most widespread form is self-employment and its various modifications, known as quasi-self-employment. There is also a type of work done simultaneously for many clients called 'portfolio work' and 'interim management' work done on a short-term basis. The work performed in this form is usually project-based and task-based. Robots and algorithms are employed for repetitive tasks. Less complex jobs, such as cleaning or transporting people, are short-lived, and workers struggle with job insecurity. In contrast, more skilled tasks allow for more autonomy in choosing assignments, and the people doing such work have expertise or specific skills. The use of these types of employment would not be possible without the Internet. Remote work has emerged with the convenience of remote connectivity. The application of such a solution may include all or part of the work process, such as contact with the manager. Remote work, otherwise known as telework, can therefore be treated as a common denominator of new forms of employment. According to Eurofound (2021), teleworking became more widespread during the COVID-19 pandemic in all EU countries, and on average one in three Europeans took up this type of work already at the beginning of the pandemic, many with limited or no previous experience. By July 2020, almost half of the respondents were teleworking at least part of the time and a third were working exclusively from home. It can be said that this form of work has become widespread, which has brought a number of benefits, but—unfortunately many problems, revealing shortcomings in the regulation of work rules, technical adjustments, as well as the proper conduct of the norms of dialogue and agreement both at the level of companies, social organizations, and state institutions. Working remotely has revealed many inconveniences with which the employee is struggling to maintain the proper level of productivity. In the course of the pandemic and the growing pressure to work remotely, there have been discussions in Western European countries such as France, Spain, and Italy about regulating the need for employees to disconnect from the network.

Some of the many phenomena observed were extended working hours, leading to a disruption of the rest time rhythm and work-life balance system. This was compounded by occasional connectivity problems and obvious limitations in the flow of communication due to the mediation of digital technology. In employees, this caused alienation accompanied by stress and decreased motivation.

In this study, the aim is to identify factors determining labour productivity of individual workers who perform their jobs remotely and to measure the importance of factors determining labour productivity. The results of a survey conducted among people working remotely in Poland, the Czech Republic and Hungary have been used. The research hypothetical relationships have been extracted and statistical tests indicated significant relationships between productivity and its factors. The results have been analysed to answer the following questions: Which of the organizational factors, work quality factors and cost factors cause changes to productivity? Which factors have relatively the greatest impact on productivity and why? The statistical analysis used the logistic regression and the k-means methods. They allow measuring the relationship between the strength of a stimulus represented by the percentage of cases showing a specific response on how productivity is verified by a stimulus.

1. Theoretical background

The investigation began with a search of three prominent online databases and identified 153 articles that met the general criteria of interest (listed in Table 1) published between 2010 and 2021. After reading the abstracts of the prequalified articles, the authors classified 53 papers as relevant to this work and thoroughly analysed them in terms of their methods, hypotheses and results of empirical analyses. The reviewed articles have been published in different open access academic journals.

Tab. 1. Criteria for systematic literature review and statistics

Database	Wiley	Proquest	SAGE
Search criteria	Labour productivity and remote work in the title or abstract		
Publication year	2010 and beyond + selected older articles		
Abstracts	22	70	82
Full text articles	12	20	20

Source: Own research.

Based on the literature review, it has been found that productivity is not everything, but in the long run it is almost everything. A country's ability to improve its standard of living over time depends almost entirely on its ability

to raise its output per worker, as Krugman writes (1997). Meanwhile, reallocation of labour and wage levels are considered to be responsible for productivity growth. Productivity increases with the reallocation of total labour resources (Mussini, 2018; Andrews & Hansell, 2021). Hence, it is believed that reallocation of workers is a measurable factor of productivity change. However, mobilities related to remote work have shrunk during the pandemic, which means that remote forms of communication and work have taken centre stage (Matthews, See & Day, 2020). In the literature, many authors focus on analysing the benefits and costs of remote working from the point of view of a firm and from the teleworker's perspective. For example, cost savings on office space is often indicated as the main benefit and the bottom-line reason for telecommuting (Allen et al., 2015), while the negative impact of long-term remote work on relationships among co-workers and teams is often indicated as one of the costs of working from home (Bao et al., 2020). The impact of remote work on productivity is widely discussed in the literature (Wamboe, Adekola & Sergi, 2014; Filippetti & Peyrache, 2013; Muhanguzi & Kyobe, 2017; Patel et al., 2021). Maintaining the efficiency and effectiveness of the workforce is critical and new research suggests that productivity and efficiency have not suffered in the face of the current global situation (Bernstein et al., 2020). Choudhury, Foroughi, and Larson (2020) point out that working remotely from any location yields up to 4.4% increase in output, greater than working remotely from home, conditional on the use of ICT. It is worth noting that in the work process, these devices are characterised by ubiquity, context sensitivity, identification functions, and command and control functions. They enable continuous monitoring of individual workers and the environment, and networked worker solutions provide contextual information and decision support, as well as lead to taking control of the worker (Kreyer, Pousttchi & Turowski, 2003). Managers should introduce these technologies by engaging employees to avoid using technology in unexpected ways. For example, employees may purposely delay responses to their managers' requests and bypass control by setting up a second monitor where they do non-work-related tasks (Miele & Tirabeni, 2020). Filippetti and Peyrache (2013) refer to the convergence that is related to productivity in the economy. They note that the countries of Central and Eastern Europe have indicated significant differences in the levels of labour productivity compared to Western European countries, which can be largely attributed to differences in the technology gap. An essential aspect is also the variation at the national level in work-from-home opportunities, which is substantial across Europe. It varies between transitional economies (e.g. Romania) with only a small proportion of workers who may be able to work from home, on the one hand, and high-income northern countries (Norway, Iceland, Denmark) and the Netherlands where half or more of the workforce have worked from home in the past. Proportions are also strikingly low in some Southern Mediterranean countries (Reuschke & Felstead, 2020). Focusing on the standard assumption about the relationship

between wages and productivity, empirical studies have shown that deunionisation with a decreasing share of the labour factor in wages and globalisation have a negative impact on productivity (Judzik & Sala, 2013). Most studies concentrate on analysing the relationship between remote work and firm or employee productivity. In both cases, the nature of the relationship is not clear in the literature. Some authors point out that remote work may cause a decrease in firm productivity (Ganguly et al., 2020). Others present findings that suggest the opposite, namely that telework may increase firm productivity (Sánchez et al., 2007; Sandoval-Reyes, Idrovo-Carlier & Duque-Oliva, 2021), which in both cases results from managerial practice and a strategy of work organisation at the company. There have been recent developments in building digital enterprise structures that enable more productive and efficient remote working (Bryant, 2021; Hughes, 2008). Researchers investigating the productivity of employees working remotely aim to formulate measures that relate to work outcome and workload (Butler et al., 2021; Bao et al., 2020; Karl, Peluchette & Aghakhani, 2021; Evans et al., 2021; Kelliher & Anderson, 2010). For example, Kordalska and Olczyk (2020) identify productivity by the logarithm of the share of annual sales and the number of permanent full-time employees. Since indirect information about employee productivity is difficult to measure, many studies looked at self-reported productivity and satisfaction (Butler et al., 2021; Evans et al., 2021). Most studies use questionnaires in addition to face-to-face interviews as the main research tool (Blasi & Kruse, 2006; Osterman, 1999; Muhanguzi & Kyobe, 2017). In the questionnaire, the teleworkers are asked about issues concerning their productivity in working from home. In this approach to the study of productivity, the terms *perceived, subjective or declarative* productivity or performance are used in the literature (Aboelmaged & Subbaugh, 2012; Toscano & Zappala, 2020; Wang et al., 2020). Evans et al. (2021) examined the relationship (for N=947) between personality and within-person changes in five job outcomes (e.g. self-reported performance, job satisfaction) and found out that, on average, self-reported performance decreased over the course of the study. Many researchers have sought to identify productivity factors, which may or may not be conducive to the perceived productivity of remote workers. Miele and Tirabeni (2020) even point out that the particularity of remote work requires the shaping of a private self. The employee should, according to the expectations of the company, be autonomous but achievable and strongly committed to the goals of the organization; productive and attentive to his/her health and well-being. Not only the characteristics of the employee, but also the characteristics of the job determine productivity in remote work. Wang et al. (2020) identified the following remote work challenges: work-home disruptions, ineffective communication, procrastination and loneliness, virtual work characteristics that influence the experience of these challenges, i.e. social support, work autonomy, monitoring and workload and self-discipline as a key factor of individual employee differences. Table 2 provides a review of

Table 2. Literature review on factors shaping perceived productivity

Authors	Year	Factors and their effects
T. Galanti, G. Guidetti, E. Mazzei, S. Zappalà, F. Toscano	2021	Work-family imbalance and social isolation adversely affect work performance, while self-leadership and autonomy in job duties increase work-from-home productivity.
F. Toscano, S. Zappalà	2020	Social isolation and stress may reduce the declarative productivity of remote workers.
B. Wang, Y. Liu, J. Qian, S. K. Parker	2020	Lack of peace and quiet when working from home, ineffective communication with co-workers, procrastination and loneliness can negatively impact remote work productivity.
P. Hardy, S.M. Leandro, J.F. Fontanari	2020	Restricted social interactions due to teleworking may negatively affect the productivity of introverts, while they may improve the productivity of extroverts.
A. Nakrošienė, I. Bučiūnienė, B. Goštautaitė	2019	The possibility of fast communication with co-workers, trust and support from the supervisor, as well as a properly prepared workplace are all factors that contribute to higher productivity in remote work. In addition, the possibility of taking care of family members while teleworking is favourable.
M. Charalampous, C. A. Grant, C. Tramontano, E. Michailidis	2019	Social and professional isolation may jeopardise a worker's professional development.
T.A. Bentley, S.T.T. Teo, L. McLeod, F. Tan, R. Bosua, M. Gloet	2016	Providing organisational support to the teleworker has a positive impact on their productivity.
R. Torten, C. Reaiche, E.L. Caraballo	2016	Experience on teleworking success has the potential to materially affect the success of the teleworking model.
T.A. O'Neill, L.A. Hambley, A. Bercovich	2014	Personality plays a role in remote work outcomes.
C.A. Grant, L.M. Wallace, P.C. Spurgeon	2013	Trust and governance are key to the effectiveness of remote workers.
M. G. Aboelmaged; S. M. El Subbaugh	2012	Job stability is a key factor in remote working productivity. In addition, job satisfaction, commitment, flexible working hours and support from supervisors have been identified as important determinants productivity.
S. Procter	2008	Work organization and human resources management policies reveal two groups of factors affecting labour productivity: organisational and motivational factors.
Y. Baruch, N. Nicholson	1997	Remote working can cause social and professional isolation that impedes job performance.

Source: Own elaboration.

the literature discussion on the issue of remote work productivity, and more specifically, the results of research by various authors who have undertaken to analyse the factors, attitudinal, and situational that may be important in shaping the productivity of a remote worker.

The authors of the cited studies most often point out the dangerous consequences of social isolation and ineffective communication with co-workers on the effectiveness of remote work (Charalampous et al., 2019; Toscano & Zappala, 2020; Baruch & Nicholson, 1997). The lack of efficient communication precludes work performance, hence many studies emphasise the need to provide teleworkers with organisational support precisely in this regard (Bentley et al., 2016; Nakrošienė et al., 2019). Some recent research has focused on analysing the impact of remote working environments on employees' career development. Remote working has the potential to stifle efforts to maintain engagement, and consequently, hinder the career development and progression of e-workers. This suggests that virtual mentoring is considered essential to ensure high performance among employees, who should continuously develop their skills while working virtually (Yarberry & Sims, 2021;Phillips, 2020). Research has emerged highlighting how to support remote e-workers. Park, Jeong and Chai (2021) proposed how human resource development (HRD) professionals can support remote e-workers' career development. The authors also point out the need for peace and quiet in the workplace (Wang et al., 2020).

Grant et al. (2013) and Nakrošienė et al. (2019) mention the role of the supervisor's trust and management style in shaping the productivity of remote workers. In the case of work done remotely, the control of the employee is difficult, hence the role of trust on the part of the supervisor and the need to focus on the results of work and not necessarily on the time of work increases. Torten, Reaiche, and Caraballo (2016) have proven that previous experience in teleworking is a prerequisite for success in teleworking. Some of the researchers also seek to identify whether gender or personality traits of telecommuters may determine the productivity of remote working (Cannito & Scavarda, 2020; O'Neill, Hambley & Bercovich, 2014; Hardy, Leandro & Fontanari, 2020; Chung et al., 2021). For example, Galanti et al. (2021) point out that when there is less control from the boss, remote work productivity gains are facilitated by remote workers' self-management competencies. In contrast, Wang et al. (2020) discuss the negative impact of employees' tendency to procrastinate on work productivity. In both studies cited here, the authors identified specific competencies or character traits that may foster or impede remote work. All of these factors are, in a way, a new group of factors that play an important role in shaping the productivity of remote work. When working on-site, employees do not have problems with social isolation, limited contact with other employees, or peace and quiet in the workplace. Some studies also identify other important determinants of high e-work productivity, such as job stability, the need for work-life balance, and job satisfaction (Galanti et al., 2021; Aboelmaged &

Subbaugh, 2012). However, the importance of these factors is similar in relation to shaping the productivity of stationary work. Osterman (1999) distinguished four organizational forms with different impact on productivity: self-directed work teams, job rotation, problem solving groups, and Total Quality Management. Procter (2008) indicated the factors that shape the productivity of remote work, which depend on work organization and HRM, by focusing on employee attitudes and strategies influencing productivity. He pointed out the need to understand the system of the management-employee relations, which might generate effects of the management actions.

All of these analyses may help to organise remote work in a way that is conducive to productivity or, in other words, to develop better remote work policies (Tanpipat, Lim & Deng, 2021).

Based partly on the literature discussion and own observations, 13 factors that may determine the productivity of remote work were adopted for investigation: the use of Information Communication Technology (ICT) tools, the frequency of remote working, the use of technical assistance during remote work, workplace adaptation, the quality of the Internet connection, work environment, the level of stress, the manager's control over the employees, communication with the manager and/or client, costs of remote working, savings of travel time to work, access to social insurance, as well as good career and promotion possibilities. Based on the literature analysis, the following hypothetical relationships (H) were set to verification with reference to the 13 factors mentioned above:

H1: A higher number of ICT tools improves remote work productivity; it is hypothesised that a higher number of ICT tools used by an employee indicates more advanced technical knowledge, which, in the case of remote work, translates into the ability to achieve higher productivity (and vice versa),

H2: The higher the frequency of remote working, the higher the productivity; it is hypothesised that more frequent remote working promotes increased productivity (and vice versa),

H3: Frequent use of technical support translates into reduced productivity of remote working; it is hypothesised that frequent use of technical assistance translates into lower productivity of remote work (and vice versa),

H4: Proper adaptation of the workplace contributes to increased productivity while performing work online; it is hypothesised that the right adaptation of the workplace promotes productivity growth during work (and vice versa),

H5: A stable Internet connection is clearly conducive to increasing the productivity of remote work (and vice versa),

H6: Peace and quiet favour productivity; it is hypothesised that peace and quiet are conducive to being productive (and vice versa),

H7: Increasing stress levels have a negative impact on the productivity of remote working; it is hypothesised that increasing levels of stress negatively affect the productivity of remote working (and vice versa),

H8: Limited managerial control may translate into less productive work done remotely; in this case, it is hypothesised that this factor may translate into lower productivity for employees working remotely,

H9: Limited communication with the manager and/or the client translates into reduced productivity when working remotely; it is hypothesised that limited communication with the manager and/or client may translate into reduced productivity of remote working,

H10: Rising costs of remote work borne by the employee will be accompanied by a fall in declarative productivity; it is hypothesised that the increasing costs of remote work, those of the employee, would be accompanied by a fall in declarative productivity (and vice versa),

H11: The time saved on the commute to an onsite job can increase the productivity of work done remotely; it is hypothesised that time saved on the commute to an onsite job can increase the productivity of work done remotely in two ways. This 'extra' time may be used either for work (overtime) or for leisure. In both cases, it will translate into an increase in declarative productivity,

H12: Access to social security and real protection of the remote worker is conducive to being productive; it is hypothesised that access to social security increases the psychological comfort of work, which clearly favours being productive (and vice versa),

H13: Career and promotion possibilities increase the productivity of e-work; in this case, it is hypothesised that the opportunity for career advancement favours remote working, and that as promotion opportunities increase, the productivity of part-time work will increase (and vice versa).

2. Research methodology

The research design serves to determine the purpose of the research, to define the methods and clarify the strategy of choice for conducting the study (Apanowicz, 2002). Regarding the potential impact of remote work on labour productivity in Poland, the Czech Republic and Hungary, this study seeks to identify factors determining labour productivity of individual workers who perform their jobs remotely and to measure the importance of factors determining labour productivity. It also identifies the most important factors which employers should take into consideration. The study involved the following procedure. First, potential productivity factors of remote working were established based on the literature and assumptions were made about their impact on productivity. On this basis, a survey questionnaire was developed, which

consisted of two parts. The first, introductory part contained questions qualifying the respondent to participate in the analysis and presenting their type and mode of work. The second part of the survey contained 20 diagnostic and prognostic questions, related to the remote work performed and its significance for the shaping of productivity. The nature of these questions and the expected answers present information through the prism of the views and evaluations of the surveyed individuals and they fall within:

1. cost driven factor of productivity (e.g. wages, expenses for technical adaptation of the workplace, securing working conditions and health and safety at work),
2. organisational aspects of remote work affecting productivity (e.g. continuous technical support, division of labour, workload, promotion possibilities, employee control),
3. quality scope of issues (e.g. freedom to organise working time and to choose the intensity of work, autonomy and independence, working environment).

The next stage of the study involved statistical analysis of the survey results. The analysis of the data obtained through the survey was based on a logistic regression for the dependent variable of labour productivity, whose vector was determined through the survey. The results of the relationship between the productivity factors and the dependent variable were subjected to k-means analysis for obtaining ensembles of characteristics of the survey respondents. Logistic regression was considered since the nature of the dependent variable, which is nominal, dichotomous in nature. In other words, the measured behaviour of the research participant's assessment of his or her productivity either increased or decreased with remote working. The result of the measurement is in this case zero-one. The results of the analysis became our main source for the proposed conclusions about the drivers of the productivity studied.

Remote workers who were eligible to provide the needed information as remote workesr now and in the past were selected to conduct the survey and set the scope of survey sample. As highlighted by J. Apanowicz (2002) several study approaches can be applied. The options include experimental survey, archival research, storyline or case study research. Each strategy has advantages and disadvantages; moreover, they can be used alternatively in research. Accordingly, the data were gathered through a survey questionnaire which best met the objectives of the study. The questionnaire consisted of questions about opinions and facts. It used close-ended and cafeteria questions addressed at respondents of varying age, sex, and education, and representing different business sectors. The questionnaires were administered by interviewees when posted online by research agencies (different in each country) at the same time. A cross-sectional study design was applied to collect data needed for this research. As a result, the data were collected at a given point in time (June 2021) by CAWI survey for the entire sample (450, but with a country quota of 150). The survey was carried out by three different research agencies, one in each country on its own group

of declared respondents. The target population consisted of all citizens living and working fully or partly remotely in the present or in the past, regardless of how long and how often, with a quota cross-section of age, gender and occupation. All questionnaires proved to be valid. Conducting the survey with the help of a research agency ensures the credibility of the respondents and has advantages over surveys conducted anonymously using an online method among previously unrecruited and unreliable respondents. This was to ensure that the results are more applicable to studies which aim to identify and measure the importance of factors determining labour productivity by individual remote workers. Thus, the results are more pertinent and they can be used to generalise for targeted populations.

2.1. Sampling procedure and analytical tools

Sampling is traditionally performed by two approaches. They are based on probabilistic or non-probabilistic methods and have some subordinate types of procedures, such as determining the sample according to a common format, stratified or systematic testing, and others (Apanowicz, 2002). Probabilistic methods assume explicit sampling, while non-probabilistic methods include purposive sample collection, snowballing, and qualified sampling (Bhattacherjee, 2012). In this study, probability sampling is valid and assumes that every representative of the population over the age of 18 has the same chance of being selected. It is unbiased and has a sufficient size for the results to be reliable (Bhattacherjee, 2012). The researchers of this study used a probability sampling approach and randomly selected 450 respondents. As a result, data was collected at a given point in time (June 2021) for the entire sample, but the country quota was 150. The sample was stratified according to the three countries selected for the study.

In order to determine the sample size, the analysis should verify the actual size of the phenomenon being analysed, rather than just follow statistical calculations. Major factors such as the confidence level and margin of error (confidence interval) should be identified. In this study, 95% confidence level and 5% margin of error are adopted. Based on the statistical calculation, it appears that for a population of 100.00+, the sample size should be at least 384 individuals (https://www.naukowiec.org/dobor.html. 10.09.2021). However, in order to improve the quality of the study, the sample size was increased to 450 individuals, so that the cut-off point decreased below 5%. The target size set at 450 was met even though respondents were eliminated after they said no to the question 'Have you ever worked remotely?' In such cases, the researchers replaced such respondents with new ones to maintain the sample size of 450. All questionnaires collected were valid.

Once the scope of the data has been defined, appropriate analytical methods were selected and implemented. Logistic regression and k-means are the methodological tools used in our study. The use of logistic regression is com-

mon in labour market and productivity analyses. In Slell's (2020) study, logistic regression and nonparametric tests were also used to reveal the relationship between occupations included in external labour markets and macro, meso, and micro variables, with managerial and theoretical implications. As the labour market is constantly changing, atypical work is becoming more relevant, especially in the current times of the coronavirus crisis restrictions. Davidescu, et al. (2020) found logistic regression to be suitable for highlighting the importance of employee development and employee flexibility as important aspects of sustainable human resource management in increasing the overall level of employee work. The paper by Sablok, et al. (2017) investigates the extent (using frequencies) and determinants (using logistic regression analysis) of training and development expenditure, management development strategies, talent management and succession planning policies. Yi and Ifft, (2019) used cluster analysis to divide dairy farms into three productivity categories (high/medium/low) based on return on farm equity, asset turnover ratios and net dairy income per hundred kilograms of milk. With respect to remote work, our proposed set of analytical techniques is in line with Davidescu at el. (2021), who applied logistic regression to test whether and to what extent teleworking, as an important source of workplace flexibility, can affect the way Romanian workers self-evaluate their level of satisfaction, and then extracted subgroups to find the main differences between them. The study reveals that flexibility is an important factor contributing to satisfaction and varies by region, sector and company type as well. Investigating the data according to the above literature, our study shapes the way to achieve the results presented below.

3. Research results

The designed research questionnaire on labour productivity under the conditions of modern forms of employment essentially consisted of two parts. The first—introductory part—included questions qualifying the respondent to participate in the analysis, a personal data sheet, as well as questions about the general forms and conditions of work. This part was aimed at obtaining the necessary information about the respondents for the analysis. The second part contained 20 diagnostic and prognostic questions related to remote work and its significance in shaping productivity.

The survey involved 450 respondents from Poland, the Czech Republic and Hungary. Men accounted for 55.8% and women for 44.2% of the respondents. The most numerous group were respondents between 30 and 50 years old. 64.2% of the respondents had higher education, 33.1% had secondary education, and less than 2.7% had vocational and primary education. The vast majority of the respondents (78%) worked in the service sector. 70.9% of the respondents worked in a hybrid way, combining remote work with work at the

employer's office, while the rest worked exclusively remotely. 44.2% of the respondents worked remotely every day, 32% several times a week, and the rest occasionally: several times a month or even a year. The most frequently declared form of work was an employment contract (81.3%), and nearly 11.6% were self-employed.

Furthermore, the dominant group are workers who declare an increase in productivity when working remotely (46.7%), while remote work with low productivity accounted for only 23.6% of the responses. The remaining respondents were unable to clearly indicate whether the current conditions of their remote work are conducive to an increase or decrease in their productivity.

Table 3 shows the distribution of responses by age, gender, level of education, divided into an increase in productivity, and a decrease in productivity. Most respondents declared an increase in productivity when working remotely and these respondents can be divided by group characteristics. People between 30 and 50 years old dominated among the respondents reporting a growth in productivity. In addition, both men and women (21.6% and 25.1% of the total respondents) predominated among those declaring an increase in productivity. Taking into account the level of education of the respondents, people with higher education (29.6% of the total number of respondents) and with secondary education (16.2% of the total number of respondents) said that their productivity increased when working remotely clearly prevailed. On the other hand, the feeling of reduced work productivity affected 23.6% of the total respondents, mainly those with higher education (14.9% of the total).

Table 3. Distribution of respondents according to declared increase or decrease in productivity of their remote work

'Current remote working conditions'		Decrease in productivity	Difficult to say	Increase in productivity	Total
Age	< 30 years	5.3%	3.3%	7.3%	16.0%
	30-50 years	10.9%	15.6%	21.7%	48.2%
	> 50 years	7.3%	10.9%	17.6%	35.8%
Sex	female	9.3%	13.3%	21.6%	44.2%
	male	14.2%	16.4%	25.1%	55.8%
Education	primary	0.4%	0.0%	0.4%	0.9%
	vocational	0.7%	0.7%	0.4%	1.8%
	secondary	7.6%	9.3%	16.2%	33.1%
	higher	14.9%	19.8%	29.6%	64.2%
Total:		23.6%	29.8%	46.7%	100%

Source: Own calculation.

In this study, to determine whether there is a relationship between 13 factors representing work organisation and work motivation groups and changes of productivity, the researchers implemented logistic regression models using the progressive selection method. Table 4 includes univariate logistic regression models and tests. To obtain more reliable data, the researchers employed logistic regression to test the 13 formulated statistical models (H) (1st column of Table 4).

In Table 4 we can see that 11 out of the 13 relationships are confirmed, while 2 out of the 13 are insignificant (rows 1 and 10). Another 11 out of the 13 confirmed relationships show varied levels of correlation with labour productivity growth. Given that there is no statistical significance for the 1st and 10th factor, the interpretation of the statistical data will only cover the remaining 11 productivity factors.

H2: The result for increased work frequency indicates that we are 3.4 (OR = 3.422) more likely to achieve higher productivity compared to a situation with lower work frequency. The β coefficient of regression was found to be statistically significant (Z2 = 18.384, p = 0.000) and the expected probability of increased productivity is 86%.

H3: The data for low frequency of technical support (TA) use indicate that we are 2.4 (OR = 2.354) more likely to have higher productivity compared to a situation where the frequency of TA use is higher. The β coefficient of regression was found to be statistically significant (Z2 = 5.126, p = 0.024) and the expected probability of increased productivity is over 92%

H4: The regression results for the right adaptation of the remote workspace indicate that we are 4.7 (OR = 4.693) more likely to achieve higher productivity compared to the situation where the workspace would be poorly adapted to work. The β coefficient of regression was found to be statistically significant (Z2 = 21.065, p = 0.000) and the expected probability of increased productivity is 91%.

H5: The data for maintaining the quality of the Internet connection at the right level indicates that we are 2.7 (OR = 2.679) more likely to achieve higher productivity compared to when the quality of the connection is inadequate. The β coefficient of regression was found to be statistically significant (Z2 = 8.817, p = 0.003) and the expected probability of increased productivity is 90%.

H6: Data on a guaranteed quiet and calm environment for doing remote work indicate that we are 4.8 (OR = 4.799) more likely to achieve higher productivity compared to a situation where this environment would not provide a guarantee to work in peace and quiet. The β coefficient of regression was found to be statistically significant (Z2 = 20.692, p = 0.000) and the expected probability of increased productivity is 92%.

H7: The data on increased stress levels while working remotely indicate that we have a 0.05 (OR = 0.046) greater chance of decreased productivity

Table 4. Univariate logistic regression models and tests

Dependent variable = productivity of remote work							Pooled test of model coefficients		
H	**Independent variables:**	**B**	**Stand. error**	**Wald**	**Sig.**	**OR**	**Cox's, Snell's R2**	**Nagel. R2**	**p**
1.	Number of ICT tools	–	–	–	0.445	–	–	–	–
2.	Frequency of remote working	1.230	0.287	18.384	0.00	3.422	0.058	0.091	0.859
3.	Frequency of use of technical support	–0.856	0.378	5.126	0.024	2.354	0.017	0.034	0.920
4.	Adaptation of the workplace	1.546	0.337	21.065	0.000	4.693	0.073	0.125	0.909
5.	Stable Internet connection	0.985	0.332	8.817	0.003	2.679	0.029	0.051	0.896
6.	Peaceful and quiet work environment	1.568	0.345	30.692	0.000	4.799	0.072	0.126	0.918
7.	Stress levels	–3.080	0.353	75.982	0.000	0.046	0.289	0.432	0.065
8.	Manager's control over the employees	–1.096	0.272	16.275	0.000	0.334	0.062	0.082	0.440
9.	Communication with the manager and/or client	–1.325	0.258	26.340	0.000	0.266	0.087	0.199	0.263
10.	Costs of remote work	–	–	–	0.639	–	–	–	–
11.	Commute time savings	1.219	0.219	17.522	0.000	3.385	0.073	0.097	0.568
12.	Access to social security	0.625	0.240	6.788	0.009	1.868	0.015	0.024	0.843
13.	Career & promotion possibilities	1.782	0.297	35.931	0.000	5.941	0.147	0.199	0.740

Source: Own calculation, based on SPSS, IBM Statistics.

compared to absence of stress. The β coefficient of regression was found to be statistically significant (Z2 = 75982, p = 0.000), and the expected probability of decreased productivity is less than 7%.

H8: The results for limited (remote) managerial control over employees indicate that we are 0.3 (OR = 0.334) more likely to achieve lower productivity compared to a situation with traditional control. The β coefficient of regression was found to be statistically significant (Z2 = 16.275, p = 0.000) and the expected probability of decreased productivity is 44%.

H9: The data on limited (remote) communication with a manager and/or a client in a remote working setting indicate that we are 0.3 (OR = 0.266) more likely to achieve lower productivity compared to a situation where this communication would take place in a traditional manner. The β coefficient of regression was found to be statistically significant (Z2 = 26.340, p = 0.000) and the expected probability of decreased productivity is 26%.

H11: The data for increased saving of time spent commuting to and from work indicates that we are 3.4 (OR = 3.385) more likely to achieve higher productivity compared to when the respondent would spend more time commuting to and from work. The β coefficient of regression was found to be statistically significant (Z2 = 17.522, p = 0.000) and the expected probability of increased productivity is 57%.

H12: The results for increased/guaranteed access to social insurance indicate that we are 1.7 (OR = 1.868) more likely to achieve higher productivity compared to a situation where access to insurance would be limited. The β coefficient of regression was found to be statistically significant (Z2 = 6.788, p = 0.009), and the expected probability of increased productivity is 84%.

H13: The data on career advancement defined by the possibility of remote work and career advancement indicate that we are 5.9 (OR = 5.941) more likely to achieve higher productivity compared to a situation where taking on additional work and/or achieving advancement would be limited. The β coefficient of regression was found to be statistically significant (Z2 = 35.931, p = 0.000) and the expected probability of increased productivity is 74%.

Taking all the results into consideration, 11 out of the 13 hypotheses have been confirmed, while two of them cannot be confirmed or rejected (Table 5).

Taking into account the results of the analysis, the individual productivity factors can be ordered according to their odds ratio for achieving higher productivity (OR index). Based on the results obtained, it can be assumed that the factors that increase the chances of enhancing the productivity of remote work are mainly the possibility of taking up employment (including additional work) and career development. It is as if remote working offers greater potential for accessibility to finding attractive employment in the labour market, and is recognised as an element which improves an employee's chances in the

Table 5. Summary of logistic regression models

	Research output	Relationship verification
H1:	Result statistically not significant	Not confirmed and not rejected
H2:	There is a relationship between the frequency of remote working and productivity. Increased frequency of remote working is accompanied by increased productivity (and vice versa).	Confirmed
H3:	Frequent use of technical support and remote work productivity are correlated. Frequent use of technical support may reduce the productivity of remote working.	Confirmed
H4:	Proper adaptation of the workplace can translate into increased productivity of remote working.	Confirmed
H5:	Stable Internet connection increases the productivity of remote work.	Confirmed
H6:	The peace and quiet of the remote working environment is conducive to increased productivity.	Confirmed
H7:	Increased stress translates into reduced effectiveness of remote working.	Confirmed
H8:	Manager's lack of full control over employees can be conducive to decreased productivity.	Confirmed
H9:	Limited communication with the manager and/or the customer translates into a loss of productivity.	Confirmed
H10:	Result statistically not significant.	Not confirmed and not rejected
H11:	Saving time on commuting is linked to increasing the productivity of remote working.	Confirmed
H12:	Social security guarantee translates into increased online productivity.	Confirmed
H13:	Career and promotion opportunities increase the productivity of remote work.	Confirmed

Source: Own elaboration.

labour market. Other important factors also include the guarantee of a quiet and peaceful working environment and the proper adaptation of the workplace to remote working. Qualitative factors play a far greater role than organisational factors, and cost factors influence is ambiguous to establish in the study. However, among the organisational factors increased remote work productivity was also significantly associated with factors such as increased frequency of remote working, or increased time savings for commuting to and from work. The other factors analysed have a lower odds ratio for improved remote work-

ing productivity, but nevertheless have a positive impact on increased remote working productivity (Table 4).

Following the research model with the results of the logistic regression study, a pooled k-means analysis was conducted to determine a summary outline of the attitudes of a remote worker. The 11 variables whose effects on labour productivity were found to be significant in the logistic regression test were used for k-means analysis (Table 4). Silhouette index values indicate the significance of the combination involving five variables for two and three clusters groups (0.22 and 0.23 respectively). In the case of the two clusters (Figure 1), the first group shows people who achieve lower productivity in remote work conditions while remaining under managerial control, when communication at their work is not limited, and remote work does not increase their stress level. The second group includes people who declare high productivity in the conditions of remote work, work in conditions of low managerial control and strongly limited communication, but their stress level is higher.

In the case of the three clusters, the first group is composed of people who achieve high productivity in remote working conditions while remaining under the manager's control. Communication with the company is not limited, and working remotely does not increase their stress level, but gives them a chance for promotion. The second focus group is people who report very high productivity and work in conditions of limited managerial control and communication with the company, and their stress level is high, however this work offers opportunities for promotion. The profession of a software developer could

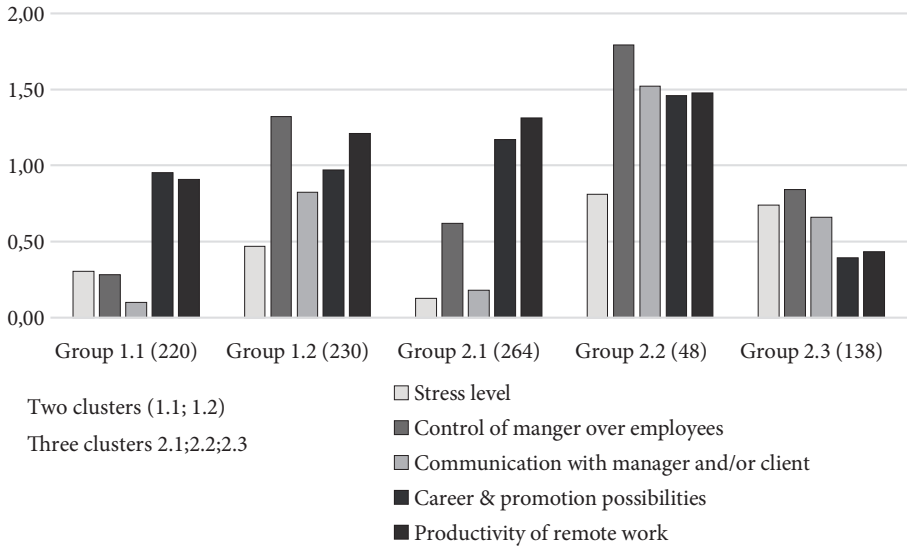

Figure 1. Cluster analysis for two and three clusters group, quantity of group, values

Source: Own calculation, based on SPSS, IBM Statistics.

have such potential. The third group are those who declare low productivity in remote work and are under the control of a manager. Communication in their work is smooth, but they experience higher stress and the chances of advancement in their career remain very poor. This attitude can be identified with low-paying occupations and routine work such as accounting. As can be seen from the k-means analysis, the productivity level of employees is mainly associated by stress and managerial control. The lover they are the lover productivity reveals, and vice versa. Moreover, a noticeable feature of employee attitudes is also potential promotion opportunities, which is associated with higher productivity. This means that the tendency to work more productively does not necessarily diminish with the implementation of remote work. Our study shows that another distinguishing factor is the type of work task, as favourable results in terms of productivity include those activities that are under regular control and those where independence and autonomy prevail.

Our analysis is in line with the recent empirical literature on labour productivity, i.e. virtual work characteristics are related to productivity, but they also highlight the heterogeneity of workers in terms of labour productivity. A worker with a high routine workload but subjected to control treats it as support, on the other hand, a worker with a higher level of self-discipline works more efficiently under less control (Wang et al., 2020). In addition, the authors emphasise that other factors, especially stress, work intensity, the Internet connection quality, and lack of peace and quiet are important determinants of labour productivity (Toscano & Zappalà, 2020; Wang, Liu & Qian, 2020; Procter, 2008; Baruch & Nicholson, 1997). It can be also related to organisational culture. As studied by Krajcsák, Z., i in. (2022), the results highlighted that due to the home office the dominant organisational culture determines the effects of remote working. In organisations with a dominant market culture, the effects changed the least. In organisations with a dominant clan culture conscientiousness, work decreased. The dominant hierarchical culture reacted most negatively. Our analysis are complementary to thesis on productivity determinants which are stated by Pokojski, Z. (2022) based on 248 employers survey. Results show that employers often notice the positive nature the similar group of factors as worker do. Among the enterprises that were surveyed, the most frequently indicated were: additional office equipment provided to an employee, remote work training, and the installation of additional computer programs. Financial support was declared by olny about 11% of the enterprises and it usually took the form of a remote work allowance or funds to cover the costs of purchasing equipment or paying for the Internet.

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Conclusions

Remote work has become a necessity among many professions, regardless of age or education level. For various reasons, work in this form facilitates the implementation of tasks that cannot be performed on-site, that is at the headquarters of the company. Due to this necessity, business owners and customers commission tasks from contractors without securing the conditions to perform the task. The relatively large physical distance means that the result of the performed work may not meet the expected requirements. The productivity of remote work has become a subject of consideration in the literature due to its key role in business. Generally, part of the discussion cited in this paper is studies on the factors that regulate the levels and trends of productivity. They were the core basis of devised questionnaire. Our statistical research on data received revealed that the group of 11 defined factors is positively (8) and negatively (3) related to remote work productivity. Some factors were found to be insignificantly related to productivity in our study. We cannot confirm the relationship between 'a high number of ICT communication tools', 'costs of remote work', and productivity, although there is a basis in the literature to claim that their relationship occurs.

The answer to formulated objectives in paper introduction as to identify factors determining labour productivity of individual workers who perform their job remotely and to measure what factors have relatively the greatest impact on productivity, presents the scope of factors with OR logistic regression measure defining the factor importance. According to our research, in order to achieve high productivity in remote work, it is worth taking into account factors that are four times more likely to increase productivity than to decrease it. These include adapting the workplace (OR:4.7) to the skills and qualities of workers which is relatively easier for highly educated workforce. Work organization features such as a quiet and peaceful environment are also very important (OR:4.8), especially that remote work is performed not only at home but also on business trips. Work satisfaction factors represented by good career and promotion opportunities seem to have the greatest impact on productivity (OR:5.9). Although limited control and communication with the manager as well as the stress for an employee who has limited opportunities to verify his/her work and can only trust himself/herself were found to be important. Their impact on productivity was rated at less than one chance of productivity loss.

The collusion from study focus on qualitative factors of higher labour productivity which are skills and qualities, promotion and future career. The organization issues however could be expected as very important but revealed less important. So adaptation of the workplace, a stable Internet connection impact productivity but less than for example a worker promotion. Costs of remote work, taken into account were not identified as statistically significant.

It should be recognised that the level of productivity achieved in these unique working conditions is primary an individual matter for the employee. Secondly, in the paper underlined the importance of investing in the quality of work. In the paper, the authors have underlined the importance of undertaking financial and organisational measures to encourage workers and managers to formulate new systems of work communication and work control. As it reveals from K-12 study that the higher control and stress can be expected directly related to higher productivity of work.

Remote working in the digital economy will trigger certain economic policy measures. Taking into account that the countries under study are at a similar level of economic development and belong to the European Union, moreover, these countries cooperate within the Visegrad triangle and their system of functioning is highly based on the market mechanism, these actions should be taken both by individual manufacturing or service companies and on the scale of the whole economy. The most important microeconomic tasks include: continuous and flexible adaptation to changing market conditions. Moreover, the adaptation of the commodity structure of products or services to the market demand will be an important factor increasing the effects of remote work and thus leading to the improvement of labour productivity dynamics. Timely delivery of the economic policy instruments on offer will also be an important factor, so that digitisation takes place at a pace balanced with the learning process. An important direction of influence on a micro-scale should be technical and organisational support for people working remotely and a system of their training.

Study has some limitations. First, relationship issues may result from any unobservable, unidentified variables in the matching model, and may also result from the cross-country nature of the data. Second, the one-time sampling procedure forced us to use data as our main dataset with limited availability of data-independent variables. The limited number of responders from each country made us to strongly limit on separate conclusion to each one.

The authors recommend further research to carry out an in-depth study on labour productivity taking into account microdata based on employee-employer relations. In this situation, research should yield a better understanding of the risks and threats of the development of the remote working model.

Future research using statistical data should include the issues of adaptation of companies to new conditions in the era of digitisation and state policy support for programs of on-the-job training and support in implementation of innovative managerial solutions (Procter, 2008). The increased interest in the

productivity of remote workers and its possible explanations (OECD, 2021) indicate that better management of remote or hybrid work requires further studies on determinants of work motivation in a digitalised economy. Nowadays companies face high pressure of work-from-home rules and try to regulate its chronology and time scope with inconsistent results in mutual satisfaction. Recent studies on micro data highlight the importance of new law rules and norms referring to remote work (Bernstein et al., 2020). Thus, it is important to examine the role of company management and intangible labour productivity factors based on micro data and a broader range of factors.

The study reveals a set of factors influencing the level of productivity of remote work, which concludes about some challenges, risks and opportunities that should be considered by those employers and employees who wish to stay with remote working in a full or hybrid form (Eurofound, 2021). The authors consider the obtained results valuable for researchers engaged in studies on the organization and management of labour resources for better generation of added value gained from remote work.

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