Nierówności Społeczne a Wzrost Gospodarczy, nr 55 (3/2018)
DOI: 10.15584/nsawg.2018.3.27 **ISSN 1898-5084**

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Impact of weather conditions yield

Introductory remarks

Attaining high labour productivity is widely recognized as one of the most important parameters of economic development, as it leads to reduced costs, increases the supply of cheaper goods and services and a more dynamic market, and translates into increased purchasing power of the overall population, as well as increasing their wealth and competitive ability. Hence it is important to identify the factors affecting labour productivity. Beside to the most obvious factors, such as wages or work organization, other factors that affect productivity should be taken into account, such as diet, physical activity and weather.

The purpose of this article is to answer the following questions: is there an accurate way to measure the impact of weather on the employee's productivity? Are all employee affected by weather conditions equally, or are there people who are more (or less vulnerable) to weather? Does gender play a role in the effects of weather on productivity of work? To what extent, in comparison with other factors, does weather affect performance? Is it possible to identify the weather factor(s) that most negatively affect productivity?

To answer the questions above, the research method used in this study consisted of a survey carried out on the basis of a prepared questionnaire of 314 white-collar workers in the Lodz region (random sampling of the branches, where the financial result is not subject to seasonal fluctuations).

The concepts of efficiency, productivity and labor yield

Efficiency is understood as the ratio of manufactured goods to the inputs of production factors involved in their production. Efficiency is an active feature, as

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reflected in the relationship between performance results obtained during a certain period of time to the effort necessary to achieve this in the time frame. It can manifest itself in the following formula: to maximize the level of implementation for a given number of copies or minimize the effort of maintaining the level of implementation [Lisiecka, 2003, p. 14].

In turn, the category of productivity follows a concrete relationship, being the result per unit of effort. Productivity expresses the efficient use of the available working time of employees, machines, or production lines and in a simplified manner, expressed as a percentage it can be calculated as follows:

PRD=[(number of pieces made)*(total time planned for the execution of one item)]/[(the total time available)*(quantity of made item)]*100%

If productivity is the quantity of goods produced per unit of labour time, then this is the yield [*Słownik ekonomiczny*, 1992, p. 211]. Yield in percentage terms is the ratio of the actual quantity of goods made to the expected amount to be produced within a certain unit of time, and in a simplified way it can be calculated using the following pattern:

WYD=(quantity of made item)/(quantity of item assumed by the standard)*100%

Analyzing the efficiency and productivity there should be taken into consideration the size of the deal in terms of the degree of implementation and planned activities and also objectives of the guidelines, and therefore in the context of effectiveness. In social terms, while the term productivity is understood as relating to mentality, the focus is on improving the continuity of the organization, especially the improvement of manufacturing processes to increase the efficiency of the work organization [Kosieradzka, 2000, p. 284].

The following types of labour yield can be distinguished [Gableta, 2006, p. 131]:
– Individual yield, which is the actual performance of a particular employee calculated based on effects characteristic of the type of work done;
– Team yield (group) is the average performance per one team member, obtained by dividing the performance of the group assembly by the number of its members;
– Social yield is the average productivity per employee calculated on trade, department, or the national economy scale.

Depending on the type of business and the strategy for enterprise performance can be affected by many factors, such as technological advances, stimulating pro-efficiency behaviour of employees, the introduction of quality assurance systems, saving materials and energy, or raising the level of qualifications of personnel.

Factors affecting the yield of an individual employee include time management, proper tools, training, a salary and cash incentive system, the relationship with immediate supervisor and working atmosphere, mental condition and physical requirements, time of day, or weather conditions.

Labour yield in Poland

Globally, productivity can be calculated by dividing real GDP by the number of employees or the number of hours worked, or as the ratio of the value added by the number of employees. Figure 1 shows the dynamics of labour productivity in industry, measured by gross value added per 1 employee. The values are calculated at constant prices, the base year is the year previous.

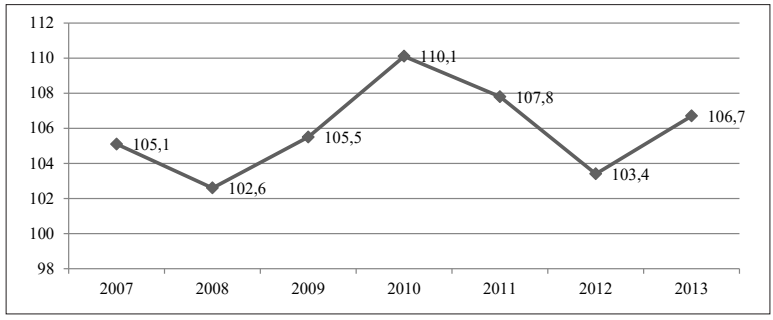

Figure 1. Dynamics of labor yield **in industry, measured by gross value added per 1 employee in 2007–2013**

Source: Own study based on the Statistical Yearbook of Industry (2014), Central Statistical Office (Polish GUS), Warsaw, p. 253.

Figure 1 clearly shows that productivity, as well as other economic quantities, forms a changing wave. After a period of growth in 2008–2010, achieving the highest value in the period considered, there was a period of decline, after which the performance started to increase again.

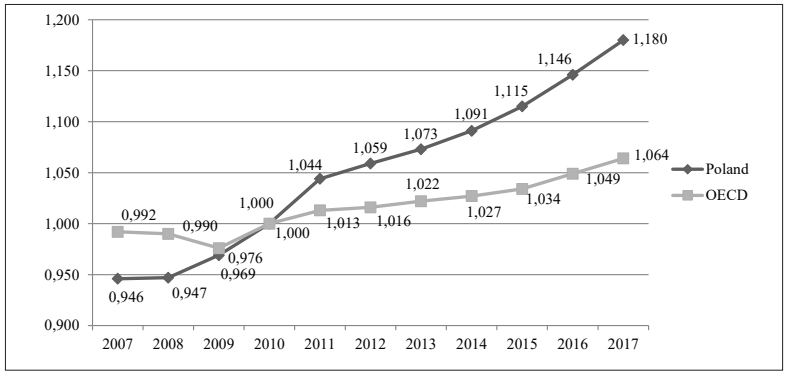

Figure 2. Comparison of labor productivity in Poland and in the countries of the OECD, the "labor yield of the total economy"

Source: Own study based on OECD, Economic Outlook No 94 – November 2015 – OECD Annual, 4.03.2016, Projectionshttp://stats.oecd.org/Index.aspx?DataSetCode=EO.

Figure 2 shows a comparison of labour yield in Poland and the average calculated for OECD countries. The year 2010 is the year of reference, and therefore assumes a value of 1. In both the OECD data and in Poland, there was a positive change in labour yield after 2010. Between 2016 and 2017 it is projected to further increase. But while average labour yield in the OECD also maintains a positive trend, it is of a lower magnitude than in Poland. Labour yield in Poland is thus higher than the average achieved by all countries of the OECD.

FACTORS AFFECTING THE PERFORMANCE OF WORK – LITERATURE REVIEW

The development of labour productivity in a given period at a certain level is the result of the interaction of many factors. Therefore one can speak of the synergistic effect of various factors of productivity. Although each of these can interact with different observable intensity, nonetheless certain regularities in terms of efficiency, determined by a plurality of causes (factors), can be observed. There are also however 'side effects', which occur sporadically in individual cases, the effect of which makes it difficult to discern any regularity.

As indicated by M. Hsie [2009, p. 762–768] among the many factors affecting the individual performance of employees mentioned time spent outside the workplace and the time of the rest, and free time which one can spent with family. The model WLB (work-life-balance) were observed many benefits of the appropriate amount of time spent away from work [Townsend, 2012, pp. 443–445]. Another model presented by S. Ahn, indicating the impact of employee absenteeism and social problems on work performance [Ahn, 2013, p. 1015].

Another important factor, as indicated by Beynon [Beynon, 2000, p. 1763], is the organization of work, which is much more effective at reducing rotation at the workplace [Tharmmaphornphilas, 2004, p. 251]. Also reduced staff rotation make work safety and employees are more involved in the realization of objectives [Carnahan, 2000, p. 544].

On employee productivity is also affected their mental condition, and therefore the level of stress, tiredness, health status and age [Hermanowski, 2013, p. 48], also contact and relationship with immediate supervisor about this situation was writing T. Oleksyn in "Art management" M. Wykowska in the book "Ergonomics", A. Stabryła in "Controlling systems, monitoring and auditing", B. Kożuch "Management. Basic principles".

Another large group of factors affecting performance is the motivation system, from payroll system for the lifestyle and self-esteem [writes about that couples authors such as Mikrut and Tomasiewicz, 2009; Siwek, 2009; Borkowska, 1985; Sikorski, 2004; Krzysztofek and Kumańska, 2011; Maj, 2007].

Among the other factors that may affect on individual work prodictivity are day of the week, experience or and adaptability to new conditions of pay and the ability to adapt to change [Maralah, 2014, p. 32].

One of the factors that may affect the individual performance are the prevailing weather conditions. The weather, as well as other factors that affect employee well-being, and the discharge of duties. Depending on the time of year crew may feel more or less tired and eager to take on new challenges. Periods autumn favor the so-called seasonal depression, which is associated with a lack of sunlight. The frequent occurrence of the disease is associated with maladjustment pace of life to the changing seasons and the insufficient amount of sleep and rest. In the summer heat can lead to a drop in comfort and concentration. Transitional periods and characteristic for them solstice lead to permanent fatigue and lack of willingness to act.

On the impact of weather conditions on productivity wrote not too many authors. This subject is undertaken in the case of the construction industry by H. Lee, who presented the model of correction schedules built Building due to the weather [Lee et al., 2009, p. 1289] and J. Zhao, who created a model of employee productivity in conditions of changing temperature parameters and wetness [Zhao et al., 2009, p. 2202].

Another industry which is undertaken about is agriculture, but the authors focus only on the impact of weather on the cultivation of the plants but not the productivity of employees.

Labour yield and the weather – own research

In the study group testing was carried out on both women (198, or 63.7%) and men (116, or 36.3%). They ranged in age from 31 to 40 years (44%); 18 to 30 years (26%); 51 to 60 years (14%); 41 to 50 years (10%); and over 60 years (6%). Most of the respondents were persons with a higher education – 66%; whereas 22% were persons with a secondary education, 10% were persons with a bachelor education; and 2% with a primary education. The majority, 57% of respondents, were employees of large enterprises (employing more than 250 employees; 20% were employees of medium-sized enterprises, 10% of small enterprises, and 13%, of micro-enterprises.

In some of the questions of the questionnaire study subjects were asked to determine on a scale of 1 to 5, to what extent certain factors affect their performance (1– irrelevant; and 5 – essential). As shown in Figure 3, for the majority of those surveyed (since 86 responses represent 27% of those surveyed), the weather was indicated as a factor of either medium importance or insignificant. However 76 persons (25%) believe that the weather significantly affects the performance of their work, and 38 (12%) consider it essential factor. At the other end of the scale, 28 people (9% of respondents) think that the weather has no effect on their individual performance. Thus the median for the weather factor of 3 is on average substantial, i.e. half of the respondents indicated the weather irrelevant or

insignificant or negligible (1, 2, or 3); while the other half indicated 3, or 4 and 5 (important and very important respectively). The average for all indications was 2.8, with a standard deviation of 0.83.

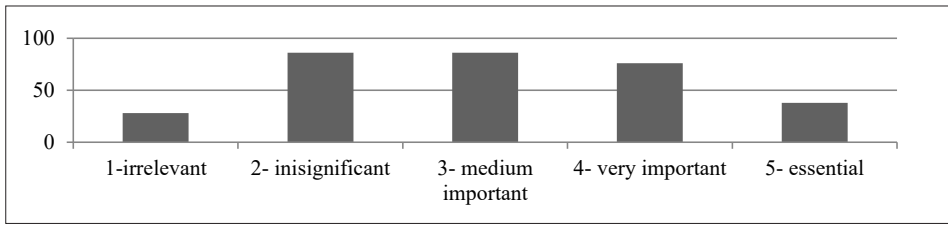

Figure 3. The impact of weather on personal yield

Source: Own study based on survey.

Analysing the results obtained broken down by gender, as shown in Figure 4, it can be seen that men more often pointed to the weather as a very important factor (17%) and as a less important factor (34%), while women more often pointed to as the weather as a factor that does not affect their yield. Other indications of the importance of weather did not differ according to gender by very much. The average for women for all indications of significance was 2.65, and for men 2.95. Half of the women chose the weather factor at a less significant level (less than or equal to 2.5; or rows affected or equal to 2.5). For men, the median was 3.5. (results from Table 1).

Table 1. Average and median divide by gender

	Women	Man	Totality
Average	2.65	2.5	2.8
Median	2.5	3.5	3

Source: Own study based on survey.

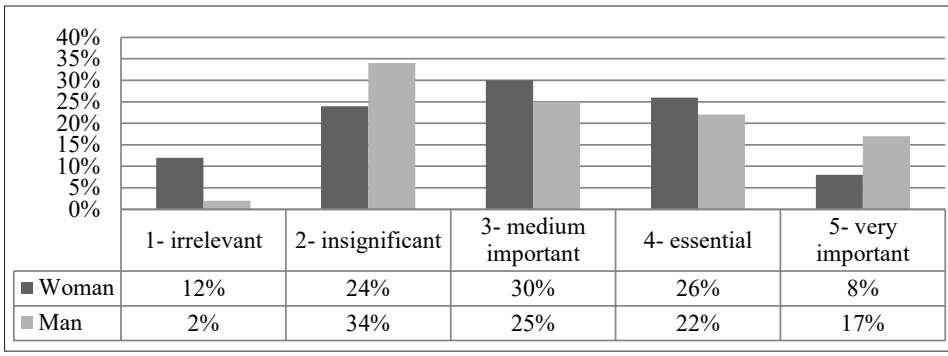

Figure 4. The impact of weather on personal yield, by gender

Source: Own study based on survey.

For the individual, employee yield is affected by the following factors:
– Salary – the main purpose for taking up employment.
– Financial system – motivating bonus: a well-constructed bonus system can significantly contribute to the growth of labour productivity.
– Tools – Those available are not only those necessary for the proper performance of their duties, but can also further motivate employees to work more efficiently and lessen employee turnover.
– Relations with supervisor and working atmosphere – good relations and a good atmosphere contribute to greater productivity, while bad relations and a bad atmosphere can lessen it and increase staff turnover.
– Weather.
– Time of day – some people work better in the morning, some in the afternoon, and others in the evening, while for others it does not matter.
– Organization of Workplace – good work organization allows employees to make the most of the time spent at work, while poor work organization contributes to the inefficient use of working hours.
– Private life – This may be associated directly with the stamina or mental health of a person; some people cannot fully devote themselves to work when they have problems of a private nature, which can significantly reduce their efficiency.
– The training system – A well-chosen, well-run training system raises qualifications and develops employees.
– Stress, pressure for results, and time pressure – This can sometimes motivate employees to work better, while it discourages others, and for others it does not matter.
– Regular rest - Permanent fatigue leads to a decline in productivity, an increased number of accidents at work, burnout, and occupational diseases.
– Physical activity - regular physical activity has a direct bearing on the health of employees, their improved mood and mental condition,
– Diet – a well-balanced diet contributes to good health and well-being.
– Health – health problems can lead to absenteeism from work or reduced productivity.

Of the above-mentioned 17 factors affecting individual performance, the category of "very important" i.e. 5 was chosen by respondents, *inter alia*, as follows: "a good atmosphere at work" – 156; "adequate remuneration" 154; "cash incentive system" (144). The "weather" factor took 14th place in this regard, with 38 respondents indicated it is a very important factor, while the least number of respondents (20) thought that "diet" was very important. As a "negligible factor", i.e.1, the highest number of such indications were given for "time of day" (46 responses), followed by "diet" (38), with "weather" being in third place with 28 indications.

Figure 5 shows the averaged results for the degree of significance. The factors occupying the 4th and 5th most important factors usually indicated appropriate "remuneration" and "a good working atmosphere", while the least important factor was "time of day". "Weather" took 15th place.

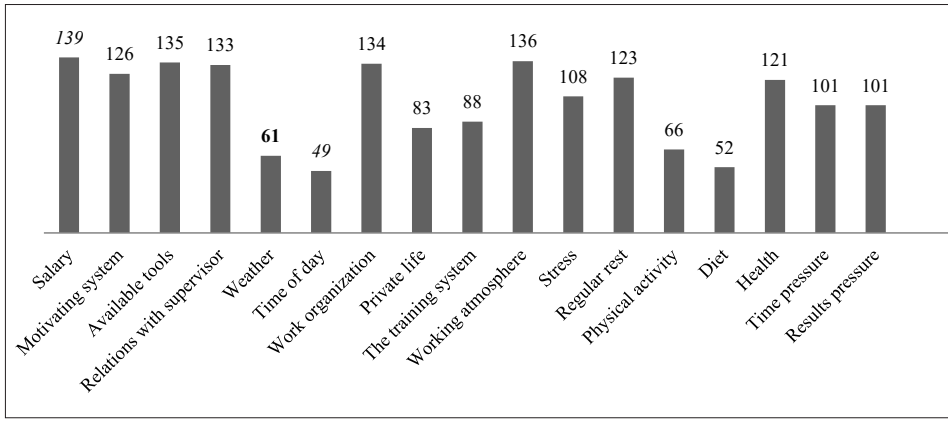

Figure 5. Factors significantly and very significantly affecting yield

Source: Own study based on survey.

Figure 6 shows that "diet", then "weather", then "time of day" were indicated as a factors having an impact, but only small one, by the respondents. Based on Figure 7 while we can see that the most respondents indicated "time of day" and "diet" as factors having the least impact, while "weather" here was in 15th place.

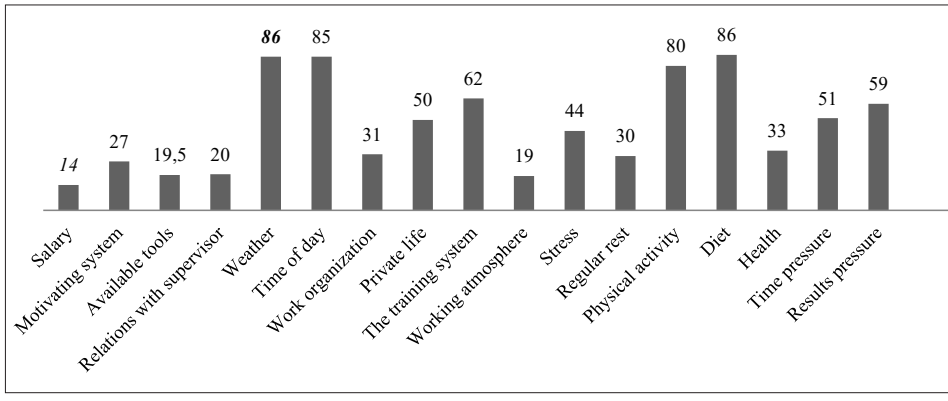

Figure 6. Factors having a small and medium affect on the yield

Source: Own study based on survey.

In terms of gender, the factor which female respondents indicated as the most important (5) and very important (4) was "good working atmosphere"(averaging results for the significance of 4 and 5 was 90% for women) and for men "salary" (92%). Fifty-three percent of women chose "weather" as a factor of low or medium importance, while 62% of men chose "time of day"

(62%). As a factor having no impact on yield of women most often indicated "weather" and "diet" (12%), while men most often indicated "diet" (25%) and "time of day" (22%).

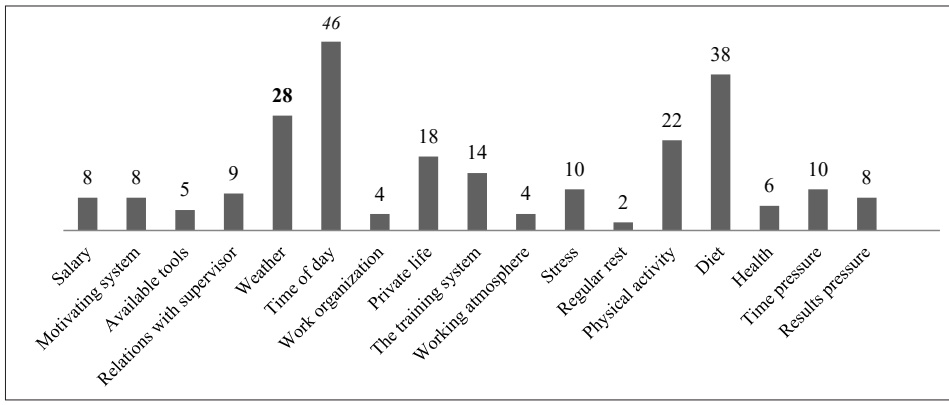

Figure 7. Factors not affecting yield

Source: Own study based on survey.

Among all of the factors that may affect the yield of work in the case of women "weather", with a level of significance of 5, was ranked in last place, while for men it ranked 14th. For the averaged value of the significance at levels 3 and 4 weather ranked in first place for women, while for men it was "time of day".

In another survey question, from five weather factors, being biomet, low temperature (below -5°C), high temperature (above 25°C), rainfall, and snowfall, respondents were asked to indicate on a scale from 1 to 5 the most relevant (5), average relevance (3) and irrelevant (1). Table 2 shows the results obtained. The surveyed individuals most often pointed to "snow" as irrelevant (106), with 102 respondents finding it of average relevance. The most important factor was "rain", while a factor deemed important or very important was "high temperature – heat". The highest mean and median was calculated for "high temperature – heat" (average of 3.3, with a standard deviation of 1.24, median 4), while the lowest average value and median was "snowfall" (average of 2.2 with a standard deviation of 1.17, median 2).

Analysing the results obtained from the questions designed to determine which weather factors are irrelevant and which the most important, it appears that both women and men assigned low values (of 1 and 2), to "snowfall", Women most often gave a value of 3 to "high temperature" and "rainfall", while the men most often chose 3 for "biomet". In turn, as a relevant factor (4) women more often chose "biomet" and men – "high temperature". As a factor that greatly affects (5) "high temperature" recorded the highest percentage of responses obtained from both men and women.

Table 2. The degree of significance of the weather[2]

WEATHER FACTOR / DEGREE OF SIGNIFICANCE	1-irrelevant	2-insignificant	3- medium important	4- essential	5- very important
Biomet	62	44	68	94	40
Low temperature (below -5˚C)	86	72	70	50	32
High temperature-heat (above 25˚C)	38	38	76	106	48
Snowfall	106	102	58	26	18
Rainfall	92	88	78	30	20

Source: Own study based on survey.

Respondents were also asked to indicate the season in which they felt most motivated to perform their duties, and the answer most frequently chosen was spring (March to May, 40%), while for 37% the season does not matter. A further 9% chose autumn as the most motivating season, 8% chose the summer, and 6% the winter. Spring term was also frequently pointed to as season in which subjects have take on new challenges and are more creative (29%), while 10% chose summer period, and 7% autumn and winter. For 47% of respondents the season did not matter in this regard.

An indirect indicator of labour productivity can also be difficulties in getting up for work and some respondents indicated a bigger problem with the start of the day. Characteristic behaviours in this regard include a reluctance to start another day of work and a longer time required to start duties, which in turn may translate into worse performance. The majority, 62.5%, declared that such difficulties occur in the autumn and winter, 36% that the season does not matter, while for the remaining 1.5% the issues were associated with the spring and summer seasons.

SUMMARY OF EMPIRICAL RESEARCH

Proper identification of factors affecting performance, such as the weather, will make it possible to effectively plan to employees' work to the maximum extent possible, and to more effectively make use of those periods when the weather is conducive to work, as well as diagnose the needs of employees and eliminate any maladies that may be the result of long-term ill effects leading to absenteeism and thus to additional costs for companies. Against the background of all the factors examined, weather conditions did not appear to be significant in the study.

However, when we look at partial results, it can be observed that a total of 37% of respondents think that the weather affects their productivity, 39% that it has an

[2] The sum of answers in each row does not add up to 314 (the number of respondents) because some respondents failed to answer.

impact, albeit small, and only 9% declared that weather conditions had no effect. In addition, the same people who indicated the weather as irrelevant or insignificant often indicated a significant or very significant impact of a specific weather factor (usually it was the biomet and heat).

For purposes of verification of the previously discussed indications in the survey the respondents were asked two more questions. In the first, they were asked to indicate their performance in different seasons – the largest group of respondents were people whose performance varies depending on the period (39%), and is very different depending on the season for 24%. The remaining 37% deem their performance to be the same for all seasons. In terms of gender, yield varies for 42% of women and for 25% is very different depending on the season, while the remaining 34% deemed their performance as the same for the whole year. For men, these values were, respectively, 36%, 24% and 42%. It should be underscored that the target group of the study was companies whose financial results are not significantly different seasonally.

In the second question, the respondents had to indicate whether a particular sentence applied to them. Sixty-four percent of respondents said that "when the sun is shining I have more energy and am more willing to spend time to work", while 57% agreed that "when the weather is nice I often think about what I will do after work", and 32% agreed that "when it rains, the only thing I think of is to lie under a blanket with a cup of tea in hand". The three above-mentioned questions can point to the fact that, depending on the weather, the workers are not always 100% focused on the work and are therefore less efficient.

Responding to the questions posed at the outset of this paper it can be said that the weather affects the yield of employees, but not for everyone equally. Some less, others more likely suffer a decline in labour productivity with respect to various weather conditions. But there are also people for whom yield is influenced by the weather just as strongly as salaries and good working atmosphere, and there are people for the weather is a totally irrelevant factor. One may be energized by beautiful weather and the sun through the window, while another loses concentration.

The weather factor having the greatest impact on productivity, for both men and women, is too high a temperature. The results developed for women suggests that they feel less impacted by the weather than men, yet women's performance varies significantly in different seasons. Perhaps this is due to the fact that women are much less likely than men to want to blame their condition on worse weather or treat bad weather as an excuse, but in reality it does affect them.

The results of the research indicate a significant problem – while the impact of weather on productivity is significant, it usually goes unnoticed or is ignored, despite the fact that it can be dealt with it if it is identified and taken into account in planning holiday periods.

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Summary

Labour productivity depends on a number of factors, starting from the most obvious – wages/salary, to work organization and to those less often taken into consideration, such as the weather. Weather affects employees' well-being, and thus the discharge of their duties. Depending on the time of year employees may feel more or less tired and more or less eager to take on new challenges. The emerging question is – is there an accurate way to measure the impact of weather on an employee's yield? Are all employee weather conditions affected by weather conditions equally, or are there people more (or less) vulnerable to weather? Does it depend on gender, or does weather affect the yield of work of both genders equally? To what extent, in comparison with other factors, does weather affect on yield? Is it possible to identify the weather factor that most effects on yield?

To answer the above questions, the research method research used in this study was a survey carried out on the basis of a prepared questionnaire of 314 white-collar workers in the Lodz region. From the analysis of the results of the survey it can be inferred that the weather affects the performance of employees, but not for everyone equally, some are less likely others to suffer a decline in labour yield depending on weather conditions. The weather factor having the greatest negative impact on labour yield, for both men and women, is too high a temperature.

Keywords: labour yield factors, weather.

Wpływ pogody na wydajność pracy

Streszczenie

Wydajność pracy zależy od wielu czynników, poczynając od najbardziej oczywistych, tj. wynagrodzenie, organizacja pracy i tych rzadziej branych pod uwagę, takich jak pogoda. Pogoda wpływa na dobre samopoczucie pracowników, a tym samym na jakość wykonywania ich obowiązków. W zależności od pory roku pracownicy mogą czuć się mniej lub bardziej zmęczeni i mniej lub bar-

dziej skłonni do podejmowania nowych wyzwań. Pojawia się pytanie – czy istnieje dokładny sposób mierzenia wpływu pogody na plon pracownika? Czy warunki pogodowe mają wpływ na wydajność, czy też są grupy zawodowe bardziej lub mniej podatne na warunki pogodowe? Czy zależy to od płci, czy też pogoda wpływa na wydajność pracy obu płci w równym stopniu? W jakim stopniu, w porównaniu z innymi czynnikami, pogoda wpływa na wydajność? Czy możliwe jest określenie czynnika pogodowego, który ma największy wpływ na wydajność? Aby odpowiedzieć na powyższe pytania, przeprowadzono badanie ankietowe wśród 314 pracowników umysłowych w regionie łódzkim. Z analizy wyników ankiety można wywnioskować, że pogoda wpływa na wydajność pracowników, ale nie na wszystkich jednakowo. Czynnikiem pogodowym mającym największy negatywny wpływ na wydajność pracy, zarówno u mężczyzn, jak i kobiet, jest zbyt wysoka temperatura.

Słowa kluczowe: wydajność pracy, pogoda.

JEL: O1, J1