

Working hours organization impact mechanism upon work-related accidents on microeconomic level

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Abstract

Work organizations rapidly change, triggering the need for a dynamic approach regarding the occupational health and safety and accident prevention. The objective of this research is to examine the influence of the factor 'organisation of the working time' upon the occupational accidents in enterprises as well as to suggest a model of an impact mechanism of working time organization on the occurrence and prevention of accidents/near accidents, using a representative Bulgarian sample. The research is based on a survey conducted in 2016 among 410 employees (52.9% women; 47.1% men) from all economic sectors. Statistical processing and analysis are performed by SPSS/PSPP and statistical modeling by EViews/Gretl. Results show that approximately every fifth employee works longer than the standard weekly occupation of 40 hours; 17.1% of all suffered work-related accident(s); 36.2% work overtime and 41.1% recognize the presence of work-related health problems (most common are total fatigue, back pain, stress and headache). Among those respondents claiming to have work-related health problems, accidents at work occur most frequently when working over 40 h/week. The suggested 3-stage impact mechanism of the working time organization on the occurrence and prevention of occupational accidents allows us to track the chain effects of existing practices in enterprises with regard to working time organization, employees' well-being and the occurrence of work accidents. Prevention strategies should consider changes in scheduling practices, job redesign, and health protection programmes.

1. INTRODUCTION

A growing body of evidence suggests that working hours' organisation adversely affects the health and wellbeing of workers. Studies have associated overtime and extended work schedules with an increased risk of hypertension, cardiovascular disease, fatigue, stress, depression, musculoskeletal disorders, chronic infections, diabetes, general health complaints, and all-cause mortality. In the past decades several reviews and meta-analyses have been published summarizing that working time is direct correlated to workers' health (Dembe et al., 2005; Kirkcaldy, Trimpop & Cooper, 1997; Lusa et al., 2002). However, existing research is still sparse and inconsistent in many areas and the prevention cost-benefit analysis is not easy.

The common perception is that the rapidly changing risks at work can be controlled effectively only when everyone in the organization has a proactive approach. Some studies have detected evidence of a relation between working hours' organisation and the increased risk of occupational injuries among workers in specific occupations like construction workers, nurses, healthcare professionals, miners, bus drivers, fire-fighters (Mirchev & Titopoulou, 2013; Sparks et al., 1997; Spuegeon, 2013).

In all economic sectors the information is an important element of management in general, but especially in the process of change management. Information and communication campaigns can be very effective in dealing with safety and can help to improve work satisfaction and to avoid risks

(Meijman, 1997). Participatory approaches to risk evaluation and management and prevention activities often have a positive impact on the level of occupational accidents. Participation in risk analysis and training of employees also has a positive impact on attitudes which is often an obstacle on preventing accidents. Workers can learn to perceive their work activities through the perspective of safety. This can lead to the identification of hazards and risks at an early stage, which in turn will help to foresee new risks since working conditions, are not a constant value and they are rapidly changing (Lowery et al., 1998). A drastic decrease in occupational accidents has been proved after projects in which employees were involved as active participants (Macias et al., 1996; Probst, Tabin & Waardenburg, 2014; Spuegeon, 2013).

This article reports on a survey of the impact of working time organisation on the risk of occupational injuries among a nationally representative sample of working adults from all educational levels from Bulgaria. Multivariate analyses are employed to control for the influence of workers' gender, educational level, industry sector and occupation. The study is based on the hypothesis that working schedules tend to diversify and that the risk of work-related accidents or near accidents increase with increasing volume of work performed in the demanding schedule. In the case of effectively organized working hours, the workers' health could be preserved and even improved.

The objectives of this research are the statistical exporting of interrelations and specification of the correlative impact assessment model of the organization of working hours on the level of traumatic occupational injuries.

2. METHODS

Subject of the survey is the active working force (employees, employers and free-lancers) in the Bulgarian enterprises. The target audience was reached on the basis of a representative sample of enterprises including all economic sectors¹. An adapted and structured self-created study survey on the working time organization on the microeconomic level was conducted in 2016 among 410 respondents. Questions included the respondents' subjective assessment on their working conditions, the applied work and rest organization regime, the knowledge of internal company health and safety at work documents, and the existing health promotion techniques.

Statistical software packages and applications are used to process, verify and analyse the data (Google Docs, Excel, VBA, R, SPSS/PSPP и EViews/Gretl).

3. RESULTS

The actual employment structure by enterprise size, realized within the original sample and the reproduced employment structure based on the weighted data is presented in [Table 1](#).

Table 1. Employee actual structure and share of respondents in sample size

Size of enterprise	Actual state	Original sample	Weighted data
Micro	30.8%	5.9%	19.5%
Small	22.6%	13.9%	26.3%
Medium	21.2%	53.1%	24.6%
Big	25.4%	27.1%	29.6%
Total	100%	100%	100%

The surveyed economic activities are presented in [Table 2](#).

¹ Unlike the surveys for businesses/enterprises which are designed to be representative of the number of enterprises and their structure based on their size, employees' surveys aim to achieve representativeness in terms of the number of employees. The main argument for the existence of this difference in research approaches is the realization of a more precise study among the target group. In the first case, the target group is business, and in the second: the employees. According to data from the National Insurance Institute in 2014 nearly 93% of enterprises are micro (with up to 10 employees) but employ approximately 31% of the total number of employees. At the same time, the large enterprises (with over 250 employed persons) account for only 0.2% of the economy, but employ more than 25% of the employees.

Table 2. Share of respondents by economic activity

Economic sector/activity	Share in the original sample (%)	Weighted data (%)
Tourism	0.2	0.1
Population services (utilities, hairdressing, etc.)	0.2	0.8
Financial services, insurance	0.5	0.5
Real estate	0.5	0.2
Mining and quarrying	1.2	2.1
Chemical industry, pharmaceuticals, cosmetics	1.2	1.6
Wholesale	1.2	3.5
Metal processing	1.5	0.8
Transportation	1.5	1.4
Business services	1.5	4.5
Textile and leather industry	2.7	1.9
Retail	2.9	4.2
Information, data and Internet services, media and publishing	5.4	4.9
Food and beverages	6.1	3.5
Porcelain, glass, ceramics	9.3	4.3
Sports, health, education	9.8	10.7
Computer technologies, electronics and optics	12.4	13.3
Other activities	42.0	41.4

According to survey's results the situation regarding the working time and its impact on microeconomic level in the country is, as follows:

- 87% of respondents are satisfied with their working conditions;
- 40% of respondents think that during the last 12 months the working conditions at their workplace have improved and only 6% say that there is a deterioration of the situation for the same reporting period;
- 27% regularly or sometimes work more than 10 hours a day;
- 30% of employees work on Saturdays and Sundays;
- 92.4% work only on one paid job.

Regarding the "work and health" element:

- generally, the respondents admit to have problems with their health;
- about 1/3 experience vision problems, back pain and muscle aches;
- 40% complain of stress;
- more than 60% are in a state of general fatigue;
- between 20% and 26% have problems with sleep, anxiety and stress.

The preliminary statistical analysis allowed us to specify a regression model explaining the subjective assessment of working conditions within enterprises (Stage 1):

$$A_i = \beta_0 + \beta_1 \cdot Night_i + \beta_2 \cdot Sat_i + \beta_3 \cdot Sun_i + \beta_4 \cdot Rest_i + \beta_5 \cdot HPI_i + \beta_6 \cdot Well_i + \varepsilon_i$$

where A_i is the subjective assessment of the working conditions in the enterprise of the respondent i , $Night_i$ is an indicator of whether the respondent works during nights, Sat_i – whether he works on Saturday, Sun_i – whether he works on Sunday, $Rest_i$ is an indicator of the availability of a separate recreation area in the enterprise, HPI_i is the above-described index of the level of work-related health problems, and $Well_i$ is the level of impact of the working time organization on the quality of life (wellbeing) of the respondent i .

The specified equation is evaluated by the smallest squares method and by the ordered choice model. Both evaluation approaches confirm the statistical significance of all the explanatory factors for the formation of subjective assessment by individuals, seen in Figure 1.

- the positive impact of the existence of a separate recreation area in the enterprise;
- the attitudes that the organization of working time has a favorable effect on the quality of life of the employees, determine the positive subjective assessments of the employees on the working conditions;
- the negative impact of frequency of work on Saturdays, Sundays, weekends and night;
- the negative impact of the degree of existence of work-related health problems.



Figure 1: Factors determining the subjective assessment of working conditions in an enterprise

Source: Own estimates of the target survey database

The statistical indicators for explaining the effect of the so-specified equation show that it largely fails to cover the main reasons for the presence of fluctuations in then individuals' subjective evaluation. The coefficient of determination of the equation evaluated by the method of least squares is estimated at approximately 25%, which is relatively high for this kind of analysis. Given that modeling is a categorical variable, the explaining force should be traced through prognostic statistics equation regression equations able to predict correctly: 39% of the respondents indicated that working conditions are excellent; 57% of respondents said that working conditions are very good; 45% think that these conditions are good; for 9% of the respondents the conditions are satisfactory. The common explaining effect of the model is 56%.

Stage 2: Modeling the impact of the quality of the working environment on health

Displayed is the following specification of the regression model explaining the impact of the quality of the working environment on health:

$$Health_i = \gamma_0 + \gamma_1 \cdot A_i + \gamma_2 \cdot Gender_i + \gamma_3 \cdot Overtime_i + v_i$$

where $Health_i$ is the subjective assessment of the impact of the quality of the working environment on the health of the respondent i , $Gender_i$ is indicative of the gender of the respondent and $Overtime_i$ - an indicator of whether the respondent works overtime.

This equation is evaluated with the least squares and categories, regression model (ordered choice model). In both approaches clearly outlined are the following factors, formulating the subjective assessment of the impact level of the quality of the working environment on the health of the respondents, seen in Figure 2.

- the positive impact of the subjective assessment of working conditions, as the higher ratings affect more favorably the quality of the working environment on health;
- negative impact factor *overtime* - working overtime leads to increasing the level of negative impact on the working environment on health;
- a statistically significant gender inequality is detected: women, ceteris paribus, the impact on the quality of the working environment on health is less favorable than those in men.

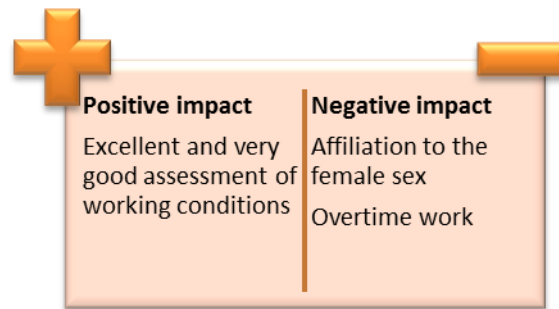


Figure 2. Factors determining the beneficial effects of the quality of the working environment on health

Source: Own estimates of the target survey database

The explaining power of the regression equation is relatively high - regression equation is able to predict correctly: 17% of the respondents indicated that the quality of the working environment greatly affects their health; 57% of respondents stated that their working conditions are very good; 89% of the respondents think that this effect is small; and according to 10% of the respondents the environment has no effect on their health. The total explaining the power of the model is 61%.

Stage 3: Modeling the occurrence or prevention of accidents or near accidents

Based on regression analysis was formulated the following specification of the regression model explaining the presence or prevention of accident or near accidents:

$$Y_i = \lambda_0 + \lambda_1 \cdot Health_i + \lambda_2 \cdot Edu_i + \vartheta_i$$

where Y_i is an indicator of work accident or near accident of respondent i and Edu_i indicates the highest level of education completed by the respondent.

The last equation is evaluated with the logistic model (*logit*). Statistically significant factors explaining the occurrence of the accident or near accident are, in Figure 3:

- the impact of the quality of the working environment on health - a more negative impact on health leads to an increase in the likelihood of accident or near accident;
- the educational degree of the respondent - the more educated employees are characterized by lower probability of occurrence of accident or near-accident.

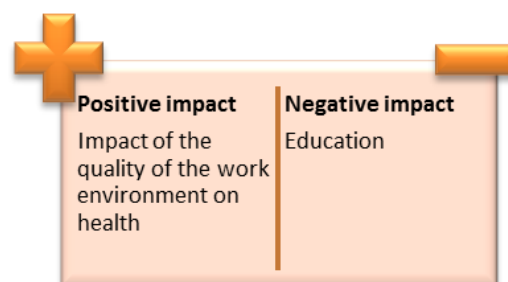


Figure 3. Factors determining the likelihood of accident or near-accident

Source: Own estimates of the target survey database

The explaining force of the logistic equation is relatively high. The classification of the results estimated in the critical value of the probability of 10% (cut-off point) shows that the model predicts correctly 86% of the accidents/near accidents occurred and 45% of non-occurrence of such accidents.

3.1. Impact mechanism of working time organization on the occurrence and prevention of accidents or near accidents

The above identified, specified and evaluated structural model includes three stages within which the examined factors interact at the level of employed persons in the surveyed enterprises. On this basis, it is proposed a specific impact mechanism of the organization of working time on the

occurrence and prevention of accidents or near-accidents. This impact mechanism allows chain effect tracing of the established practices within the enterprises regarding the organization of the working time on employees' well-being in the enterprise, on their attitudes about the occupational safety and health and the quality of the working environment, and consequently on the occurrence of accidents or almost incidents among these workers.

In the first stage of the described mechanism the employed person in a given enterprise builds up his/her subjective assessment of working conditions. This subjective assessment is the result of the decisions of the management regarding the organization of working time and the specifics of the position occupied by given employee. The statistically significant indicators that influence the attitude of the employee are whether he/she works during the night work, on Saturday or on Sunday, and whether there is a special place for recreation in the enterprise. Along with the organization of the working time, two other factors also form the subjective assessment of the employee: whether and to what extent the person experiences work-related health problems; and impact of the working time organization on the wellbeing of the employee. Thus formed assessment of working conditions in the enterprise, together with the gender effect and the adverse impact of overtime determines the result of the impact of the quality of the working environment on the person's health (within the second phase of the displayed mechanism). The described impact of the quality of the working environment on health, along with education of the employee form the probability of occurrence of an accident or near-accident.

The statistically significant indirect effect on the working time organization provokes identifying of adequate management decisions that lead to an effective reduction in the level of occupational accidents (Figure 4).

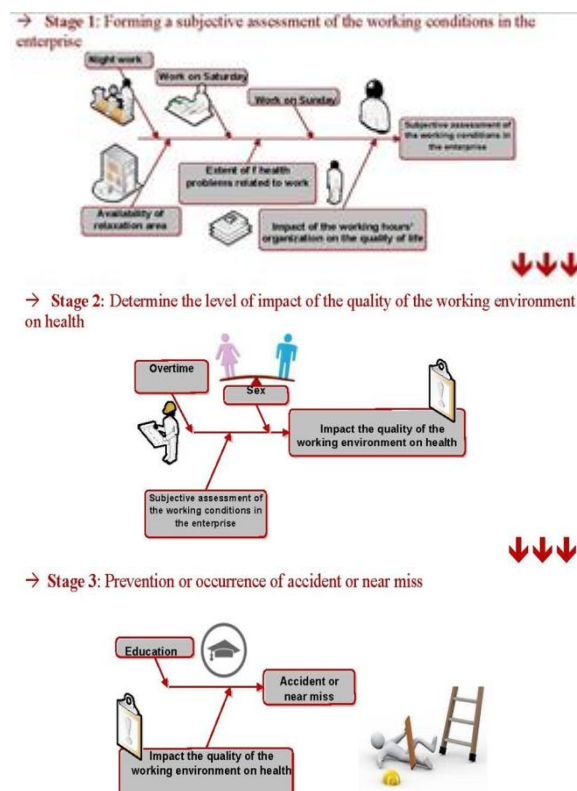


Figure 4. Impact mechanism of factors related to the working time organization on prevention or the occurrence of accidents or near accidents

Source: Own estimates of the target survey database

Based on the survey conducted, it can be concluded that there is:

- a relatively strong positive link between the indicators for working time organization, namely the length of the working week and the frequency of work on weekends, holidays and at night. In practice, the interpretation of this result is entirely logical: the employees having a longer working week often work on weekends, holidays and at night.

- a relatively strong positive link between the indicators of the presence of work-related health problems. For example, the presence of stress was statistically linked to the onset of other health problems such as anxiety, irritability, etc.
- a positive correlation between the influence of the organization of working time on life quality and the subjective employees' evaluation of working conditions in the organization. The more favorably affects the organization of working time on the welfare of workers, the more positive assessment they have on working conditions in the enterprise. The overall assessment of the impact of the working environment on the health of the respondents is negatively correlated with the presence of work related health problems (if a person has health problems, his assessment of the impact of the working environment is negative).

The statistically significant correlations between the three groups of indicators prove the direct interaction between them:

- a) more often people work on weekends, holidays and at night, more negative becomes their assessment of the impact of the working environment on their health;
- b) health problems are correlated (albeit relatively small) on the welfare of the respondents and their subjective assessment of the working conditions;
- c) there is a positive correlation between the frequency of working on holidays and anxiety;
- d) there is a direct link between accidents/near-accidents and stress in the workplace.

In addition to these direct relationships, correlations clearly demonstrate indirect links between the indicators discussed.

4. ANALYSIS

This study of nationally representative data from Bulgaria adds to the growing body of evidence indicating that the inappropriate organization of work hours increases the risk for occupational injuries. Unlike previous researches, our investigation had the advantage of covering a large variety of economic sectors and is in consistency with the hypothesis that work schedules tend to diversify and that the risk of work-related accidents increase with increasing volume of work performed in the demanding schedule.

Based on the survey results, a statistically significant, indirect effect of the working time organization on the occurrence of occupational accidents or near incidents was established. This provides grounds for identifying adequate management decisions on the prevention of work-related accidents on microeconomic level:

- normal working time is preferable;
- where work involves non-standard working hours, such as shift work, night work, extended working shifts, etc., work schedules must be in line with good practice;
- regulated breaks, tailored to the activity, working conditions, physical load and nervous pressure should be properly adapted within enterprises;
- the nonstandard working time should be assessed as a risk factor in order to undertake appropriate preventive and/or corrective actions;
- after a certain period of time the effectiveness of the preventive and / or corrective actions taken should be evaluated;
- the periods of prophylactic medical examinations and check-up of employees in non-standard working hours should be strictly observed;
- an effective internal control organisation should be implemented for the placing and keeping up-to-date the necessary safety signs of dangerous work places, especially during night work;
- the level of training on safety and health at work, including familiarization with operating instructions of work equipment, training on the use of personal protective equipment provided and other OSH (Occupational safety and health) trainings should be increased.

On the basis of the research we can outline the future challenges for the management of prevention of traumatic occupational injuries: Enhancing Occupational Health and Safety culture through awareness, training and common and shared social responsibility; Implementation of wide-ranging and effective integrated control of compliance with labor legislation; Understanding of the benefits of decent work; Easier access to employment and participation in the labor

market; Focusing on the social dimensions of workforce mobility; Improving the balance between work, family and private life; Provision of qualitative education, particularly in the field of safety and health at work and improving the adaptability of workers and expanding opportunities for lifelong learning.

Moreover, further attention should be paid at the analyses of the specific employees' target groups. The particular attention of the safety management should be focused on the following issues with great national impact:

- the demographic changes in EU with the emerging trend of an aging workforce require taking concrete measures regarding the risks leading to occupational accidents and diseases regarding aged workers.
- another indicator, influenced by the trends of feminization of the workforce in our continent is taking into account the specific characteristics of women in terms of health and safety at work and the labour organization.
- particular attention should be paid to young people who are at 50 % greater risk of accidents, compared with their more experienced colleagues.
- specialized information and awareness campaigns and programs for risk prevention and work accidents are recommended for employees in small and micro enterprises as well as for the self-employed.

5. CONCLUSION

At present we face a number of challenges related to ensuring sustainability in the economy and technological progress, employment, especially the creation of green jobs, stabilization of social security systems, education, quality jobs and effective balance of work, family and private life. Labour market tensions, lack of security and job prospects in some industries and territories, restructuring accompanied by redundancies, unpaid wages and social security contributions are difficulties faced by workers on a daily basis (Duchon & Smith, 1994). On the other hand, the data on rapid climate change, which require the development of sustainable production strategies and development, are particularly worrying.

The new environment requires sufficient capacity to accelerate the development of innovative strategies and take full responsibility for joint decisions, piloted non-traditional practices and the behaviour of employers, workers and consumers. These target groups can be positively influenced by environmental protection campaigns, environmental education, green jobs, and others, with the exchange of good and, in some cases, bad practices.

Clearly defined rules for the working time organization in enterprises at the following points would largely minimize and eliminate the tensions between workers and employers:

- daily working hours restrictions (maximum work shift times and minimum daily rest periods);
- restrictions on weekly working hours;
- breaks during the working day;
- paid annual leave;
- protection for night workers;
- Unusual / precarious organization of working time;
- Achieving a balanced flexibility of working time.

Efforts should be aimed at increasing the capabilities of workers to handle and manage the risks at their workplaces. Lifelong learning is becoming more important in cases where workers seek to preserve their employability, but also their health and safety. Workers on temporary and fixed-term contracts, as well as those on part-time jobs have limited access to training and often perform tasks that require fewer skills, so they have fewer opportunities for training at work. These workers are also less informed about the risks at their workplaces, and that creates a problem for the management of occupational health and safety, but also for the management of human resources. Lifelong learning can contribute to the anticipation of change.

Here are two examples of integrated training programs: Organizing annual, targeted and mandatory training in health and safety for all employees is a common practice in the chemical

industry; Some certification systems (e.g. VCA scheme) focus on repetitive training, which can help to promote lifelong learning. In order to renew the certification every employee must pass the basic regular training. VCA (Vehicle Type Approval) is the designated authority for approval and maintenance of all approvals in the UK that provides internationally recognized testing and certification according to the automobile directives and most regulations of UN for vehicles and their systems and components.

REFERENCES

- Dembe, A.E., Erickson, J.B., Delbos, R.G., et al. (2005). *The impact of overtime and long work hours on occupational injuries and illnesses: new evidence from the United States*. *Occupational and Environmental Medicine*, 62:588-597
- Duchon, J., Smith, T. (1994). *Extended workdays in mining and other industries: a review of the literature*. Minneapolis: United States Department of the Interior, Bureau of Mines, Information Circular, Twin Cities Research Center
- Kirkcaldy, B., Trimpop, R., Cooper, C. (1997). *Working hours, job stress, work satisfaction and accident rates among medical practitioners, consultants and allied personnel*. *International Journal of Stress Management*, 4:79-87
- Lowery, J., Borgerding J, Zhen B, et al. (1998). *Risk factors for injury among construction workers at Denver International Airport*. *Am J Ind Med*, 34:113-20
- Lusa, S., Hakkanen, M., Luukkonen, R., et al. (2002) *Perceived physical work capacity, stress, sleep disturbance and occupational accidents among firefighters working during a strike*. *Work and Stress*, 16:264-74
- Macias, D. J., Hafner, J. I. I., Brillman, J. C., et al. (1996). *Effect of time of day and duration into shift on hazardous exposures to biological fluid*. *Acad Emerg Med*, 3:605-10
- Meijman, T. (1997). *Mental fatigue and the efficiency of information processing in relation to work times*. *Int J Ind Ergon*, 20:31-8
- Mirchev, A., Titopoulou, M., (2013). *Provision of sustainable economic business development by improving the health and safety at work, Economical problems of sustainable development*. Матеріали Міжнародної науково-практичної конференції, Том 1, Сумський державний університет. 194-195, ISSN 2307-62
- Probst, I., Tabin, J.-P., Waardenburg, G. (2014). *Les atteintes à la santé dues au travail: du visible à l'invisible*. Organisation, gestion productive et santé au travail. Toulouse: Octares. 293-303.
- Sparks, K., Cooper, C., Fried, Y., et al. (1997). *The effects of hours of work on health: a meta-analytic review*. *J Occup Organ Psychol*, 70:391-408
- Spuegeon, A. (2013). *Working time: its impact on safety and health*. Geneva: International Labor Organisation. <http://www.ilo.org/public/english/protection/condtrav/publ/wtwo-as-03.htm>