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METHODOLOGY FOR ASSESSMENT OF OCCUPATIONAL AND SAFETY LEVEL AT CONSTRUCTION SITES

METODYKA OCENY STANU BEZPIECZEŃSTWA PRACY NA PLACU BUDOWY

A b s t r a c t

This paper presents the process of the development of methodologies for assessing the state of safety on construction sites. An analysis was conducted to calculate the number and causes of accidents in the construction sector over the last few years, and the main groups of factors affecting the state of occupation safety have also been defined.

Keywords: Civil Engineering, occupational safety,

S t r e s z c z e n i e

Artykuł przedstawia proces opracowania metodyki oceny stanu bezpieczeństwa pracy na placu budowy. Przeprowadzono analizę ilości i przyczyn wypadów w sektorze budowlanym na przełomie ostatnich lat oraz określono główne grupy czynników wpływających na stan bezpieczeństwa pracy.

Słowa kluczowe: budownictwo, bezpieczeństwo pracy

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1. Introduction

Occupational safety, regardless of profession and place of work, has a universal character. Its main objective is to create such conditions for employees, so that they can carry out their work in a productive manner, without being exposed to any unjustified risk of an accident or occupational diseases, excessive physical exertion or threats to their mental health (1). The domain of Occupational Health and Safety in civil engineering is defined by legislation, in particular the Labour Code and the Construction Law bill as well as many other regulations that lay down the basic rules for occupational health and safety. Core regulations in the area are stated in the Regulation of the Minister of Infrastructure of February 6, 2003, on health and safety during construction works (2).

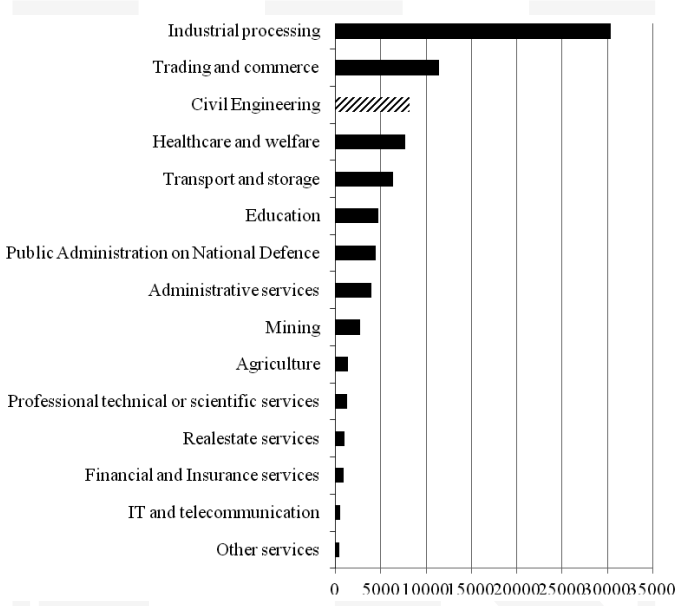


Fig. 1. Injured in accidents at work divided by sections of the national economy in 2012 (CSO, 2013)

In the investment process, occupational safety topics are raised as early as the design stage, when the designer prepares information on safety and health protection. Based on the construction project which contains information on safety and health, the construction manager is required to prepare a plan of health and safety (BIOZ), and to assure that all employees are familiar with it and comply to all the rules contained therein.

Work safety level on construction sites differs depending on the type of investment, and it is not possible to define it as a fixed parameter, the only known factor is that it will be subject to modification and re-examination as construction progresses. Too lower the level of safety on a construction site can result in accidents (3). The following coinciding elements are required for such an incident to be qualified as an employment accident:

– sudden nature,
– caused by external factors;

– resulting in injury or death;
– incident was related to carrying out work duties.

The civil engineering industry requires special interest in the topic of Occupational Health and Safety due to the high probability of accidents when compared to other branches of industry. The data published by the Central Statistical Office (Fig. 1) presents civil engineering as one of the most dangerous branches of Poland's industry in 2012.

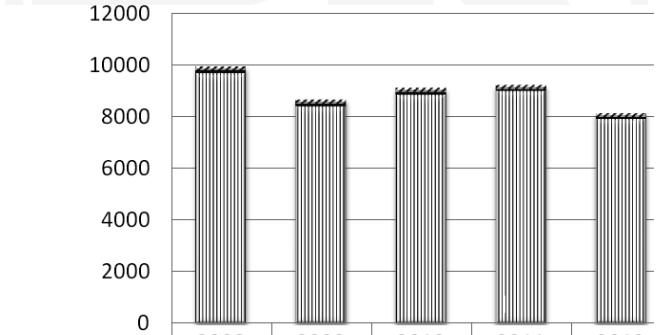
The assessment of OHS level at a construction site which determines the probability of employment accident occurrence can initialize the process of increasing the awareness of OHS importance among the investment process participants and help to decrease the number of accidents.

2. Employment accidents on construction sites in the years 2008–2012

Any irregularities and deficiencies in the system of employee's protection, can directly or indirectly contribute to accidents. For several years Poland has been witnessing increasing awareness of OHS issues related to the various working positions present in the construction industry. Based on published data from the Central Statistical Office from years 2008–2012 (Fig. 2), we can notice a decrease in the number of accidents in 2012 relative to previous years, but we cannot yet conclude that this trend will be maintained in the future.

Based on the analysis of statistical data, lots of factors have been determined that influence the probability of accidents in the construction industry.

The age groups of the employees undergoing most accidents have not changed considerably over the past years. In 2008 persons aged 20–29 years were those most prone to accidents, over time the accident rate in that age group has leveled out, and then slightly decreased relative to the 30–39 age group (Fig. 3). Such a distribution of age groups in relation to employment accidents is the result of insufficient training of young, newly employed staff, while further attention should be paid to workers aged 40–49 years, for whom the number of accidents is still very high.



	2008	2009	2010	2011	2012
heavy accident	164	172	132	141	131
fatal accident	122	117	112	99	82
other	9651	8395	8854	8982	7932

Fig. 2. Accidents at construction sites in the years 2008–2012

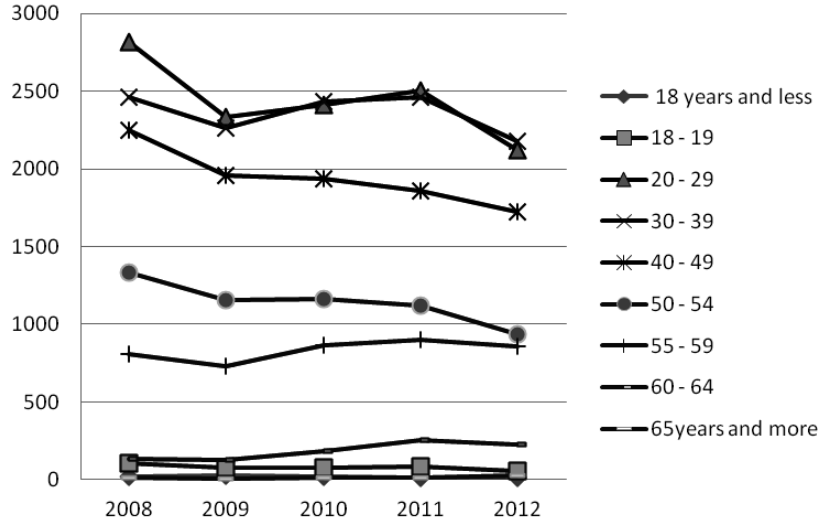


Fig. 3. Injured in accidents at work in the construction industry – divided by age – 2008–2012 (CSO)

The amount of professional experience is another factor affecting the number of accidents among those working in the construction industry (Fig. 4). The largest number of accidents is among those employed for one year or less, thereafter this number decreases steadily depending on the number of years in the profession, 2–3 years, 4–5 years, 6–10 years, 11–15 years. An upward trend in the number of accidents occurs among people with experience of 16 years and more. This is due to these workers disregard for personal protective equipment such as protective clothing or not taking the necessary precautions when working at heights.

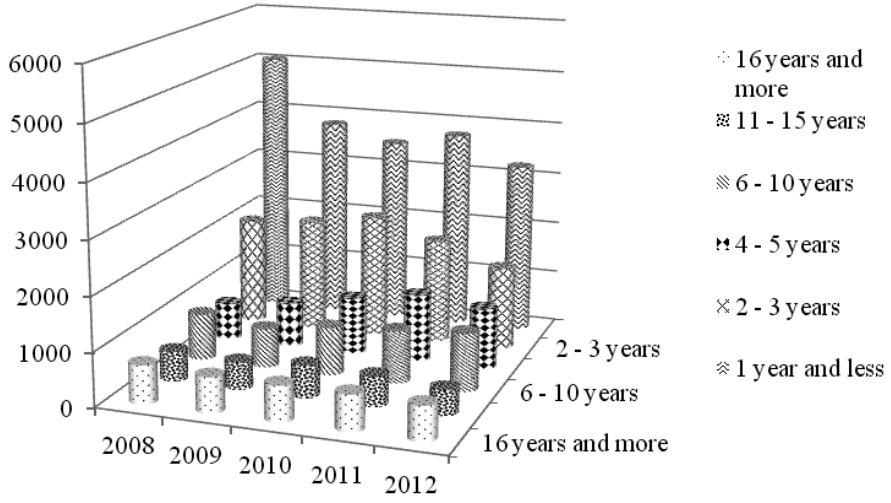


Fig. 4. Injured in accidents at work in the construction industry – division by experience – 2008–2012 (CSO)

Table 1

Injured in accidents at construction sites – division by selected groups of occupations (CSO)

year		2008	2009	2010	2011	2012
total number by selected occupations	technicians	120	111	109	110	102
	secretaries, office workers etc.	66	80	94	31	25
	Salesmen (street, door-to-door, cashiers)	25	10	17	10	7
	Security services workers	5	3	7	3	7
	shell construction work workers	3062	2455	2549	2210	1800
	finishing construction work workers	1160	1066	1160	1355	1206
	foundry molders, welders, assemblers, construction	824	607	653	643	512
	smiths locksmiths and related	346	299	312	297	253
	Mechanical machinery and equipment operators	166	170	148	162	116
	electricians, builders,	503	449	497	502	485
	workers in food processing and related	41	1	12	2	0
	wood workers,	100	90	75	80	65
	operators of mining machinery and equipment and related	266	348	319	435	507
	Assemblers	133	116	121	147	131
	truck drivers	309	288	312	312	296
	domestic help and cleaners	34	30	28	19	18
	unskilled industry workers	48	26	34	24	23

Accidents in construction industry may occur regardless of the employees position, as well as his or hers profession, or cooperation with a given industry. The most vulnerable professional group are employees engaged in shell construction works and other related work positions (Table 1), consisting from 22.7% up to 31.7% percent of all workers in the construction industry depending on the year (22.7% for 2012, 31.7% for 2008). Another professional group ranking high in terms of the number of accidents are workers engaged in finishing works and related activities, then welders, fitters, construction contractors, and electricians. Workers belonging to the above mentioned occupational groups comprise of about 55% of all accidents, other accidents that occur are very finely divided among other professional groups.

3. Assessment of the safety of the construction site

The development of methodologies for assessing the state of safety on construction sites is a complex process, involving the analysis of accidents in recent years as well as their reasons and circumstances. Creating a database on the basis of information obtained from the Central Statistical Office and the State Labour Inspectorate, together with a current review of construction sites, which provides the basis for determining the factors affecting safety. The last step is based on collected data, including the development of methodologies for assessing the state of safety on construction sites. This process has been presented in graphical form in Fig. 5.

Factors influencing the safety of work, are derived from the factors that originally constituted threats to the life and health of employees. According to PN-80/Z-08052 these factors are divided into: dangerous, harmful and annoying.

These are further divided into four groups: physical, chemical, biological and psycho physical. With regards to the environmental impact of these factors induced on the human body, environmental hazards of work are divided into:

– Accident, leading to injuries of varying severity (slight accidents, severe and fatal),
– Sickness, leading to diseases and disorders of varying severity unions, to disability and death.

Due to the cause of the threat, the factors causing the accident can be divided as follows: technical factors, organizational factors, human factors and natural environmental factors. The division presented creates clear boundaries between factors, which allows for easy qualification of an event for the right reason. Technical factors are associated mainly with state machinery, equipment and tools, and applied technical conservation measures. Human factors arise from the state of psycho physical and human behavior, and organizational factors include the complement between workers and machines, among others, supervision of staff, training, instruction, professional preparation.

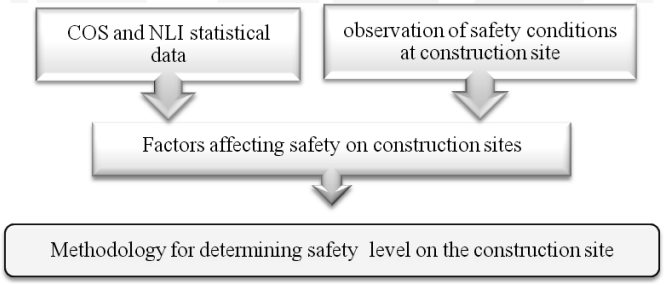


Fig. 5. The process of developing a methodology for assessing the safety of construction sites

Factors affecting occupational safety should have easily identifiable boundaries of influence on the work environment. Because of that the following division of factors were adopted: human, technical and organizational.

Development of a methodology for assessment of occupational safety on construction sites requires the refinement of factors listed in the three-group division, and assigning proper weights to each of them. Determination of the degree of the factor importance will be based on its impact on work safety. For example, the analysis of statistical data from the year 2009

(PIP 2009) allows the analyst to determine the structure of the causes of accidents and organize them in the following divisions: organizational causes 45,4%, human-related 43,5%, technical 11.1%, which indicates that the greatest emphasis should be put on organizational factors . Among organizational factors, lack of proper supervision and tolerating deviations from the rules and principles of OHS by supervisors accounted for the greatest number of accidents. This causes the mentioned factor to be considered the most important and gives it the highest weight. A schematic representation of the process of determining the degree of importance of factors affecting occupational safety is presented in Fig. 6. The database of factors obtained by applying this process which includes their degree of importance is the basis for creating a survey addressed to construction managers and construction company owners. The survey aims to determine the status of occupational safety on construction site.

The result of survey, presented on a 1–10 scale, will be the subject of further studies using the snap-reading method to compare the results with other sources of data. The comparison of results will include a number of factors, to avoid any concealment of information by those responsible for filling in the survey.

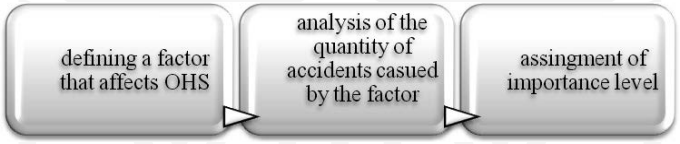


Fig. 6. Schematic representation of the process of determining the degree of importance of factors affecting occupational safety

4. Conclusions

The method for assessing the occupation safety at a construction site presented, will allow for quick determination of the status of occupational safety. The result obtained will be presented on a scale of 1–10 and will provide information for many of the participants of the investment process. Employees will know if the employer cares about employee's safety at the construction site, construction manager, because of their obligation to comply with the principles of OHS at the construction site will be able to check the degree of security, and employers will not have to worry about their employees' health and lives.

As statistics show, the state of safety measures in the construction sector has improved in recent years, however, we should be aware that not all accidents on construction sites are reported, due to the fear of the consequences (financial penalties). The presented methodology of evaluation of safety on construction sites will allow for easy analysis of the safety of works to be carried out, which in turn should prevent accidents in the industry.

Currently, the primary criterion for awarding tenders in Poland is low price and the shortest delivery time, which results in a numerous abuse and neglect of safety. Informing participants of the investment process and of the importance of maintaining occupational safety on construction sites, may in a few years, cause the assessment of construction site safety concerning previous contracts carried out by the subcontractor to emerge as an important criterion in the tendering process.

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