1. The accidents – statistical data

The superficial analysis of Polish statistics of accidents at work shows that they are caused mainly by:
- the non-observance of valid regulations,
- incorrect action of the service (of operators),
- the nonergonomics of machines and technical devices,
- the wrong condition and psychophysical abilities of the operators.

The reasons for accidents are (from 2002 to 2004) shown in figure 1.

![Figure 1. Causes of accidents in years 2002-2004](image)

1 - improper bearing of worker; 2 - bad condition of the material factor; 3 - the lack or bad usage of material factor; 4 - improper wilful bearing of worker; 5 - wrong work organization; 6 - wrong organization of a place of work; 7 - bad psychophysical condition of the worker; 8 - non-usage of the protective appliance.
This figure shows that the biggest percentage parts in accidents are as follows:

- improper bearing of worker,
- bad condition of the material factor,
- the lack or bad usage of material factor,
- improper wilful bearing of worker.

A total number of accidents is decreasing, however the percentage contribution in particular categories of events stays on the similar level. The next chart (fig. 2) presents the number of injured per 1000 employees in 2003 in Poland. The analysis of the chart in fig. 2 leads to conclusion that accidents often took part in the following domains:

- the mining,
- industrial processing,
- building,
- farming, hunting and forestry (without the individual farming),
- the fishery and the fishing,
- the health care and the social welfare,
- manufacturing, supplying with electric energy, gas and water.

According to statistical data published by GUS (Polish Central Statistical Office) data, in previous years the main events causing accidents in 2003 were following:

- blows - 33.7% of the whole of events,
- fall of persons - 32.9%,
- colliding with sharp objects - 8.5%.

The dominating cause of accidents, as alike as in last years, was improper action taken by of worker (53% general number of causes). Secondly, a bad labour organization caused approximately 12.9% of total number of causes. Next cause was a bad state of the material factor and finally - the lack or improper using the material factor - 8.6% and others.
For comparison purpose the statistical data connected with accidents in 1994-2000 years in the European Union are following: building, farming, hunting and forestry, the transport and the communication, industrial processing.

2. The reduction of number of accidents

The introduced statistical data connected with accidents shows that there is the huge number of accidents in domains where the mechanized tools are used. The psychophysical abilities, fitness perceptiveness and quick reacting to danger are factors which play the main role in avoiding the accidents at work. The consequences of accidents are following:
- death of the worker,
- the inability remained to the work or temporary.

The accidents at work caused 3 073 107 days of workers inabilities in 2003 in Poland. This number does not include treating and the rehabilitation of injured persons. Undoubtedly, it leads to significant losses for employers or companies. What is more, it is very difficult to determine moral losses of victims of these accidents. Such situation has a bad influence on the atmosphere of the work. So far it is difficult to find data on the subject of financial losses incurred by the state as a result of all accidents.

There are groups of businesses in the state where accidents rarely occur. These jobs are connected with operating of devices or services, e.g.:
- operator in the power station, a nuclear power plant,
- operator-supervisor of flights,
- operator of devices below the ground,
- a crane operator, diggers etc.

The improper reaction of such operators to the emergency signal can result in the risk or the disaster where considerable financial and human losses can occur (vide Czarnobyl disaster).

In the most cases, the biggest percentage contribution in an accident has a human factor. A human factors includes individual training, psychophysical abilities the professional education. The process of the professional education is a process tested easily in principle; however the psychophysical ability is being controlled on the quite weak level, almost in all businesses and specialities so far. Candidates for the majority of the jobs are passing general medical check-ups. It often turns out after the long enough and expensive period of the training course that the candidate is not very perceptive, he is reacting to outside signals poorly and he is not fit enough to making the future work.

In order to reduce an influence of the psychophysical state of the worker (operator), exposed to the risk of incorrect action at work, on possibilities of occurring an accidents, an application of simple computer simulators is suggested. Such simulators should be based on
PC computers, which are to use in every company or institution, so it does not produce any additional costs. The aim of these simulators is to assess the psychophysical abilities of the operators before taking the work.

The simple PC-based simulators are able – in the authors’ opinion - to aid:
- preliminary selection of candidates for the given work or services,
- periodic testing the professional and psychophysical ability,
- testing the psychophysical ability of operators in the particular days or part of the day (e.g. before beginning the work hours).

It is expected that using simple simulators will significantly reduce a risk of accidents and consequently reduce number of injured employees and fatalities.

3. PC-based simulators

The idea of using the simple simulation programs consist of (it depends on particular place of work) testing of the specialist knowledge connected with performing a particular job (e.g. solving test problems) or examining the response time to the sound or light signal.

In the case of the intellectual simulation interaction user and testing programs is connected with pressing button “Y” (yes) on a keyboard or “N” (no). Program automatically counts amount of incorrect answers and presents finally a percentage result or an amount of mistakes and a time of the solving of the tests (another possibilities is a multiple choice test, but is not considered at the current stage of the research). Testing the psychophysical ability can consist of pressing only one button on the keyboard e.g. “space” after appearing of light or sound signal about the diverse structure. In such a case the time of response to such signal is measured and registered.

In the both cases, the time of lasting the program should not exceed 2 minutes. Assessment of the physical fitness (abilities) is presented as a report, which can be e.g. printed or emailed to expert (or superior) who is to assess the results.

Such programs can be applicable during the selection of candidates for operators of very expensive machines where the cost of the training course and hourly using the machine is huge e.g. in aviation, for the army, police etc. Apart from benefits already described, superior can - on the base of many results of the tests - determine:
- the assessment (forecast) taken to the individual for the possibility to determined character for the work,
- the personal (individual) predispositions,
- psychophysical abilities (the estimation of the risk, making a mistake, significant the aberration from the typical data).
A simple simulation programs, dedicated to testing the psychophysical abilities of operator, should meet the following general requirements:

- should be very easy in use,
- the user interface should use typical kind of signals warning about dangerous situations: colour signals, voice signals etc.,
- should give the users feeling of working in the real work environment,
- should work in Windows 98/2000/XP environment.

4. Conclusion and future work

Statistics without the emotions show that every place of employment is in danger connected with incorrect action of the worker. Therefore it is worthwhile investing in PC based simple simulators and test programs, because PC computers are in work places in relatively big amounts. So without any additional costs it is possible to test the psychophysical abilities of candidates for operators.

The future work is connected with constructing a full simulation environment and aiding it with elements of expert knowledge acquisition. It helps in better fitting simulators to particular domain or specific job.

References