

## **Summary**

### **Modelling and forecasting the impact of improvement of management processes in the OSH management system on the safety performance in the enterprise**

The systematic approach to management has evolved since the middle of the previous century, embracing the diverse aspects of organizations management. These include Occupational Health and Safety management systems (OSH MS), which play an important role in many companies. Evolution of OSH MS standards is accompanied by a debate about their effectiveness and the factors that determine it.

It is assumed that the effectiveness of the OSH MS is its ability to improve the safety performance in the enterprise. There is no doubt that the effectiveness of the whole system is determined by the extent to which the specific management processes that make up the system are implemented and tailored to the specific needs of a particular company. However, many researchers and practitioners in the field of OSH management believe that certain processes may determine the effectiveness more than others. Processes of risk management, internal audit, communication and information, training and competence, but primarily leadership and employee participation, are considered to be of particular importance for OSH MS effectiveness.

The goal of the study was to identify the OSH MS management processes, the improvement of which:

- impacts on the improvement of the greatest number of other management processes and improvement of safety performance,
- causes the highest increase in the performance levels of other management processes,
- results in the highest increase in the safety performance.

Two hypotheses were adopted. According to the first one, the improvement of the leadership process exerts the greatest positive impact on the improvement of the remaining management processes and the improvement of the safety performance in the OSH MS. In the second hypothesis it was foreseen that consecutive improvement: first, the leadership process, followed by the employee participation process, exerts more positive impact on the improvement of the remaining management processes and the improvement of the safety performance than the simultaneous improvement of both processes.

The fuzzy cognitive map method was used to achieve the goal of the study and test both hypotheses. This method allows for forecasting the future value of system objects (concepts) based on their current value and the value of interconnections (influences, causal weights) that exist between them.

In the first stage of the study, a model of OSH MS was developed with the use of the fuzzy cognitive map method. For this purpose, 15 management processes have been identified and placed together with safety as concepts on the map. The values of concepts in this model were equivalent to performance levels of management processes and safety performance. The improvement of the process was expressed by increasing the level of its performance. Then, based on the assessments of 9 experts in the field of OSH management it was defined how these processes and safety affect each other (i.e., between which objects on the map there are interconnections, what are their directions and values).

In the second stage of the study, simulations were carried out using the developed OSH MS model in order to verify the assumed hypotheses. A dedicated computer tool consisting of a set of MatLab scripts was employed for this purpose. In subsequent simulations, the initial values of the model objects were assumed to reflect hypothetical situations in which, with equal levels of performance, the level of one of them was improved by a certain value. The forecasted new values of the system model objects (forecasted levels of processes performance and forecasted safety performance) were received as a result of the simulation.

The results confirmed the assumptions adopted in both hypotheses. They also enabled the identification of processes (excluding the leadership process), the improvement of which causes the highest increase in the performance levels of other management processes and causes the highest increase in the safety performance. These are primarily processes of internal audit, organizational roles, responsibilities and authorities, incident, nonconformity and corrective actions, as well as training and competence.

At the next stage of the study, the system model was synthesized to verify its usefulness in the planning process that should be undertaken to ensure that the future safety performance and future levels of processes performance reach their assumed values. In order to verify the possibility of practical application of the OSH MS model simulations were carried out on the basis of data on the performance levels of the processes and the safety performance recorded in a selected company. The obtained results have confirmed that the developed OSH MS model can be used to forecast changes in the performance levels of processes and in the safety performance, and then, based on forecasts, to plan preventive actions in the OSH MS.

Fuzzy cognitive maps are often used to model systems composed of intangible objects the precise measurement of which is very difficult and expensive. Based on the expert knowledge, they allow for analysis of the interconnections that occur between objects in these systems and forecasting changes in the value of objects. Forecasts support the decision making process concerning the further development of modelled systems - optimally in terms of time and cost.