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PROJECT APPROACH TO INDUSTRIAL FACILITY SAFETY MANAGEMENT

Abstract. The article describes the industrial facility safety management system. The importance of the project`s safety management implementation is shown in order to achieve the required safety level. The authors propose to implement safety issues as separate projects. The most important is to choose the proper safety project. The project`s start up time is determined based on an assessment of the current state of entire safety issues. Mamdani method is used to form the fuzzy decision of the needs to initiate the safety projects of industrial facility.
Keywords: labor safety, project management, project.

PROJEKTOWE PODEJŚCIE DO ZARZĄDZANIA SYSTEMEM BEZPIECZEŃSTWA PRZEDSIĘBIORSTWA PRZEMYSŁOWEGO

Streszczenie. W artykule rozpatrzony jest system bezpieczeństwa przedsiębiorstwa przemysłowego. Pokazana jest konieczność stosowania zarządzania projektowego w celu osiągnięcia pożądanego poziomu bezpieczeństwa. Autorzy proponują realizować przedsięwzięcia z ochrony pracy jako projekty. Aktualne jest pytanie dotyczące wyboru stosownego projektu. Czas jego początku lub inicjowanie wyznacza się na podstawie oceny potocznego stanu bezpieczeństwa przedsiębiorstwa. Wykorzystana jest metoda Mamdani'ego w celu utworzenia niewyraźnego wniosku o konieczności inicjowania projektów zapewnienia bezpieczeństwa przedsiębiorstwa przemysłowego.
Słowa kluczowe: ochrona pracy, zarządzanie projektami, projekt.

Introduction Safe working conditions at an industrial enterprise's workplaces are ensured by its safety system which makes an integral part of the overall management system. To completely disclose the enterprise's staff labor potential we need to create safe and comfortable working conditions.

The security system of every industrial enterprise is a subject to both external and internal factors' constant changes.

Safety measures have specific with their pronounced "project character" i.e. they do bear all the characteristics and properties of a project, being initiated, planned, executed and monitored through the safety management system.

According to Ukrainian legislation, the occupational safety is guaranteed by the labor safety measures complex, representing a system of legal, socio-economic, organizational, technical, medical, preventive and other activities aimed at preserving human life and health while professional activity at workplace [6].

The project management embodies an effective tool able to create and maintain the required safety level at industrial enterprise. That is clearly evident from the recommendations of the International Labor Organization (ILO) [2], as well as chapters on safety ensuring found at project management standards. They refer to such knowledge fields as the occupational health and safety, technological processes safety, environmental safety, social protection, etc. [3, 4].

The project-oriented management is implemented out through occupational health and safety projects (Project OHS (P_{OHS})), aimed at creating not only safe, but the optimal working environment.

From a systematic viewpoint the occupational health and safety project P_{OHS} can be described with such variables' chain:

$$P_{OHS} = (MIS, OBJ, CR, IR, X, Y, CS, PM, RM, STM, T)$$

where: *MIS* – project mission, *OBJ* – project goal, *CR* – criteria of the project's success, *IR* – project information resources, *X* and *Y* – input and output data of P_{OHS} project measures, *CS* – project current status, *PM* – project management, *RM* – resources management, *STM* – management strategy (project's importance, urgency, priority), *T* – time.

As the project represents a provisional arrangement within an enterprise, the optimal choice of its starting time does essentially determine its success. Therefore, choosing the instance of occupational health and safety project (P_{OHS}) initiation is an important task for the industrial enterprise's system of industrial safety within the project-oriented management at overall Business Management System frame.

This research is aimed at substantiating the feasibility of project approach to the industrial enterprise safety system management.

Research description. The working environment at real industry workplaces does appear as a complex set of interlaced and interacting factors of indus-

trial production environment parameters. Such environment can cause an additional (not due to nature or specificity of work), the body burden of the employee.

The working environment can represent a direct hazard as to the life and health of the worker, appearing as a single traumatic impact entailing an irreversible disability either as an incremental accumulating hazard, which, certain period elapsed, would manifest as an occupational disease. The timely initiation of an occupational health and safety project will not only ensure safety at workplaces, but will also create the optimal and favorable labor conditions for the staff.

The right moment of occupational health and safety project's initiation depends onto the whole enterprise condition as well as the labor conditions at particular workplaces.

The industrial enterprise safety system project-oriented management includes the enterprise's current state monitoring for the purposes of data collection and analysis by the decision support system for P_{OHS} initiation scheduled to specific calendar dates.

The source [5] exposes that the time of P_{OHS} initiation at an enterprise is determined by the enterprise's current state. This problem is characterized with a high uncertainty degree because the enterprise's current safety level parameters are different by their nature and effect, as they describe various physical values, processes, etc.

Experts in the field of safety ensuring allocate several basic groups of factors: legal, social economical, administrative and technological, sanitary hygienic, health safety and prophylactic, psychophysiological, rehabilitative ones etc. Every of these groups can be subdivided into subcategories, which include lists of respective parameters.

These parameters are characterized by quantitative values, Boolean indicators, expert estimations, verbal descriptions.

The collected data complexity and heterogeneity do imply these data primary transformation including data sorting and aggregation.

Thus, for collected data secondary transformation with the aim of safety level assessing, the authors propose to use the Lotfi Zadeh fuzzy logic and Mamdani algorithm [6] for fuzzy inference as to the moment of labor safety projects initiation.

As an example, let we consider a group of microclimatic parameters to evaluate working conditions at the workplace. This group is described by the following variables: temperature (t, ºC), humidity (φ,%), the air flow speed (u, m / s) and the level of radiant heat (e, W/m2).

To assess the safety level, linguistic variables are presented as a tuple [6]: <β, T, X, G, M>, where β - the linguistic variable denomination; T - its values (terms) set; X - the fuzzy variables universum; G - syntactic process of new terms formation; M - semantic procedure, forming the fuzzy sets for each of the linguistic variable terms. For the microclimatic parameters group variable G and

M will be similar. Therefore, for the microclimatic parameters tuple a group of linguistic variables will appear as follows:

Temperature: <t, T, X>, where t – temperature value, ºC; T_t –{«low temperature», «optimum temperature», «high temperature»}; X – [12; 38].

Humidity: <φ, T, X>, where φ – relative humidity value; T – {«low humidity», «normal humidity», «high humidity»}; X – [0; 100].

Air flow speed <u, T, X, G, M>, where u – velocity of air movement; T – {«low wind speed», «normal wind speed», «high wind speed»}; X – [0; 1].

Heat radiation: <E, T, X ,G, M>, where w – value of heat radiation level; T – {«allowed heat radiation», «intolerable heat radiation»»}; X – [0; 350].

The process of fuzzy inference represents a fuzzy algorithm for obtaining, using fuzzy logic, some conclusions.

This process departs from the membership as to the temperature, humidity, air velocity and thermal radiation (Fig. 1-2), [7, 8].

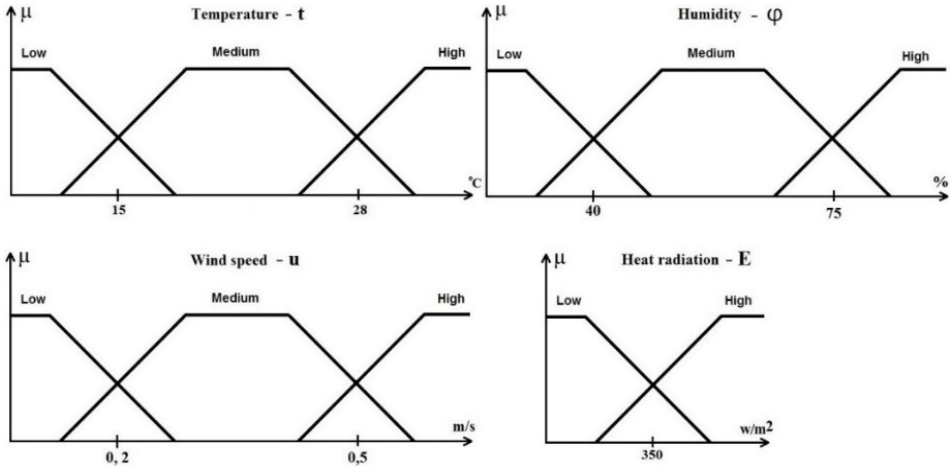

Fig. 1 Graphical representation of the membership function for a group of micro climatic parameters

We apply to the fuzzy inference mechanism and elaborated set of fuzzy rules for evaluating labor conditions at the workplace:

1. if (**t** is mid) and (**φ** is mid) and (**u** is lo) and (**E** is lo) then conditions of work are optimal
2. if (**t** is lo) and (**φ** is lo) and (**u** is mid) and (**E** is hi) then conditions of work are tolerated
3. if (**t** is hi) and (**φ** is hi) and (**u** is mid) and (**E** is lo) then conditions of work are harmful
4. if (**t** is lo) and (**φ** is hi) and (**u** is hi) and (**E** is lo) then conditions of work are harmful

5. if (**t** is hi) and (**φ** is hi) and (**u** is hi) and (**E** is hi) then conditions of work are dangerous
6. if (**t** is hi) and (**φ** is hi) and (**u** is hi) and (**E** is lo) then conditions of work are dangerous
7. etc.

Let we consider a workplace specific with the following set of parameters: temperature 19^0C, humidity 45%, wind speed 0.3 m/s, thermal radiation level 400 W/m^2.

This example embodies a graphical representation of the following rule to comply:

*if **t** mid and **φ** mid and **u** mid and **E** hi, then* conditions of work is harmful

When we introduce the fuzzification for given values of microclimate, the result appears as shown at the Fig. 2.

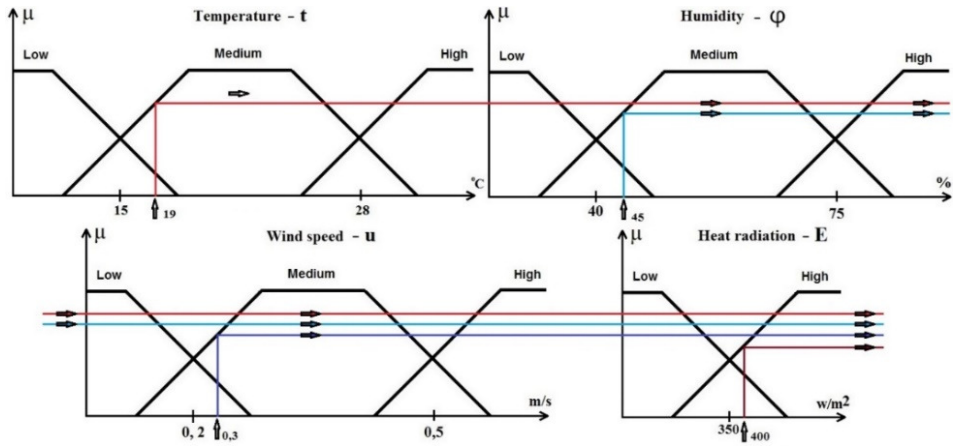

Fig. 2. Bringing to fuzzification

Using the rule of minimum we determine the truncation levels for each rule of work environment conditions. For the given parameters set and the considered rule the result will appear as shown at Fig.3.

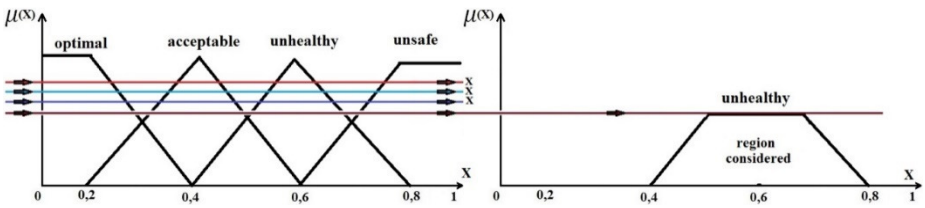

Fig. 3. Truncated function of the considered evaluation rule

Similar truncated functions have been obtained for each of above described rules. Combining the resulting truncated functions we get the total fuzzy subset. The resulting truncated total membership function's projection of the found gravity centre onto *0X* axis allows us to assess the enterprise's safety level by the microclimatic features group Z_1 (Fig. 4.)

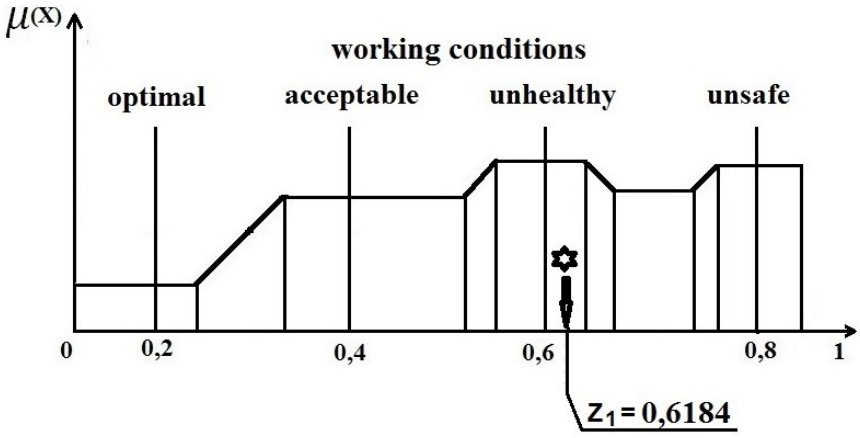

Fig. 4. Total truncated membership function

The enterprise safety management information system therefore will be based onto computational procedure implemented within Matlab environment using the $evalfis$ functions for the given parameters set:

$$Z_1 = evalfis\ ([19\ 45\ 0.3\ 400], mik).$$

By fuzzy inference using Mamdani algorithm we can assess the working conditions by other parameters thus determining (when needed) the time of occupational health and safety project initiation at the enterprise.

Fuzzy logic allows evaluating various parameters with respect to their mutual influence and actual health impact.

The summarising fuzzy inference about the hazard level for the enterprise's personnel will appear as:

$$Z_{\Sigma} = evalfis\ ([Z_n], P_{OHS});$$

where Z_n – an enterprise's safety assessment by various groups of parameters describing the workplace safety condition, P_{OHS} – occupational health and safety project.

Conclusions. Elaborated is a complex technique for fuzzy assessment of an industrial enterprise's current safety system condition. This methodology serves to initiate the occupational health and safety projects for implementing the

effective safety system management at the given enterprise. Therefore we get an opportunity to completely control the enterprise's working environment at the same time that to improve the taken decisions' feasibility and promptitude.

The proposed methods can be extended up to enveloping the social-and-economical as well as organizational and administrative, technical objects and facilities, whose development management is based on their current status assessment. The proposed methodology adaptation will consist in the identification of significant measurable parameters necessary to assess the object condition for management decisions making.

References

[1] Law of Ukraine "Occupational safety" http://zakon4.rada.gov.ua/laws/show/2694-12 (in Ukrainian)
[2] International Labour Organization. ILO DWT and Country for Eastern Europe and Central Asia http://www.ilo.org/public/english/region/eurpro/moscow/index.htm
[3] A Guide to the Project Management Body of Knowledge. Fifth Edition (PMBOK® Guide). An American National Standard ANSI/PMI 00 – 001 – 2013. – 615 pp.
[4] ISO 14001:1996. Environmental management systems – Specification with guidance for use.
[5] Moskaliuk Andrii Y. Finding the project initialization time on machinery production factory / A. Moskaliuk, P. Teslenko, V. Purich // East European Journal of advanced technologies. – 2013. № 10 (61), pp. 209-213.
[6] Zadeh L. Fuzzy Sets// Information and Control. – 1965. – Vol.8. – P. 338-353.
[7] Guide on Hygienic Assessment of Factors of Working Environment and Work Load. Criteria and Classification of Working Conditions 128 pp.
[8] Kopylov A. V., Moskovtsev A. V. The Model of Assessment of Strategic Resources of Industrial Enterprise on the Basis of Fuzzy Set Theory // World Applied Sciences Journal. 2013.