Identification of Key Relations for Work Safety—A Case Study

SEBASTIAN KUBASIŃSKI¹, JONATAN PIECHOCKI² and MAŁGORZATA SŁAWIŃSKA³

Keywords: improvement of work organization, integrated health and safety management system, critical requirements

ABSTRACT

The main goal of an economic organization is to generate profit. However, it should be noted that at the core of the company's operation lies the necessity to meet the requirements of work safety. Consequently, we have two areas of different groups of organizational factors. On the one hand, there are elements decisive for the increasing productivity of work and increasing its efficiency and savings, on the other hand, elements of improving the safety and ergonomics of work and elements deciding about the well-being of the employee. To eliminate this apparent antagonism, the activities of the organization should be considered in the aspect of links between its elements at the level of the integrated system of occupational safety and health management. The article presents a practical way of recognizing important system relations using the specification method of correlated critical requirements, thanks to which it obtains support in management decisions. The improvement proceedings were presented on the example of the aluminum cans production process, within which the basic needs of all stakeholders of the organization were taken into account. This allowed to present a synergistic effect of the approach using integrated work safety management.

INTRODUCTION

Part of the organization's management system is the security system, the creation of which results from the employer's obligation, that is, the organization of safe workplaces [1]. Therefore, the strategic goal is to ensure stability of the level of employee safety and improve the quality of the security system [2]. For effective operation in this area, it is important to recognize the set of system features, which improvement will affect the fulfillment of system requirements and will allow to understand the organization's context and the needs of cooperating entities.

¹Poznan University of Technology, Faculty of Engineering Management ul. Strzelecka 11, 60-965 Poznan, Poland
²Poznan University of Technology, Faculty of Engineering Management ul. Strzelecka 11, 60-965 Poznan, Poland
³Poznan University of Technology, Faculty of Engineering Management ul. Strzelecka 11, 60-965 Poznan, Poland
The article presents the results of research, which indicate positive relations between the factors of growth of safety culture and the planned effects of the organization's activities. This gives grounds for adopting a stable organization and development strategy in the long run. Therefore, the planned improvement process is based on the stakeholder theory, which assumes running a business by building transparent and lasting relationships with all interested parties (stakeholders), with owners, employees, clients, suppliers and cooperators, with the local community and with representatives of all organizations that may affect the company's operations. The expectations of various stakeholder groups have been documented, i.e. entities that have a direct or indirect impact on the achievement of the organization's goals or are affected by the implementation of these objectives. Then, a group of critical requirements was methodically ranked according to their importance for the proper functioning of the entire safety management system. At the final stage, the nature of the relationship between requirements (positive/negative/none) was examined, on the basis of which directions of actions improving the level of enterprise security were developed.

CHARACTERISTICS OF THE COMPANY’S SECURITY

Basics of safety culture

An efficient organization that achieves the intended goals are efficient elements and their cooperation to achieve synergy. In this approach, for the improvement of the functioning of the whole enterprise, important connections between various areas of the organization's functioning and interrelationships between them become important [3]. An enterprise, which is a system consisting of organizational units and relations between them, requires constant evaluation of achievements in all areas of undertaken activity. A plane integrating various goals is to develop the culture of the organization as a base for the culture of work safety. Initially, the culture of the organization aroused interest due to competitiveness. Czesław Sikorski, who contributed to the development and popularization of the area related to organizational culture in Poland, presented organizational culture as: "system of assumptions, values and social norms that stimulate those behaviors of members of the organization that are important from the point of view of formally adopted goals"[4].

Each company produces its own culture. The assumptions of the organizational culture are accepted by the company's members in an unconscious way. The takeover of certain models of conduct by employees takes place faster, if certain imposed patterns seem to be the right ones and their standards will be good practices standards, about which the authors of the publication write about in their work: Contemporary standards in the field of occupational health and safety management [5] and by building conditions for the development of a security culture, one can refer to the universal definition of a security culture, according to which they are conducts and activities aiming at guaranteeing security in the private sphere, work and the whole environment. Adequate adaptation of knowledge, skills and activities in order to achieve an acceptable level of culture of the individual, organization, company and society as a whole. The relationship between individual elements is directly proportional to the level of safety culture [6], [7].
Prior to the organization, new challenges and policies have been posed to support the local community as well as improving the safety of employees. The company aims to intensify actions aimed at raising awareness and building the highest possible level of security culture.

The priority of activities in the surveyed enterprise is to ensure systemic security, which will include all employees, guests and subcontractors with simultaneous care for the economic result. The company implemented standards resulting from the Occupational Health and Safety Management System in accordance with the requirements of OHSAS 18001, which is one of the elements of the Integrated Management System, including also Quality Management and Environmental Management.

**Analysis of health and safety at the aluminum can production department**

The company has been operating on the metal packaging market for over 20 years. During this period, it became a leading producer in the beverage packaging industry in Central and Eastern Europe. Employment in a company is related to the volume of sales and is subject to quite large fluctuations. Men prevail in the employment structure because the company needs a large number of warehousemen and drivers. Due to the profile of the company's activity, there are more worker positions than non-manual ones.

The company is a constantly growing organization in terms of both geography and product. The current organizational structure is a reflection of the processes taking place in it. The dynamic development of individual areas of activity requires the creation of a target structure based on the production industry division (beverage can, steel can, closures for bottles) covering domestic entities.

The subject of activity of the Production Department is aluminum can and various types of aluminum caps. All product elements are produced in the production process on this section, while the raw material for their production, i.e. aluminum, comes from other production departments in the company. In the final phase of production, the products are assembled and prepared for transport.

![Figure 1. Aluminum cans - own photography.](image)

The entire production process takes place in a closed production hall and is divided into individual process stages. Each production stage has a designated hall area which
allows linear optimization of the work process. The employees are equipped with personal protective equipment in the form of protective glasses, anti-aerosol masks and hearing protectors. Mechanical ventilation and bench exhaust ventilation are installed to protect workers from exposure to harmful agents. The company's warehouses are located in separate halls for this purpose.

In the administrative and office building attached to the described hall, there are sanitary facilities, offices and a conference room. There are procedures for dealing with an accident, a fire, as well as a procedure for handling particularly dangerous activities related to the operation of stoves.

In 2016, there were 3 accidental events in the company. The resulting accidental events were directly related to the use of machines. The production hall is equipped with a modern machine park that meets the minimum and essential requirements for machines. Each machine has protective covers to protect the work area to minimize the possibility of accidents at work. The result of each event were upper limb wounds - hands, accident 21.03.2016 - left hand cut wound, accident 11/09/2016 - lacerated wound of the left hand, accident 03.10.2016 - cut right hand wound. The following were assumed for the causes of the occurrences: 1) lack of documents allowing identification of hazards at work and emergency procedures, 2) lack of work instructions at all work stations.

**THEORETICAL BASIS OF THE TEST METHOD**

**Assumptions**

The authors of the study conducted tests similarly to the DEMATEL method, they created a proprietary development of the matrix of relations between requirements. The DEMATEL method (Decision Making Trial and Evaluation Laboratory) [8] allows to explain the relationship between the adopted elements of the model and to determine the matrix of direct and indirect relations. The method was originally developed as a tool enabling identification of the role of the cause-and-effect chain elements. Due to its simplicity and flexibility, the method finds numerous applications in solving complex decision-making issues, including such as presented in the article.

To implement the presented concept of improving work safety due to the importance of systemic relations in the organization of work, the following assumption was made:

1. Organizational activities that are integrated in the quality system due to the employee's safety generate a synergy effect in achieving goals in various areas of the company's operation.
2. The foundations of the stakeholder theory and the access to the knowledge structure of stakeholders' stakeholders were considered key in the comprehensive approach to continuous improvement of occupational safety.
3. In the research process, a practical way of recognizing significant system relationships using the method of specification of correlated critical requirements is required, which will enable to receive support in management decisions.
4. In order to take into account the essential needs of all stakeholders of the organization, an integrated approach to occupational safety management was
proposed, which determines the synergistic effect of the effectiveness of the implementation activities.

5. Correlation between the factors in the growth of safety culture and improving organizational activities.

6. In the research process, factors determining the context of the organization's environment were accepted as equivalent to the relations existing in the company.

7. The aspects of risk-based management in relation to the creation, implementation and maintenance of the work system were taken as significant for the effectiveness of improvement activities.

8. Compliance with the organization's commitments was considered to be important in the system approach to the company's development strategy.

**Defining system requirements**

The following stakeholders in the research process in the area of functioning of the internal Safety Management System (SMS) were included in the group of stakeholders:

1. The board, the owner of the company—provides safe and hygienic working conditions. He supervises the efficiency of machinery and production equipment and also keeps current documentation of machine inspections. His duty is to conduct an individual book of faults occurring in machines. It orders all external repairs and maintenance of machinery and equipment to external companies.

2. Health and Safety Department—carrying out control of working conditions, ongoing information to the employer about identified occupational hazards, along with the conclusions aimed at removing these hazards, giving opinions on detailed instructions on occupational health and safety at particular work stations. Participates in occupational risk assessment, ensuring an appropriate level of training in the field of occupational health and safety and ensuring appropriate professional adaptation of newly hired employees, advising on the application of regulations and health and safety rules not only for the employer but also for employees, performers tasks of the social labor inspector and company trade union organizations, if they operate in the plant.

3. Logistics department—as an internal client and internal supplier, securely delivers and receives materials and the final product.

4. Director of the Production Division - supervises the safety of the Production Division, and also supervises the employees subordinate to him. He is responsible for documentation of security reasons in production halls.

5. Production manager - supervises the safety of the production process and also supervises the employees subordinate to him. Performs daily inspections in the production hall in terms of safety.

6. Machine operators and production workers—carry out production work related to the production of an aluminum can. Their duties include first of all performing production activities according to predetermined rules, adherence to job instructions, compliance with health and safety regulations as well as the use of personal protective equipment applicable at a given workplace. The production worker closely cooperates with the employer in order to continuously improve the production process.
Due to the specific objectives of the stakeholders, the experts' specification of the critical requirements was obtained and sorted according to the given order: the highest criterion of validity was given (1), because they ensure the proper functioning of the entire safety management system as opposed to the criterion - significant (2) which the omission situations do not result in the malfunctioning of the SMS and the criterion - not significant (3) that complement the correct operation of the SMS.

The list of system requirements elaborated is as follows:

1. Improving working conditions.
2. Reducing the number of accidents at work.
3. Introduction of procedural proceedings in case of an emergency situation.
4. Increased sense of security at the plant as well as during work.
5. Cooperation of all employees in achieving safety goals.
6. Preparation of workplace instructions at each workstation.
7. Reducing the number of threats occurring at workplaces.
8. Building a safety culture among employees.
9. Drawing up the scope of duties and entitlements.
10. Machines and devices that meet minimum construction safety requirements.

The standpoint division of tasks and the various scope of responsibility and dynamics of the organizational environment makes that the specific objectives may be in opposition to each other, therefore an overriding decision objective is required.

In the context of improving occupational safety, it was adopted as a systemic indicator: the importance of the relationship between specific objectives of stakeholders and the ultimate goal, security. In the Table 1 shows the results of the research, thanks to which the validity coefficients for the requirements in this aspect were developed.

<table>
<thead>
<tr>
<th>N.G.</th>
<th>REQUIREMENT 1</th>
<th>REQUIREMENT 2</th>
<th>REQUIREMENT 3</th>
<th>REQUIREMENT 4</th>
<th>REQUIREMENT 5</th>
<th>REQUIREMENT 6</th>
<th>REQUIREMENT 7</th>
<th>REQUIREMENT 8</th>
<th>REQUIREMENT 9</th>
<th>REQUIREMENT 10</th>
<th>LINE RESULT</th>
<th>IMPORTANCE [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>X</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>13,6</td>
</tr>
<tr>
<td>2</td>
<td>X</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>9</td>
<td>20,5</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>X</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>6</td>
<td>13,6</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>X</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>6,9</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>X</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>6,9</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>X</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>4,6</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>X</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>8</td>
<td>18,2</td>
</tr>
<tr>
<td>8</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>X</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>2,3</td>
</tr>
<tr>
<td>9</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>X</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>X</td>
<td>0</td>
<td>6</td>
<td>13,6</td>
</tr>
<tr>
<td>SUM</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>X</td>
<td>6</td>
<td>100</td>
</tr>
</tbody>
</table>

Comparison of critical requirements in pairs indicated which of them are the most important and allowed to set priorities for action. According to the assumptions adopted in the list of requirements, the requirements directly related to the reduction of hazards occurring at workplaces are the priority for the actions, which will directly translate into a reduction in the number of accidents at work.
In order to determine which improvement actions are related to the wider area of impact on the system, proper research on the relationship of individual requirements has been carried out. For this purpose, the matrix of relations between the requirements presented in Table 2 was used.

Table 2. Matrix of relations between requirements (+ - replacement positive, [-] – negative relationship, 0 – no relationship) (own research).

<table>
<thead>
<tr>
<th>REQUIREMENT 1</th>
<th>REQUIREMENT 2</th>
<th>REQUIREMENT 3</th>
<th>REQUIREMENT 4</th>
<th>REQUIREMENT 5</th>
<th>REQUIREMENT 6</th>
<th>REQUIREMENT 7</th>
<th>REQUIREMENT 8</th>
<th>REQUIREMENT 9</th>
<th>REQUIREMENT 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>REQUIREMENT 1</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>REQUIREMENT 2</td>
<td>+</td>
<td>x</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>REQUIREMENT 3</td>
<td>+</td>
<td>+</td>
<td>x</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>REQUIREMENT 4</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>x</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>REQUIREMENT 5</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>x</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>REQUIREMENT 6</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>x</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>REQUIREMENT 7</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>x</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>REQUIREMENT 8</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>x</td>
<td>+</td>
</tr>
<tr>
<td>REQUIREMENT 9</td>
<td>0</td>
<td>+</td>
<td>0</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>x</td>
<td>0</td>
</tr>
<tr>
<td>REQUIREMENT 10</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>x</td>
</tr>
</tbody>
</table>

The matrix of relations between the requirements showed that their relationships are positive.

TEST CONCLUSIONS

The matrix of relations between the requirements showed that their relations are positive, so the implementation of the requirements will comprehensively affect the final product of the implemented SMS, which is security.

1. As a result of the analysis, it can be seen that all of the aforementioned objectives as set requirements are feasible goals. Belong to them:
   - improvement of working conditions
   - reducing the number of accidents at works
   - introducing procedural procedures in case of an emergency situation
   - increasing the sense of security within the enterprise
   - cooperation of all employees in achieving safety goals
- preparation of work instructions for each workplace
- reducing the number of threats occurring at workplaces
- building a safety culture among employees
- drawing up the scope of duties and entitlements
- machinery park that meets the minimum safety requirements of the structure.

2. The implementation of individual missing elements of the system will allow the proper functioning of security systems.

3. Observed deficiencies in the existing security system concern documents allowing identification of threats in non-routine work and emergency procedures.

4. The abovementioned detailed objectives will be developed by designated persons who will also be responsible for updating and supervising them.

5. Systematic response to the needs in the scope of ensuring safe and hygienic working conditions allows minimizing accidents at work and, consequently, costs associated with them.

6. The fulfillment of the company's requirements in accordance with OHSAS 18001: 2007 will allow to confirm the importance of occupational safety and health in the company's operations.

7. The implemented occupational health and safety management system will increase the safety culture and thus improve the reputation of both internal and external clients.

**SUMMARY**

The basis of effective business management lies in occupational safety. Because it is a necessary condition for the workstation to function, therefore, in order to achieve the organization's goals, it is necessary to identify the relations between security factors and elements of the system that create the situational context for the planned operation of the unit. For production enterprises that are determined by specific economic goals, it is necessary to indicate systemic relations that connect various areas of the company's operations. In these areas, first of all, the conditions of cooperation of employees in the system of vertical connections due to the responsibility for the assigned tasks and in the horizontal arrangement - due to the co-responsibility for the processes. The security aspect fits equally into arbitrarily oriented systems of connections, creating additional systemic property of the organization - work safety.

**REFERENCES**


