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## **SAFETY 4.0: MODERN TALKING OR NECESSITY**

***Abstract:** The paper examines the future of the safety reporting management and its possibility to be upgraded to the highest level for purposes of the reaching zero injury/accident goal. The safety field can not resist the advances in ICT technologies and as such, one of the possible way of digitalization is presented. Mobile real-time application for delivering reports of big data analysis in a terms of unsafe act and unsafe condition is developed and presented.*

***Keywords:** unsafe acts, unsafe conditions, safety 4.0, digitalization*

### **1. Introduction**

Nowadays, there is no question rather companies will adopt its business to the newest way of the organization and fulfilment of individual customer needs, or remain faithful to the traditional way of thinking (Vaidya, Ambad and Bhosle 2018). The essence of the Industry 4.0, introduced 2011 (Alcácer and Cruz-Machado 2019), is to ensure transformation of the traditional manufacturing processes into digitalized one based on Internet of Things (IoT), Industrial Internet of Things (IIoT), Cloud based manufacturing and smart manufacturing (Erol et al. 2016). Integration of the nine pillars of the Industry 4.0 will bring desired improvements in the field of automation, networking, optimization of the production processes which leads to the greater efficiency (Rüßmann et al. 2015).

In this way, exchange of the information become faster and interactions between different sectors are much stronger. Sharing and acquisition of the data and its analysis is

of the high importance as well as IT solutions which will provide to support it (Rennung, Luminosu and Draghici 2015). Today's manufacturing environment requires fast and precise respond to the changes on the market and adequate adoption of the new rules and approaches regarding whole company's supply chain management (Jain et al. 2013). Beside the fact that companies are trying to lower costs as much as possible through waste elimination in the production processes, safety is still number one. The whole Industry 4.0 concept aims to digitally connect, network and organize production (Bahrin et al. 2016), but the key ingredient is still a human (worker). Romero (2016) introduced the highly skilled, motivated and smart operators in the sense of the development of the Operator 4.0 concept. This concept will not be successful if smart technologies and advanced machines are bought and implemented in the shop floor. All processes should be redesigned and reshaped with addition of the advanced training to support development of the requested skills and employee empowerment

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(Kaasinen et al 2019). The same authors gave some interesting results concerning worker involvement in design of the workplace and production processes which will decrease problems workers they encounter in their daily work.

Taking into account the growing trend in the number of the robots in manufacturing processes (IFR 2019) and evident interaction with workers, safety has new emerging role in providing zero injury/accident goal. Proactive thinking is the most appropriate approach, act on the cause before any consequence happens. The Industry 4.0, with all its specifics and requirements, has immediate impact on the field of occupational safety and health (OSH) (Badri, Boudreau-Trudel and Saâdeddine Souissi 2018). The same authors pointed out co-evolution of the manufacturing organizational philosophies and occupational safety and health. Fernández and Pérez (2015) stated importance of the advanced approach to the field of occupational safety and health. New emerging risks are appeared and the existing tools and methodologies are unable to identify and solve abovementioned risks. One of the first research combining Industry 4.0 and occupational safety and health singled out ergonomics and human factor as the most important element (Badri, Boudreau-Trudel and Saâdeddine Souissi 2018). One of the main challenges could be using and analysing information gathered through internet/intranet environment (Mattsson, Partini and Fast-Berglund 2016.). Vogl, Weiss and Helu (2016) discuss about positive impact on safety providing combination of the historical data with current one and real-time decision making process. In this way, there is possibility to proactively react on the identified cause.

One of the possible way to lower the number of the injuries/accidents is decreasing the number of the unsafe acts (UA) and unsafe condition (AC). According to the safety pyramid (Heinrich 1941) up to 100.000 UA and UC lead to 1 fatal injury. In this way,

UA and UC are considered as accidents' precursors (Lorenzo et al., 2015) and has to be considered as vital one.

Authors of this paper give support to safety within Industry 4.0, called Safety 4.0, based on ICT solution able to assist to the digitalized management of safety reports.

## 2. Problem statement

The main problem identified in the field of safety is information flow. Sometimes it is slow, and sometimes there is no sharing of the information. Companies based on contemporary production philosophies (Lean manufacturing, Toyota Production System - TPS, World Class Manufacturing - WCM) insists on zero injury/accident goal. Their focus is on the proactive approach and identification of the precursors of the accidents. In this sense, based on the Heinrich safety pyramid (Heinrich 1941) decreasing the number of the UA and UC decreases the number of the accidents. In addition, many companies use manual handling of the paper documents which is very complex and time consuming. Authors identified from practice three issues that impact on the quality of the occupational safety and health reports:

- UA and UC acquisition/data collection,
- information flow and
- report management.

The first issue, UA and UC acquisition/data collection, seemed to be the main issue. Acquisition/data collection means identification of the UA and UC at the workplace and its environment. This process is related to the workers and their willingness to be included in the acquisition process. The majority of workers consider this job as additional one, which is performed after their shift is over. One possible way for changing the mindset is through introduction of the advanced safety culture, raising awareness about safety

pyramid importance.

The second issue is related to the information flow and information sharing. When UA and UC are identified (if any), paperwork has to be done. In practice, the existing form for UA and UC identification has to be filled in. After that, the paper has to be placed in the box or place dedicated for collecting UA and UC. There is no time limit for this part of the process. This is the biggest problem. It is observed that filled forms could stay in the box couple of days with no action taken. Consequently, appropriate corrective measures can not be done unless OSH manager or OSH engineer insert the forms into the system. One of the possible ways to stimulate workers to do it better is to introduce reward system. In this way, worker's effort will be recognized and he/she will feel like a part of the company.

Reports are crucial for planning of the any improvement. The issue with reports is the lack of transparency and lack of necessary information. The reports have to be structured, easy for use and with data necessary for decision-making process.

The authors are of the opinion that by introducing an advanced ICT solution, all of three mentioned issues could be solved. Some of the improvements will be:

- engaged and rewarded workers,
- high level of the company culture,
- higher percentages of the solved issues,
- faster sharing of the information,
- better interpersonal relations,
- better reports,
- etc.

### 3. ICT solution for UA and UC management

Taking into account all the mentioned issues and challenges in the OSH field regarding UA and UC, with special emphasis to Industry 4.0, authors propose ICT solution

for real-time UA and UC management. The main aim is to easier the job as much as possible for workers involved as well as for OSH manager who are responsible for results.

The ICT solution is mobile application for all types of the mobile devices (mobile phones, tablets, etc) supported by main cloud based server. The proposed application should allow better communication between workers and OSH manager. Reporting system provides the type of UA and UC, location of the identified UA and UC, and assigned risk level. If everything is filled in right manner, responsible person receive notification about it. Responsible person could be worker, shift manager, supervisor, maintenance department, OSH engineer, OSH manager and/or CEO (if it is something of greater importance). Notification instructs responsible person to create the task according to the information and data collected. This task will be send either to the worker or OSH engineer to perform action to improve current condition by solving the identified issue. After the task is done, feedback is sent to the system. If the issue is solved then OSH manager closes the task, otherwise he/she gives additional instruction until task is solved.

Mobile application meets the requirement of the Minimum Viable Product (MVP) (Ries 2011) which means the mobile application could be placed on the market. Now, it is in the phase of adoption for the testing purposes of the one automotive company. The most important thing that this application has to be adopted and configured to the requirements of the observed company. Companies are different, starting from core organization to the machines and devices at the shop floor.

The functionality of the mobile application and the quality of the reports is based on the answers to the four questions:

- Where location of identified UA and UC is (localization)?

- What type of the UA and UC is (classification)?
- What risk level of the identified UA and UC is (priority)?
- What information could be beneficial for responsible person (description)?

#### 4. Mobile application interface

The whole correspondence is performed through graphical user interface (GUI). The first level of the GUI with its components is presented on Figure 1.



**Figure 1.** GUI of proposed mobile application

The first step is precise localization of the UA and UC identified. The selection is performed from predefined list of the sectors. Alternatively, localization could be performed using GPS, but for the use of this paper it will be used predefined list of sectors. Then, UA and UC classification should be performed according to the contemporary industry standards. UA and UC could be selected from the menu, where all possible UA and UC are identified and could be found at the workplace. There is a risk assessment of the UA and UC identified

under classification part. In this way, worker who spotted UA and/or UC has to give level of urgency. This level of urgency has to be checked by trained persons before it could be transferred to the next stage. In the description part, worker gives opinion about safety issue in a form of the text or recorded voice message. The picture of the spotted UA and UC could be uploaded.

The overall goal of the this mobile application solution is:

1. digitalization of the safety reporting system supporting Industry 4.0 concept,
2. improvement of worker involvement and increasing level of the safety culture and
3. recognition and rewarding of individuals for contribution to the safety excellence.

#### 5. Conclusion

The zero injury/accident goal could be reached through the proactive identification of accidents precursors – unsafe conditions (UC) and unsafe acts (UA). This type of approach has all companies based on contemporary production philosophies (Lean, TPS, WCM).

Started from industry practice and identified issues, authors, stakeholders and ICT professionals developed and proposed novel mobile application for real-time UA and UC management as support to the Industry 4.0 concept, Safety 4.0 specifically. Developed mobile application has, to a great extent, impact on safety reporting which is crucial for planning and decision-making process for improvement in the OSH field.

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