Education: an Essential Tool for the Dissemination of the Culture of Safety

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The authors, operating within The General Safety Issues and Goals in Turin Universities -TGSIGTU research project, started from a thorough analysis of the International literature on the Culture of Safety, and made the challenging effort to classify and organize the covered sub-topics, highlighting in particular the sub-categories of Educational processes. It is important to underline that the goal of such a classification is to better manage the amount of information collected and not to compartmentalize the theme of Safety, universally recognized as a multidisciplinary Science.

There are numerous examples of interventions aiming the goal of a widespread dissemination of the Culture of Safety, and different parameters that make them incomparable, but useful: among them, authors quote the audience they are addressed to. In particular:

1. The National Institute on Occupational Safety and Health - NIOSH developed the Youth@Work—Talking Safety to educate young people about essential information transferable across industries and occupations.
2. With a different audience, Politecnico di Torino, in cooperation with Occupational Medicine experts, Environment and Workplace Prevention Technicians from Università di Torino, and some experts of National Boards operating in Occupational Safety and Health - OS&H field, provides some bachelor courses on OS&H basics.
3. Furthermore, Politecnico provides general information and engineering-readiness skills focusing on some core competencies for post graduate students, employees and practitioners operating in the field of OS&H, and National Inspectorate such as: OS&H topics and discussion, Computer-aided systems as support in the analysis of scenarios, research projects about the advanced techniques for the analysis of accidents.

All the activities are based on the assumption that education should be tailored for three main groups of people:

- the new entry workforce;
- medium-term employed workforce;
- the experienced workforce.

Moreover, a fourth category is raising. In fact, the third group is growing directly proportional to the ageing of the workforce, in turn connected to the raising of the retirement age. Similar considerations leaded European Occupational Safety and Health Administration - EU OSHA and NIOSH to develop research campaigns on the matter.

The paper summarizes the approaches to the dissemination of the Culture of Safety to those various categories of people, in particular the main approaches developed in Politecnico di Torino, and suggests that these topics can be effectively addressed in parallel with the progress of knowledge in the technical fields.

1. Introduction

Data available in statistical databases on work-related accidents and health impairments show still high frequency indexes, with a not encouraging trend (De Cillis et al., 2017b). The causes are poor Hazard Identification, uncritical Risk Assessment and, consequently, Risk Management lacking of a Quality approach. Figure 1 summarizes the results of an extensive investigation carried out as expert appointed by the public prosecutor, based on in depth analyses of fatal accidents occurred in industries and construction yards: the sequence covers poor Hazard Identification (HI) -the Hazard Factor was not recognized, or identified with a too generic description (90% of the cases)- uncritical Risk Assessment (RA) and, consequently, Risk Management (RM) inadequate and lacking of a Quality approach. (De Cillis et al., 2017a)
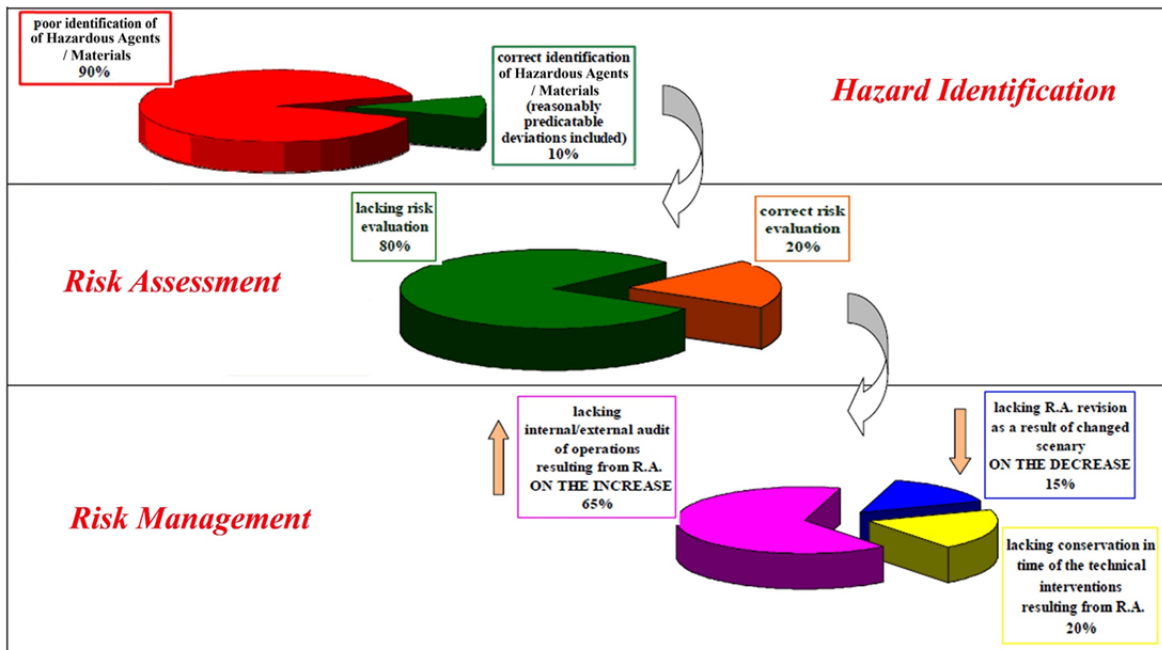

Figure 1: Main causes of fatal accidents occurred in industries and construction yards.

In this scenario, it becomes important to involve people in the OS&H aspects, so the dissemination of the Culture of Safety is an important tool to support enhancements of the situation at the same time with the progress of knowledge in the technical areas.

Previous research work confirmed that in complex situations, e.g. the highway maintenance yards, the dissemination of the "Culture of Safety" can play a key role in the reduction of risks of workers and third parties (Borchiellini et al., 2017a).

In fact, peculiar situations impose special Risk Assessment and Management for an effective and timely identification of both patent and embedded safety criticalities for workers and third parties, and for the adoption of possible improvements of OS&H (Borchiellini et al., 2017b).

Likewise, in addition to the context, it must be considered the audience the "Culture of Safety" is addressed to. To optimize the learning outcomes, the authors, within the TGSIGTU research project, made an important effort to classify and organize the extensive information collected from international literature on the various aspects of the Culture of Safety, focusing on the sub-category of Educational processes. The assumption of this study is that Educational processes should be specially tailored for different groups of people identified on the basis of some common characteristics.

2. Method

The authors carried out a thorough analysis, starting from the national and international databases and using suitable tools, to investigate the why of the deviations occurrences, and why the practitioners involved noticed –or did not notice- the anomalies and did not introduce countermeasures to break the event chain leading to the accidents. A better understanding on the Chain of Intermediate Events up to the Root Causes became

possible thanks to the use of special accident investigation original techniques (i.e. Computer-aided Cause Consequence for Prevention – CCCP) (Borchiellini et al., 2017a)

In some accidents analyzed as expert appointed by the public prosecutor, it was confirmed that one recurrent cause is the lack of a general Culture of Safety (Cirio et al., 2016) of all people involved at the different levels in the line and staff organization, and of the technicians charged of the inspection activities. A widespread awareness is important, since individuals' erroneous assumptions let events go unnoticed or misunderstood, and often human rigidity of belief and perception (i.e. subjectivity) can lead to disregard the complaints and warning signals from workers. This leads to judgment errors, cognitive lapses, deficient supervision and communication difficulties that Safety scientific orthodoxy sees as critical in creating a discrepancy between a safe system and an actual system state (Reason, 1997). The same occurs in terms of attention and comprehension capability of the results of applied research on the topics of OS&H, as discussed e.g. in (Borchiellini et al., 2018).

To improve the situation, it is very important to devoid special attention to the aspects of education: at the very first stage of the definition of the Educational processes, the audience should be identified and classified as follows:

1. the new entry workforce, more vulnerable to occupational accident risks since they are both young and new to their jobs. In this case, Authors suggest referring to the prevent-harm ethics approach, i.e. awareness and knowledge on the OS&H themes;
2. medium-term employed workforce, still learning and consequently putting a higher attention level in their task;
3. the experienced workforce, with already affirmed knowledge, skills and competences necessary to operate independently, but sometimes too confident and consequently not aware of the all the Risks of their activity.

Once the audience has been identified, the next step is to recognize what are the skills and the knowledge that every audience need to achieve. Knowledge and skill are determinants of Safety Performance (Griffin et al., 2000), hence they should be specific for every type of audience. The authors selected several examples of Educational processes from research projects of recognized organizations; Politecnico di Torino also provides specific knowledge and skills to those various categories of people.

2.1 Some examples of effective approaches

Some -certainly not exhaustive- examples of effective approaches are: the education and publication activities of the International Training Center of the International Labour Organization -ILO ITC-, the European Agency for Safety and Health at Work EU-OSHA E-fact examples about companies that involve young people in the organisation's safety management system, and the Youth@Work—Talking Safety, a curriculum designed by the National Institute on Occupational Safety and Health - NIOSH.

2.1.1. ILO ITC

The only tripartite United Nations -U.N.- agency, since 1919 the ILO brings together governments, employers and workers of 187-member States, to set labor standards, develop policies and devise programs promoting decent work for all women and men.

The ILO aims to create worldwide awareness of the dimensions and consequences of work-related accidents, injuries and diseases and to place the health and safety of all workers on the international agenda to stimulate and support practical action at all levels: the basic idea being: Decent work is safe work.

ILO ITC runs training, learning and capacity development services for governments, employers' organizations, workers' organizations and other national and international partners in support of Decent Work and sustainable development.

In the Turin campus, Regular programs are offered in a multicultural and multilingual environment at the campus or through e-learning. Tailor-made programs are offered at the organizational, national or regional level, including: Decent work and sustainable development; Employment and labor market policies; Enterprise Development; Gender, equality and diversity; Green jobs; Informal Economy; International labor standards; labor administration and labor inspection; labor market statistics and analysis; labor migration; Learning methodologies and technologies; Microfinance; Occupational safety and health; Rural development; Skills development and vocational training; Social and solidarity economy; Social dialogue and tripartism; Social protection; Strengthening employers' organizations; Strengthening workers' organizations; Unacceptable forms of work; Youth Employment; Procurement management; Project and program cycle management; Job creation in fragile states.

Through these programs ILO ITC forms in a specific and complete way the experienced technicians.

2.1.2. EU-OSHA

EU-OSHA summarized some examples of company practice involving young workers (the typical medium-term workforce) such as:

- UK energy company E. ON's apprentice training: every three months a skills coordinator takes the apprentice's views on OSH, graduates are required to investigate real-life safety projects, and they are also asked to make recommendations for improvement, helped by apprentice forums;
- German energy supplier, RWE Westfalen-Weser-Ems encourages second-year apprentices to explain their own experiences of accidents and near misses to their newer peers;
- UK construction sector company ROK Construction encourages young workers to face colleagues or superiors with questions or recommendations;
- apprentices of UK construction company Sheldon have regular discussions with the human resources manager, training manager or health and safety manager.

The EU-OSHA E-fact 78 "Involving Young Workers in OS&H" concludes assuming that although these are examples from bigger companies, these types of approaches could be adopted by every organization.

2.1.3. NIOSH Youth@Work—Talking Safety

Surveys indicate that 80% of teens have worked in the United States since they finish high school. In 2003, an estimated 54,800 work-related injuries and illnesses amongst youth younger than 18 years of age were cured in hospital emergency departments. Given that only one-third of work-related injuries are treated in emergency departments, it is probable that almost 160,000 youths sustain work-related injuries and illnesses each year (Stephenson, 2008).

NIOSH conducts research and praises how to protect these young workers (new entry workforce). To help teachers in middle and high schools to prepare students for safe and healthy work, researchers with the NIOSH Safe-Skilled-Ready Workforce program and their partners developed a curriculum called Youth@Work-Talking Safety. Talking Safety is free, tailored for all U.S. states and territories to reflect local child labor laws and resources, and it supports current educational standards. Through Talking Safety, young people learn foundational knowledge and skills in workplace safety and health, the NIOSH 8 Core Competencies.

These competencies are transferable to other life domains, portable through all jobs and industries, and they help students form a solid base of safety knowledge on which job-specific training and skills can be putted up. (Howard, 2016).

2.2 The contribution of Politecnico di Torino

Politecnico di Torino, directly or in cooperation with Occupational Medicine experts, Environment and Workplace Prevention Techniques from Università di Torino, and some experts of National Boards operating in Occupational Safety and Health - OS&H field, contributes to the dissemination of the Culture of Safety with courses organized for different categories of students from 1st (Bachelor) and 2nd (M.Sci.) up to 3rd (PhD) level, and for new entry and medium term employed workforce and practitioners or Inspectorate technicians operating in the field of OS&H (Masters and refresher courses):

- OS&H topics and discussion of theoretical aspects and practical developments, responding to the Italian and European laws and standards;
- thanks to the plurennial experience as consultants in Prosecutor's investigation and to the cooperation with the National Inspectorate, trainers bring to the classes real examples of injuries and fatalities, supporting the audience to actively interact to identify improvements and solutions to the Safety and Health criticalities highlighted in the Risk Assessment analyses;
- to support the analysis and comprehension of difficult scenarios, Politecnico developed Computer-aided systems (Computer-aided Cause Consequences for Prevention - CCCP, Functional Volumes, Statistics sampling,..) and made them available during the class activities.
- disseminates the results of research projects about the advanced techniques for the analysis of accident databases for lessons learning and prevention and about the integrated risk assessment of the technological, human and organizational factors.

As an example, The Occupational Risk Assessment and Management Course (12 academic formative credits, Master Degree, 2nd (final) year) provides to the student knowledge to deal, in a comprehensive and rigorous approach (risk should be expressed in numerical terms deriving from a solid statistical investigation, rather than using objectionable adjectives), with the problems of a thorough Hazard Identification, and deriving Risks Assessment and Management. (De Cillis et al., 2017a)

After completing this course, the student will be able to carry out a simple Occupational Risk Assessment and Management, in coherence with the Prevention through Design and System Quality approaches, and obviously in compliance with the up to date Safety and Health Regulations and Standards.

Post-Graduated Master and PhD courses directly organized by Politecnico di Torino cover specific aspects such as:
- original applications of Forensic Investigation techniques and subsequent Job Safety Analysis;
- technique to focus step by step the intermediate and very root causes of a work-related accident;
- computer assisted approach to identify the input data useful for the analysis, to correctly examine the risk assessment flaws, the non-compliances with the safety regulations and the prevention lacks;
- computer assisted techniques for the statistical confirmation of the results of measurement campaigns of pollutants in workplaces.

Moreover, some experts of Politecnico contribute to the ILO – Universita' degli Studi di Torino ITC master on OHS providing coordination of the module "Engineering in mining and underground operations: Risk assessment and management" focused on: underground operations and innovative techniques and technologies, OSH management approaches, Risk Assessment and Management in mines and tunnelling operations, natural and deriving from the excavation operations pollutant forecasting, measurement and management, ventilation systems and their availability.

Some experts of Politecnico di Torino officially cooperate also with the I level University degree "Environment and Workplace Prevention techniques", held at the Università degli Studi di Torino. Courses cover the OS&H aspects through an Engineering approach. Students acquire basic knowledge on OS&H from the Glossary of correct terms to the basics of Hazard Identification (the 1st year), then they experience the Risk Assessment in industry and yards during the 2nd year (enriched by stages and activities with senior tutors), to finally reach competences in the Risk Management at the end of the last year.

3. Results and discussion

NIOSH and its partners, including the Labor Occupational Health Program at the University of California/Berkeley, the Massachusetts Department of Public Health, and the Education Development Center Inc., first designed Talking Safety almost three years ago.

Stakeholders across the country have since championed it and continue to be important partners in its dissemination.

Miami-Dade County Public Schools -M-DCPS- the nation's fourth-largest school system, is the first-ever school district to enter into a formal settlement with NIOSH to incorporate workplace safety and health into their academic programs using the curriculum.

On May 2015, M-DCPS built skills for safe and healthy work into the mandatory content to be covered in all eight-grade science classes, which will reach just about 17,000 teens each year. (Howard., 2015)

In the Miami-Dade County Public Schools, eighth-grade students received training on Talking Safety in their science classes. Pilot results from more than 1,650 study participants indicate substantial shifts, pre- to post-test, in eighth graders' knowledge and approaches about workplace safety and health, and self-efficiency and social intentions to use the skills they learned through the program. (Howard., 2016)

Regarding University education on OS&H in Politecnico di Torino, the Occupational success of both the Post-Graduate Master and PhD attendants, ranged in the period 1997-2014 up to 85% employed in OS&H field within 1 year, in the last 5 years.

Moreover, every year the Doctoral School – Design Production and Management area, supports a mean of 3 students on topics of OS&H, and the ILO ITC graduates a mean of 3-4 masters' students with thesis on OS&H engineering.

As demonstrated, to have an effective dissemination of the Culture of Safety in terms both of contents, methodology and research results, it is necessary a multidisciplinary approach deriving from a synergy between experts in Occupational Medicine, Engineering and other science branches, involving Universities, Public institutions and practitioners.

4. Conclusion

Educational processes result precious for a correct dissemination of the "Culture of Safety". As seen, the goal is to transmit information to all the workers, regardless to their previous knowledge and background. Authors analyzed many Educational approaches, stressing strengths and weaknesses, not in absolute terms, but considering the related typology of audience.

In order to point out the best dissemination techniques, decision makers should ensure a multidisciplinary approach in each situation, never forgetting all the links of an Educational process, from the identification of the audience' cultural background, to the auditors' expectancy and the predefined formation goals.

This brief screening on the different approaches found in literature, integrated with direct experiences, is aimed to provide a first step of structured approach to the complex issue of an effective Identification of

suitable Educational processes. Obliviously the present considerations need further deepening and continuous update.

In any case, decision makers involved in the Dissemination of the Culture of Safety should be aware of the evolving Social Economic needs, of the evolution of the audience categories and of the possibility of rise of new ones (e.g. due to aging workforce, as discussed by EU-OSHA "Healthy Workplaces for all Ages"). Moreover, they should consider new Knowledge, Skill and Competence (as "cluster of related abilities, commitments, knowledge, and skills that enable a person -or an organization- to act effectively in a job or situation" defined by European Qualifications Framework - EQF).

Finally, the authors are deeply convinced that to create a methodical collection of Educational campaigns can help people involved in the Information Formation and Training sector, to compare, assess and improve the quality of their activities to define the most suitable in every situation.

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