SUSTAINABLE DEVELOPMENT: SETTING THE CURRICULA FOR ENVIRONMENTAL AND OCCUPATIONAL SAFETY AND HEALTH SKILLS AND EDUCATION

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Abstract - Environmental and occupational safety and health (EOSH) is considered very important aspect to achieve sustainability. EOHS is not just a moral and legal responsibility but a multiplier for the societies looking towards high and sustainable standards of living. In addition accidents are not only counterproductive, but they also cost, which inevitably affects a principal pillar of sustainability. Therefore, the scientific interest is directed towards the socio-economic dimensions of the EOHS. In this debate, education can act as catalyst by encouraging a dialogue to promote a safety culture. Thus, the current research, addressed a questionnaire in order to study EOSH and the safety culture through analyzing socioeconomic determinants.

Keywords - Health and Safety; Occupational Accidents; Education for Sustainable Development

I. INTRODUCTION

The World Health Organization and the World Bank attributes approximately 3% of the total human life losses to occupational accidents and casualties (Kreis & Bödeker, 2003). Moreover, internationally 270 million incidents are recorded according to the International Labor Organization annual report on occupational accidents, out of which approximately 2.2 million employees are killed, and 160 million suffer from short or chronic sickness. According to recent data, in 2016 in the USA alone, more than 2.9 million EOSH incidents were recorded. Unfortunately, similar are the data at the European level. Although over the 2007-2011 period, a significant reduction of the occupational accidents resulting in more than three days of absence from work rate was noted, recent Eurostat reports record approximately 3.2 million of such incidents, 3.739 deaths, translated into a substantial increase by comparison to the preceding year, by 49 thousand and 65 thousand recorded incidents accordingly.

The consolidation of the EOSH started by systematically investigating and understanding the accident causes and mechanisms. At the begging of the 20th century, literature of the subject suggested the theories (Greenwood & Woods, 1919; Newbold, 1926) according to which all accident and injury causation was just a matter of (Targoutzidis, 2007) a. chance, b. liability and accident proneness. However, quite often there is insufficient evidence about what actually happened and it is usually understood that EOSH incidents are due to human error rather than the system malfunctioning (Woods, Dekker, & Cook, 2017). Moreover, it is currently well known that less than 20% of the work-related accidents are caused by a single factor, the rest are caused by an accumulated series of factors and events (Dembe, 1999). Therefore, and according to Kletz (1991), the human error perception is neither true nor useful by means of producing useful actions. These initial, and rather simplistic, theories were been overtaken and replaced by the multiple causation theory (Hosseinian & Torghabeh, 2012), which supports the existence of more than one causes, each of which may have been caused by more other, thought more than one.

In this context, in order to determine the mechanism of causing accidents, namely the specific causes and the interaction of the events that led to it, the models of accident causation were developed (Attwood, Khan, & Veitch, 2006; Lundberg, Rollenhagen, & Hollnagel, 2009). The evolving course of these models, reflecting the changes that occurred in the EOSH the previous years, presents a shift from one-cause recording to multi-cause recognition and from identifying the sequence of events that triggered the accident to representing the entire system (Attwood et al., 2006). Indicatively, three main types of models of accident causation are presented (Katsakiori, Sakellaropoulos, & Manatakis, 2009): i) The sequential models, which are simple, linear models that consider the accident as the result of solely discrete sequential events, ii) The epidemiological models, which are considered linear compounds according to which the accident is the result of various pathogenic situations which inevitably result in a certain percentage of accidents to occur, and iii) the systemic models, which are complex, non-linear systems, which consider that the analysis of the accidents should be based on the analysis of system functional characteristics. Although the economic dimension of the EOSH is also underpinned by

ethical issues, it cannot be disregarded, even so more because according to Pouliakas and Theodossiou (2013) accidents occur at work, and working is an economic activity. Similarly, earlier, Smith (1776), regarded as the first modern economist, in his famous treatise '*The Wealth of Nations*', even more cynically characterized the risk as a normal part of working. By agreeing to work, people also accept this risk (Smith, 1776). Thus, in this context, the socio-economic dimensions of the EOSH are identified with the following three parameters (Targoutzidis, 2007). A) Social Mobilization and Motivation, B) Understanding Mechanisms, C) Enhance the true economic situational picture.

The protection of workers firstly, and the environment secondly, against work-related sickness, disease and injury forms a primary objective of the EU (Venema, Geuskens, & van den Heuvel, 2011). Both the 1986 Single European Act (Article 118a) (Moravcsik, 1991) as well as the subsequent Treaty establishing the EU (Article 137) (Council of the European Union, 2012) set out the foundation standards to ensure improvement of the EOSH. Directive 89/391/EEC was the first text adopted by the EU with regard to the social dimension (Colosio et al., 2017). Milestone in the development of the EU legislations on EOSH is considered to be the 22nd May 1990 when the Commission on the adoption of a European schedule of occupational diseases was established (see Commission Recommendation 90/326/EEC).

Regarding Greece, the Greek Governmental Gazette 319/A/21-11-1911 was the first legislative attempt to address the EOSH. This attempt is still considered groundbreaking for its day given that it included inter alia provisions on cleanliness, lighting, all kinds of machinery, outdoor work, *etc*. However, point of reference for the EOSH legislative process on a systematic basis, is the Greek Law 1568/85, which until today is considered the first comprehensive legislative act (Mekos, 2016). Under this law, the fundamental principles governing the EOSH take on a whole new meaning both nationally, regionally or by individual undertakings. The law introduces new preventive regulations, such as the obligation for employers to employ doctors and safety technicians, as well as the right of employees to establish health and safety committees. In 2010, and towards codifying the Greek Law 1568/1985 and the Greek Presidential Decree 17/1996, the new code of EOSH was ratified by the Greek Law 3850/2010. Thus, currently in Greece, the occupational accidents and diseases institutional framework is undoubtedly established.

However, the prolonged economic and financial crisis, the continued growth of unemployment -along with the possible environmental effects (Vardopoulos & Konstantinou, 2016, 2017)- the flexible forms of employment and the black labor market (undeclared and uninsured labor) rising phenomena, resulting in EOSH resources reduction, is an increasingly major source of concern. This concern was most emphatically first recorded in a 2009 pan-European survey, arguing that the economic crisis is expected to have a major impact on working conditions. Indeed, in 2013 a notable EOSH incidents increase was recorded, directly linked with the working conditions changes resulting from austerity measures imposed. Particularly, according to the Hellenic Statistical Authority reports, with regard to the occupational accidents resulting in more than three days of absence from work, incidents recorded in 2011 numbered 13.527, in 2012 were 13.333, while in 2013 and 2014 increased by 3.762 and 4.241 accordingly. In addition, the Pan-Hellenic Federation of Labor Inspectors Associations latest figures show a 15% of reported EOSH incidents increase in respect of the equivalent figures noted the earlier year; in 2016, 1421 EOSH incidents were reported, while in 2017 reports reached at 1608.

According to EU figures, these EOSH reported incidents cost, and are charging the society 76%, 13% the employees and their families, and 11% the enterprise (Binazzi, Scarselli, & Marinaccio, 2013; Hinze & Gambatese, 2003). In monetary terms, Mottiar (2004) estimated the amount close to 20 billion € borne by the EU, and 171 billion $ borne by the USA. However, more recent figures, point out costs rising from 190 to 250 billion $ (Leigh, 2011), out of which most cost affect employees and their families. As far as Greece is concerned, the costs of EOSH incidents slightly exceeds 1 billion €, equivalent to between 0.5% and 1% of the national GDP, without considering care costs and social security benefits for permanent incapacity. It is also worth noting, that insurance costs for EOSH incidents, account for about 2-3% of the western economies GDP. In particular, EOSH incidents are roughly equivalent to 4% of the global GDP according to the International Labor Organization, and some 2.6-3.8% of the European GDP according to European Commission reports. At the other end, of particular interest is that by ensuring a safe and accident-free working environment contributes towards strengthening the competitiveness, efficiency and profitability of small, medium and large-sized enterprises. It is noted that EOSH investments produce a multiplier effect to resource savings. Return on EOSH investment is ranging from 1:2.2 to 1:5.9, a significant economic incentive.

Therefore, it becomes more clearly understood that the EOSH economic dimension is as well important as the social (Binazzi et al., 2013). More specifically, economic benefits can be broken down into direct and indirect (Hinze & Gambatese, 2003). Direct, are related with the immediate expenditures resulting from an occupation accident such as, patient transport, health care, rehabilitation costs, *etc*. Indirect, concern difficult to quantify expenditures such as company image (identity) damages, labor

under-performance, technical and logistical setback, *etc*. (Hinze & Gambatese, 2003). Indirect benefits are estimated to four times the direct (Heinrich, 1931).

Undoubtedly, a fundamental economic concept is the cost, which includes the expenditures borne by society and businesses, and which can be distinguished in social, in terms of intangible impact for cases that cannot be valued in monetary terms, and in economic on the part that is valued in monetary terms. However, the economy is not the only concept in the current contemporary system of things. Sustainable development is the principle of achieving development targets while preserving the capacity of natural systems to provide the natural resources and services that depend on the economy and society (Theodoropoulou, Vamvakari, & Mitoula, 2009; Vardopoulos, 2017). While sustainable development education is described as the education system that promotes improvements in understanding, skills, principles and behaviors to make society more sustainable and equitable in all aspects, aiming aims to empower and equip current and future generations to meet the needs using a balanced and integrated approach to the economic, social and environmental dimensions of sustainable development (Koutrouba, Vamvakari, & Theodoropoulou, 2008).

Thus, education is one of the key instruments to achieving global sustainability. In fact, sustainable development has to be integrated into higher education curricula. One of the difficulties of this challenge is to know if students are able to achieve the basic skills, something that is extremely important in emergency management. Thus, assessment of student's work outside the classroom, non-formal curriculum, is essential to adjust the subjects of education for sustainability. In line with the above, statistics show that new employees often lack the requisite experience and the level of physical and mental maturity to deal with the multiple risks encountered at work. They are, therefore, a high risk group with an increased likelihood of suffering a serious accident at work compared to older workers (Laberge & Ledoux, 2011). Therefore, the promotion of occupational health and safety, in order to develop skills and a commitment to act independently and collectively to sustain and enhance the natural and occupational environment should be one of the educational goals (Van Dijk, Bubas, & Smits, 2015).

II. METHODS

Following a critical review of relevant studies, and given that it did not bring to light any other due research tool, for the scope of the current research, a web survey of 222 Harokopio University members was carried out. The questionnaire developed, was send via e-mail to undergraduates (classes of 2014, 2015, 2016, 2017), to graduates (classes of 2016, 2017), faculty and staff. The research provides some insights into the determinants that affect respondents' willingness to contribute to the Harokopio University efforts to further promote EOSH education, as well as into the determinants that affect students' willingness to be provided with a university EOSH course.

Empirical results are based on the estimation of the two following expanded logistic specification;

a) For respondents' willingness to contribute to the Harokopio University efforts to further promote EOSH education:

(1) $Logit[(Symvoli=1)] = b_0 + b_{1\ Seminar_F} + b_{2\ Capacity} + b_{3\ Priority} + b_{4\ Age} + \varepsilon_i$

b) For students' willingness to be provided with a university EOSH course:

(2) $Logit[(Course=1)] = b_0 + b_{1\ Seminar_F} + b_{2\ Capacity} + b_{3\ Priority} + b_{4\ Age} + \varepsilon_i$

Where, *Symvoli*: the respondent is willing to contribute to the Harokopio University efforts to further promote EOSH education or not (YES = 0, 1 = otherwise). Course: the student is willing to be provided with a university EOSH course or not (YES = 0, 1 = otherwise). *Seminar_F* is a dummy variable accounting for zero if the respondent is willing to attend to University organized EOSH lectures and 1 of otherwise. *Capasity* is a dummy variable accounting for 1 if the respondent is a University Student and zero otherwise. *Priority* is a dummy variable accounting for zero if the respondent considers that the EOSH education promotion must be of top priority among the University academics, and 1 if otherwise. Age is a dummy variable accounting for 0 when the respondent is under thirty five years old, and 1 if otherwise, while ε is an error term. The empirical results from the estimation of Equations (1) and (2) are presented below.

III. RESULTS

The following section presents the results of the statistical and econometric analysis in two separate sections. First the descriptive statistics are presented, while the logistic regression analysis follows.

Descriptive statistics; From the sample of 222 respondents, 64.4% were women and 35.6% were men. Most respondents were between the ages of 18 and 25 years (53.6%); 23.9% were between 25 and 35 years old, 19.4% between 35 and 50 years old and only 3.1% above 51 years old. As regards the educational or employment relationship with the University, 50.5% were undergraduate students, 32.9% were master students, 9.5% were doctoral students, while faculty and staff were only 7.1%. Between the four departments of the Harokopio University, the respondents affiliated with the Department of Nutrition and Dietetics were 33.8%, the respondents affiliated with the Department of Geography were 23.9%, the respondents affiliated with the Department of Home Economics and Ecology were 22.1%, while the respondents affiliated

with the Department of Informatics and Telematics were 20.3%.

Next, interviewees were asked to report if they acknowledge the EOSH in all aspects of their day-to-day routine. The majority (99.1%) stated they acknowledge and understand, out of which specifically, 60.4% very good, 21.6% good, and 17.1% fairly enough.

As regards whether the Harokopio University brings to bear on safety and health for students, faculty and staff, 49.5% of the respondents answered positively, 43.7% responded to a partial degree, while only 6.8% responded negatively. However, when the participants in the survey were asked if they were informed of the risks they might face during their work or apprenticeship around Harokopio University premises, 61.7% responded negatively, 29.75 to a partial degree, and only 8.6% positively. Whereas a similar trend was recorded when the interviewees where asked if they are educated or trained to prevent and then confront the risks they might face. In particular, 62.2% responded negatively, 28.8% to a partial degree, and 9% positively for preventing, and 64.9% responded negatively, 29.7% to a partial degree, and 5.4% positively for the confrontation. Lastly, when interviewees were asked if the Harokopio University encourages discussion on matters associated to EOSH, only a 5.5% responded very frequently, 27% occasionally, 41.4% rarely, and 26.1% never, while at the same time, they report - albeit to varying degrees- that they would be interested to contribute to the University effort to further promote EOSH (97.3%).

Finally it is important to notice that when survey participants were asked if they have involved in Harokopio University emergency preparedness exercises and if they consider these exercises necessary, 46.8% reported they consider them very important, 47.3% quite important, and 5.9% somewhat important. However, the vast majority (97.7%) reported that they have never being involved in a Harokopio University emergency preparedness exercise. An additional interesting, in several ways, point stands on the answers to the question asking the Harokopio affiliates if they have experienced EOSH incidents both as victims or witness, where 79.3% answered positively.

With respect to personal protective equipment, 95.9% consider them necessary, but 41% uses frequently, 14.9% uses them occasionally, 25.7% rarely, and 18.5% never.

The Harokopio University affiliates also reported that the issue of promoting EOSH should be a major priority for the academic community (94.1%), that although they have previously attended seminars and lectures on OSH (68%), they would be interested - albeit to varying degrees- to attended seminars and lectures on EOSH and in the future (97.8%). Respondents reported that they would want an EOSH related classroom course on their syllabus (67.1%),

Logistic regression analysis; Certain significant findings were obtained from the empirical estimation of Eq. (1). Table 1 details the empirical results of the logit equation estimated coefficients with respect to respondents' willingness to contribute to the Harokopio University efforts to further promote EOSH education. Hosmer-Lemeshow goodness-of-fit tests revealed that for the statistical significance level $a > 0.05$ ($x^2 = 2.981$, $a = 0.7$), there is a good fit of the data sample, thus the model is well calibrated. In addition R^2 (Ngekkerke) = 0.374. *Id est* the model provides a 37.4% estimated probability of respondents' willing to contribute to the Harokopio University efforts to further promote EOSH education.

Variables	Estimated Coefficients	Odds Ratio	$e^{\beta-1}$
Constant	3.717	-	-
Seminar_F	-1.811***	0,163	- 0,837
Capacity	-0.502	0,606	- 0,394
Priority	2.114***	8,278	7,278
Age	0.415	1,515	0,515
R^2 (Nagelkerge)	0.374		
2Log likehood	170.258		
Hosmer and Lemeshow	2.981		
Note: *, **, *, represent levels of significance at 1%, 5% and 10%, respectively.**			

Table 1 Estimated binary logistic regression for the probability of respondents' willingness to contribute to the Harokopio University efforts to further promote EOSH education

IV. CONCLUSION

Analysis of the current research implies that age and capacity are the two not statistically significant factors (with respect to statistical significance level 1%) in the willingness to contribute to the Harokopio University efforts to further promote EOSH education. *Priority* positively affects respondents' willingness, contrary to *Seminar_F* which affects negatively. Results clearly indicate that someone willing to attend to University organized EOSH lectures is less likely to contribute to the Harokopio University efforts to further promote EOSH education. On the other hand, one who feels that the EOSH education promotion must be of top priority among the University academics, is more likely to contribute to the Harokopio University efforts to further promote EOSH education. Odds ratio wise, concerning *Seminar_F* (1.163), odds ratio < 1, *id est* someone's contribution to the Harokopio University efforts to further promote EOSH education is less likely, while *Priority* odds ratio > 1 which means that someone's contribution to the Harokopio University efforts to further promote EOSH education is more likely. In particular, *Priority* odds ratio = 8.278, and marginal effect = 7.278 ($e\beta$ - 1 = 8,278 - 1 = 7,278). This means that the probability of respondents' willing to contribute to the Harokopio University efforts to further promote EOSH education in correlation with their consideration that the EOSH

education promotion must be of top priority among the University academics, is increased by 72.78%, given that the all other variable remain constant. The results of the current research indicate that any Harokopio University moves towards the promotion of the EOSH skills and education would be an act actively embraced by students and staff.

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