www.ceejme.eu
ww.wsb.pl/wroclaw/ceejme

ISSN electronic version 2353 - 9119
Central and Eastern European Journal
of Management and Economics
Vol. 3, No. 1, 51-69, March 2015

CEEJME
Central and Eastern European Journal of Management and Economics

The importance of occupational safety and health in management systems in the construction industry: case study of construction in Hermosillo

David Slim ZEPEDA QUINTANA, Nora Elba MUNGUÍA VEGA, Luis Eduardo VELAZQUEZ CONTRERAS

University of Sonora, Mexico

Abstract: Occupational Safety and Health (OSH) are concepts not fully integrated into management systems in the construction industry. This article shows the results of a research study conducted in two construction sites in the city of Hermosillo, Sonora, Mexico. The objective of this research is to identify and evaluate occupational risks in their activities. As a result, it is intended to demonstrate the importance of including occupational health practice into the management systems and potentially prevent, reduce and / or eliminate occupational risks and hazards in construction activities of buildings. Case study was used as a methodological design. Integrating OSH practices in management systems will facilitate construction industry move toward sustainability patterns and consequently increase the quality of life of its workers.

Keywords: sustainability, occupational health, sustainable management systems, construction, risks in construction.
JEL: L7, L74, Q55, I130

1. Introduction

The construction industry is one of the most important in the world due to the high number of people employed as labor force (Tiwary and Gangopadhyay 2011: 18-24). The human resource is the most valuable asset of any organization in the world (Loosemore et al. 2003), therefore, taking good care of this resource should be the task and primordial duty of the leaders of each company; However, the majority of employers in the construction pay too much attention

Correspondence Address: David Slim Zepeda Quintana, Blvd. Luis Encinas y Rosales s/n CP. 83000, División de Ingeniería, Universidad de Sonora – México. E-mail: david.zepeda@unison.mx.

to profits of an organization and ignore the importance of the health of their employees (Leung et al. 2009: 126-134). According to Hassanein and Afiffy (2007: 25-34), this inattention to the care of the human resource poses significant risks in construction, which origins the presence of accidents in construction sites

Table 1. Injuries in construction workers in México 2004-2005

Type of injury	2004		2005	
	Builders	**Labourers**	**Builders**	**Labourers**
Fractures	2,087	1,248	2,081	1,249
Wounds	2,236	1,560	2,359	1,465
Luxations and sprains	1,519	797	1,606	791
Traumas	2,893	1,681	3,109	1,662
Burns	143	96	139	94
Amputations	51	34	51	38
Intoxications	17	11	16	16
Foreign bodies	299	143	291	139
Others	429	244	446	239
Total	**9,674**	**5,814**	**10,098**	**5,692**

Source: IMSS (2006)

An accident at work is a fact arising of or in the course of work which leads to fatal occupational injuries or occupational non-fatal injuries (International Labour Office 1996: 96). More than 55% of the accidents on construction sites occur in ways and places of work (Roto et al. 1993: 91-104). According to the Mexican Social Security Institute (IMSS 2006) in the period 2004-2005, more than 30,000 injuries affecting construction workers across the country (table 1) were reported. This shows that accidents at work constitute a serious social and economic problem in the industry of construction (López-Valcárcel 1996). There are different factors that cause accidents on construction sites; According to Suraji et al. (2001: 337-344), 88% of accidents are attributable to problems directly related to the execution of the work, followed by problems in the planning and control of construction projects. Errors and omissions that occur during the stages of design, planning and management of the work are reflected directly in the health and safety of workers (Vasconcelos and Barkokebas 2008). These accidents and their consequences should be inadmissible for a society like ours that has state of the art technology and techniques for construction (Rubio et al. 2005: 70-75).

Occupational accidents cause direct, indirect and hidden costs for the whole society involved (Hämäläinen et al. 2005: 137-156). These cause loss of productivity by companies, loss of wages for employees, unsafe work conditions and even long-term costs as compensation, payments or pensions for employees; In addition to a negative impact on the well-being of workers their attitude, State of mind and morale (Malek et al. 2010: 1-9). During 2010 alone, in Mexico the total cost caused by work-related accidents represented an economic impact of more than $ 5 billion pesos and incalculable social costs (STPS; Secretariat of Labor and Social Prevention 2010). Therefore, Occupational Safety and Health (OSH) must be considered inevitably as a factor that directly affects the profitability of a company (Malek et al. 2010: 1-9).

2. The importance of integration of OSH programs in construction projects

Hämäläinen et al. (2005: 137-156) state that the number of accidents rates will raise concurrently with the increase in industrialization in countries, which will directly affect the quality of life of construction workers. In addition, the lack of laws and regulation of the works of industry favors accidents becoming more common in construction projects (Kheni et al, 2010: 1104-1115). This demonstrates the importance of integrating plans and programs of OSH in construction projects in order to prevent, reduce or eliminate occupational risks in the construction activities (Hinze 2000: 121-127).

According to the mandate established in the occupational Safety and Health Act of the Occupational Safety and Health Administration (OSHA 1970), it is corporate responsibility to create the conditions of health and safety within the workplace for employees. The way to achieve this is through the programs of OSH, which are the strategies that a construction company follows in order to prevent, reduce or eliminate accidents at work within their projects (Shahbodaghlou and Haven 2000: 260-271). Programs of OSH used in the majority of the construction works have not been updated, and Health and Safety Executive (HSE 2013) confirms this fact, since it reported that indicators of fatal accidents in the construction industry have not changed significantly in the past 20 years. According to Baxendale and Jones (2000: 33-40), this is because employers in the construction industry classify the task of integrating these programs to their projects as tedious, bureaucratic and irrelevant. To continue categorizing OSH schemes in this way will harm the task of integrating health and safety in construction (CIRIA 1997). The companies in the sector that are committed to the design and implementation of programs of OSH ensure that they can significantly reduce rates of incidents in the industry (Hinze 1997).

Properly including measures of safety and hygiene from the planning of the projects will benefit the task of making the integration of the OSH systems a common practice in any project of construction (Cameron and Hare 2008: 899-909); however, the Act of making a planning per se does not guarantee the success of the project.

To ensure the success of the programs of OSH, construction companies should involve all their staff and create a culture of safety in all its areas of work (Spath 2004: 63-66).

A safety culture is intended to create a process for implementation of safety programs within companies (Malek et al. 2010: 1-9) and a key factor in the creation of this is the ability to identify unsafe acts and situations (Hinze et al. 1998: 67-71). Unsafe acts are those in which there are elements, phenomena, environments and human actions that have a potential to cause injury or material damage (Huang and Hinze 2003: 262-271). However, knowing and identifying these variables does not guarantee that within a construction site may exist a culture of security as stated by the Organization for cooperation and economic development (OECD 1999) which proposed five measures to implement it as shown in Figure 2.

Figure 1. Measures for the implementation of a culture of security

Source: OECD 1999

According to Abudayyeh et al. (2006: 167-174) the culture of safety is inversely proportional to the rate of accidents at work. Thanks to this, the proportion of incidence of all injuries and non-fatal diseases within the construction workers has declined from 13.1% in 1992 to 5.4% in 2007 (BLS 2002; BLS 2008). This demonstrates the effectiveness and importance of the implementation of a safety culture in the workplace (Auld et al., 2001: 900). Despite this, there is still little interest and participation in the development of it, especially by the managerial and administrative levels (Ceylan 2012: 909-918). These should be more involved since they commonly lead projects in companies (Rajendran and Gambatese 2009: 1067-1075) and are responsible for creating conditions of health and safety within the workplace (Toole 2002: 90-95).

3. Sustainable Management Systems (SMS) in construction

To achieve sustainability in construction, sustainable practices must be promoted and integrated into all aspects of construction (Bordass et al. 2001: 144-157). This is because, from a managerial and administrative point of view, the natures of sustainability practices and construction practices are very different (Cole 2000: 949-957). The practices of sustainability can be said to exist in three different levels; principles, heuristics and specifications (see Figure 3), While the construction practices are merely technical (Pearce and Vanegas 2002: 54-93). The way in which the construction industry seeks to integrate these two kinds of practices and at the same time aspire toward sustainability is through the SMS (Bourdeau 1999: 354-366).

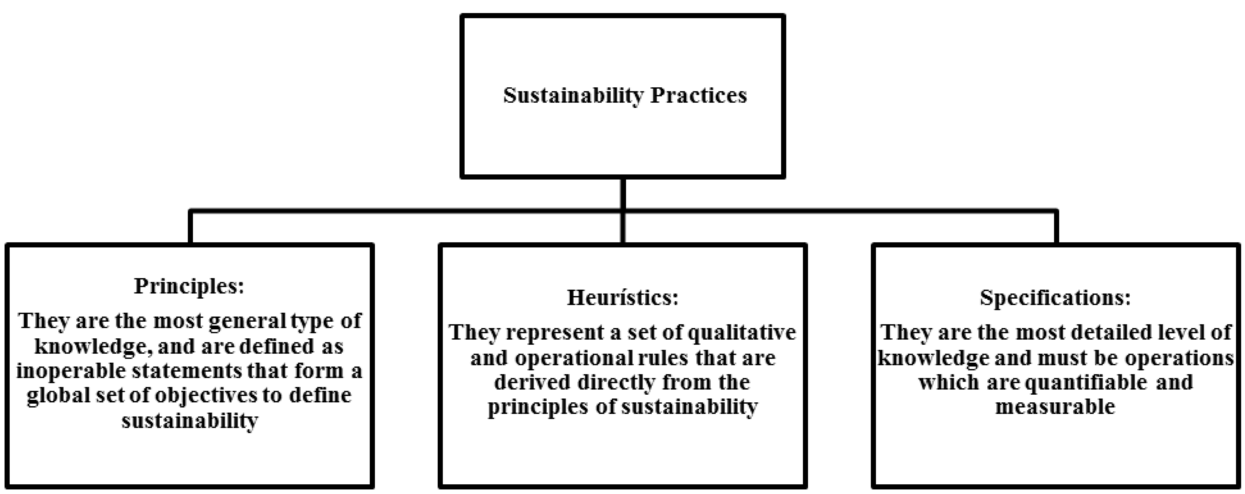

Figure 2. Sustainability practices
Source: Pearce and Vanegas 2002

Currently, these systems of management in the construction industry are focused on improving the organizational structures of companies and increasing the competitiveness of them against large firms (Wu and Low 2010: 61-70). Construction companies must use management systems in which sustainable practices are promoted in order to achieve a balance between the economic, social and environmental factors in all of its projects (Bordass et al. 2001:144-157).

There are limitations that hinder the creation of this type of management systems in the construction industry (Matar et al. 2004: 1-12). Within these barriers are the lack of interest among those who are involved in construction projects, lack of training or education in design and sustainable construction (Du Plessis 2002), slow recovery of the investment of sustainable practices (RRG 2003: 14-17), high initial costs of the alternatives for sustainable construction (Landman 1999), lack of a well-defined set of practices of sustainable construction that can be applied in construction projects (Pearce and Vanegas 2002: 54-93), the need for a legal framework that is assistant in the implementation of sustainable practices by companies (Scheuer and Keoleina 2002), among others. This shows the need to produce tools that help to eliminate these barriers and eventually facilitate the design and implementation of a SMS (Matar et al. 2008: 261-275).

An approach of sustainability must be always present when designing a SMS (Sartori and Hestnes 2007: 249-257). It is well known that a construction project generates many economic benefits and, on the other hand, it also generates many impacts on the environment and society (Bordass et al. 2001: 144-157). Therefore, to ensure that a management system is truly sustainable it must take into account all stages of the life of the construction project (which is shown in Figure 4) in order to minimize the impact on the three aspects of sustainability;

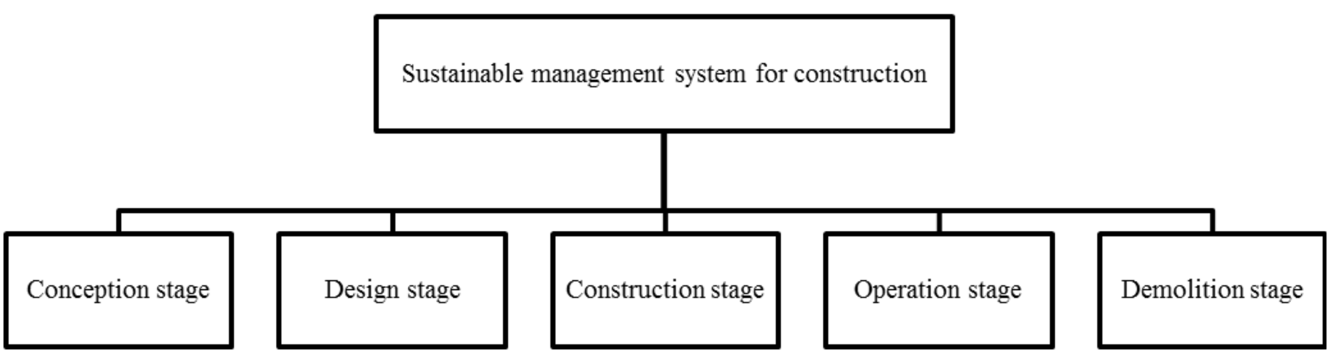

Figure 3. Sustainable management system and the life cycle of a construction Project
Source: Shi et al. 2012

The most neglected aspect of SMS for construction is OSH (Linstroth 2012: 30). Dewlaney and Hallowell (2012: 165-177), state that the integration of practices of health and safety in the construction industry SMS will help the industry itself to approach more and more to sustainability, through strategies of safety management in phases of design and construction of buildings. The SMS in the construction industry must integrate the problem of OSH, as well as environmental problems (Rajendran and Gambatese 2009: 1067-1075), since, as Towse states (2008), no company can be sustainable if their employees are not sure. Unfortunately, there is still a lack of methodology to help construction companies create an environment that facilitates the integration of the SMS in their construction sites (Shen et al. 2005: 339-349).

Construction site managers tend to be those who take the role of leader at the time of implementing a SMS (Rajendran and Gambatese 2009: 1067-1075). Similarly, supervisors play an important role in the design of sustainable practices since they are those who coordinate, manage and delegate the work carried out in the construction phases and can help the creation of policies and/or work standards (Bilec et al. 2007: 265-269). This type of collaboration within the SMS will facilitate the planning of sustainable projects and at the same time help obtain best results (Beheiry et al. 2006: 384-392).

4. Methodology

A case study was performed in order to demonstrate the importance of integrating occupational health practices in the construction industry management systems at two construction sites in the city of Hermosillo, Sonora, Mexico, in order to detect and evaluate the occupational risks involved in their activities. As a result, it is pretended to potentially prevent, reduce or eliminate occupational risks in the construction activities. The research work lasted for almost two years; from September 2012 to July 2014.

For data collection, a digital sound meter EXTECH RS-232, a digital vibration meter EXTECH 407860, a detector of volatile organic compounds (VOCs) PHOTOVAC 2020 COMBOPRO and different methods of ergonomic evaluation were used.

5. Results

Table 2 shows the information corresponding to analyzed construction work sites.

Table 2. Analyzed Construction work sites

No.	Name of the Project	Company Responsible	Number of employees (Administrative)	Number of employees (operations)	Work area
1	Office of the Superior Institute of Auditing and Control (ISAF)	ISAF	6	40	2407 m(2)
2	Residential Development “La cima”	Grupo Ruba	5	55	1903 m(2)

Source: authors’ own elaboration.

A review of the mission, vision and policies of the companies was conducted in order to identify if they make implicit or explicit mention of OSH concepts; as well as of sustainable development or sustainability. The results are shown in table 3. Neither company had a policy of sustainability, thus, one was designed.

Table 3. Mention of OSH concept and sustainability in case studies

Document	ISAF			GRUPO RUBA		
	Explicit	Implicit	No mention	Explicit	Implicit	No mention
Mission			X			X
Vision			X			X
Sustainability policy			DNA			DNA

Source: authors’ own elaboration.

5.1 Identification of Occupational Risks

Identification of occupational risks was through observation in construction work, involvement with the staff working in them, knowledge of the physical conditions of the site, the manner in which the materials are stored, and through the characterization of the process. Table 4 shows the occupational risks identified at each of the stages of the construction process.

Table 4. Occupational risks identified in each activity of the process

	Operation	Description of the risk	Occupational risk
1	Remove existing vegetation in the area destined to the construction site	Exposure to noise Exposure to extreme temperatures Machinery traffic	Physical Physical Other risks
2	Trace widths of Foundation to carry out excavation	Exposure to shock, stumbles and falls Exposure to extreme temperatures	Other risks Physical
3	Excavation for foundation	Exposure to noise Exposure to extreme temperatures Machinery traffic Exposure to trips and falls	Physical Physical Other risks Other risks
4	Leveling of the ground (lying and compacted)	Exposure to noise Machinery traffic Vibrations Exposure to extreme temperatures Exposure to trips and falls	Physical Other risks Physical Physical Other risks
5	Construction of the foundations (cyclopean, footing or slab)	Exposure to extreme temperatures Exposure to trips and falls Exposure to emissions of chemicals Uncomfortable positions	Physical Other risks Chemical Ergonomic
6	Construction of the building structure (columns, girders, walls)	Exposure to extreme temperatures Exposure to shock, cuts and falls Exposure to emissions of chemical products Exposure to contact with chemical products Uncomfortable positions Excessive loads Repetitive tasks	Physical Other risks Chemical Chemical Ergonomic Ergonomic Ergonomic
7	Bricklaying works	Exposure to shock, cuts and falls Exposure to emissions of chemical products Exposure to contact with chemical products Uncomfortable positions Excessive loads Repetitive tasks Exposure to extreme temperatures	Other risks Chemical Chemical Ergonomic Ergonomic Ergonomic Physical
8	Applying paint according to specifications	Uncomfortable positions exposure to inhalation of chemicals exposure to extreme temperature exposure trips and falls	Ergonomic risks Physical Chemical Other risks
9	Application of floors and tiles	Uncomfortable positions Repetitive tasks Exposure to contact with chemical products Exposure to inhalation of chemical products	Ergonomic Ergonomic Chemical Chemical
10	Coarse and fine finishing works	Uncomfortable positions Exposure to trips and falls	Ergonomic Other risks

Source: authors' own elaboration.

5.2 Evaluation of the identified occupational risks

This section shows the results of the evaluations of the identified occupational risks.

5.2.1 Physical risks

Noise: Exposure to different levels of noise occurs throughout the construction process since machinery and tools that generate it are used. the noise originated by the use of tools in different activities for evaluation in both construction sites were measured. Data were taken during the use of these tools. Table 5 shows the ranges of decibels that were detected when using the tools.

Table 5. Number of decibels per tool

Tool	dB(A)
Rod cutter	107.5 – 115.6
Concrete mixer	98.2 – 102.4
Concrete vibrator	98.3 – 102.1
Machinery (Motor grader, backhoes, cranes, etc.)	84.6 – 96.3
Steamroller	92.5 – 97.4
Jack Hammer	102.3 – 110.4
Spray guns (paint, roof finish, etc.)	104.8 – 108.5

The Mexican Official Standard NOM-11-STPS-2001, relating to the conditions of safety and hygiene in the workplace where noise is generated , states that for an 8 hour day, the maximum permissible exposure limit is 90dB (A) and as the decibels increase, the exposure time decreases (Table 6).

Table 6. Maximum noise exposure times

dB(A)	Maximum permissible exposure time
90	8 hours
93	4 hours
96	2 hours
99	1 hour
102	30 minutes
105	15 minutes

Source: authors' own elaboration.

Vibrations: Like in the evaluation of noise, vibrations assessments were carried out per tool used in the different activities and data were taken during the use of these.

For the directional component of weighted acceleration the following equation as used.

Equation 1

$$a_k = k_j \sqrt{\frac{T}{T_0}}$$

Where:
a_k is the directional component of weighted acceleration.
k_j is the n-th frequency-weighted.
T is the duration of the exposure (in seconds).
T0 is the term of reference of 8 hours (28,800 seconds).

Table 7 shows the results of these evaluations.

Table 7. Results of evaluation to vibrations per tool

Tool	m/s2	ak
Disc cutter	48.9 – 72.5	17.28 – 25.63
Concrete vibrator	8.5 – 13.2	3 – 4.66
Steamroller	4.6 – 7.8	1.62 – 2.75
Machinery (Motor grader, bachoes, cranes, etc.)	1.2 – 3.6	0.42 – 1.27
Plate compactor	11.6 – 13.4	4.1 – 4.73
Jack hammer	47.1 – 50.4	16.64 – 17.81
Spray guns (paint, roof finish, etc.)	4.5 – 6.8	1.59 – 2.4
Drill	18.3 – 21.7	6.46 – 7.67

Source: authors' own elaboration.

The NOM-024-STPS-2001 relating to the conditions of safety and hygiene in the workplace where vibrations are generated sets a maximum permissible exposure limit of up to 4 ak for a workday of 8 hours, and as the ak increase exposure time decreases (Table 8).

Table 8. Maximum permissible exposure times to vibrations

ak	Maximum permissible exposure time
Up to 4	4 to 8 hours
Up to 6	2 to 4 hours
Up to 8	1 to 2 hours
Up to 12	Less than 1 hour

Source: authors' own elaboration.

5.2.2 Chemical risks

Procedures indicating the NOM-010-STPS-1999, concerning the recognition, evaluation and control of chemical contaminants in the environment were used to assess the presence of volatile organic compounds (VOCs) into the environment.

Measurements were made on activities where the use of chemical substances was observed and data were taken during the performance of the same. In addition, product safety sheets for components were used.

Table 9 shows the ranges of concentration of VOCs that were detected and the maximum limits of exposure that the NOM-010-STPS-1999 establishes.

Table 9. VOCs measurement results

Activity	Substances	Components	ppm of VOCs	MPET in ppm
Painting	paint	Titanium dioxide Calcium carbonate Etylene glycol Styrene	6.5 – 9.8	-- -- -- 50
	Thinner	Toluene Methyl Alcohol Acetone Hexane Xylene Ethyl Acetate	74.3 – 82.7	5 200 1,000 50 100 400
Concrete casting	Concrete	Portland Cement calcium sulphate Calcium carbonate Calcium oxide Magnesium oxide	4.4 – 4.7	-- -- -- -- --
	Separating agent	Non specified	4.3 – 4.7	--
	Concrete curing compound	Non specified	3.9 – 4.5	--
Water proofing	Wáter proof sealer	Acrylic Resine Calcium carbonate Titanium dioxide	0 – 1.1	-- -- --
Trabajos de albañilería	Concrete adhesives	Buthoxy ethoxy ethanol	58.4 – 73.3	26
	Grout	Cemento portland	3.2 – 4.1	--
	Anclaje epóxico	Epichlorohydrin hexane Aminomethyl Trimethyl Diethylenetriamine	7.3 – 9.7	2 50 -- 25 1

Source: authors' own elaboration.

5.2.3 Ergonomic risks

12 tasks were selected to evaluate; These were selected according to the frequency with which they are performed, the effort required for the preparation of and the positions adopted by the workers to perform the task. The assessment method that is more suitable to the activity to assess was selected for evaluation.

Table 10 shows the methods of ergonomic Checklist that were used for each activity and the results.

Table 10. Methods of ergonomic evaluation and risk levels

No.	Task to evaluate	Evaluation method	Risk level
1	Hammering	REBA	HIGH
2	Carriage of wooden or concrete bars	NIOSH	MEDIUM
3	Metal rods cutting	OWAS	HIGH
4	Metal rods flexing	JSI	HIGH
5	Collocation of supporters and spacers	OWAS	HIGH
6	Steel binding	OCRA	HIGH
7	Concrete casting	RULA	HIGH
8	Concrete vibration	RULA	HIGH
9	Concrete curing	RULA	HIGH
10	Carriage og cement sacks	NIOSH	HIGH
11	Carriage of bricks	NIOSH	MEDIUM
12	Brick collocation	OCRA	HIGH

Source: authors' own elaboration.

6. Conclusions

The results obtained in this study demonstrate a very poor use of OSH practices in the process of the construction projects analyzed along; from the stage of the project planning to the execution of the works.

The mission and vision of the companies which are referenced in this research do not make mention of implied or explicit concepts of sustainability or occupational health, factor that can be decisive in the integration of the same mission and vision because they define the basis of companies and represent why and what they exist for. In addition, all lines of work, programs, plans and projects of the companies are based on these. Not to include these terms implies a lack of social responsibility of the company with the workers and society in general. The inclusion of these concepts within the strategies of each company in order to create a culture of safety and to ensure the introduction of these in all areas of the company is required. In addition, as discussed by Vasconcelos and Barkokébas (2008), these omissions occurring during the stages of design, planning and management of the work are reflected directly in the health and safety of workers. The identification and assessment of occupational risks are the most important part of this investigation, since it is through these assessments that the need to integrate practices of OSH in the SMS is proven. Physical and chemical risks that were identified and assessed exceed most Mexican official standards; this means that tasks that are performed every day in construction can be harmful to the health and well-being of workers. Similarly, the ergonomic risk assessments showed the reality of very poor ergonomics in all the evaluated activities. 33% of activities had a medium risk level, which involves an in-depth study of the possible damage to the health and future redesign tasks, while 66% of the evaluated activities present a high risk level, which leads to imminent damage to health, mainly in the muscle-skeletal system.

The presence and extent of the risks that were identified through this research are the consequences of the neglect to the human resource that exists by construction companies; neglect which, as mentioned by Hassanein and Afiffy (2007: 25-34), is the main cause of accidents on construction sites. The elimination or prevention of these risks will only happen if the construction companies succeed in creating a culture of safety in all their areas of work (Spath 2004: 63-66), starting with the high levels of the companies since they are responsible for creating conditions of health and safety within the workplace (Toole 2002: 90-95).

It is important to mention that during the observation made in this research measures to tackle problems related to the construction, acquisition of inventory management, progress of work, hiring staff, among others, were identified. The problems related to the OSH only were attacked after the presence of some kind of accident or injury, confirming that the more neglected aspect within the management systems in construction is the OSH, as commented by Linstroth (2012: 30).

Including OSH practices in construction companies brings a variety of economic, welfare and labor benefits such as a considerable improvement in the work area, reduction of injuries and illnesses, which is translated into decreased risk premium, higher quality and efficiency in the work done, reduction in expenses for work-related accidents and disabilities, among others. In addition, they contribute to the construction industry to advance toward a more sustainable reality and increase the quality of life of workers.

At the end of this research it can be concluded that there are risks to health in the majority of activities involved in construction work. Current management systems do not integrate properly OSH practices, originating the presence of risks to the health of workers.

Through the evaluation of the identified risks, it was found that the OSH is not integrated fully into existing management systems since the magnitude of these risks denote an inattention to them; in fact, during the conduct of this investigation, there were no modifications made in the way in which these activities occur.

Systems management in the construction industry should include health, hygiene and safety measures in all phases of the project, especially in the stages of planning, since it is here where the way in which these risks will be controlled or eliminated is defined.

OSH is not only a factor of utmost importance in management systems to contribute to the increase of the quality of life of workers, also by the wide range of benefits in the short and long term that it generates. The integration of this will drive down accidents and occupational injuries, will reduce costs, will create better working conditions and help the construction industry move towards sustainability.

Bibliography:

Abudayyeh O., Fredericks T.K., Butt S. E., Shaar A. (2006), An investigation of management's commitment to construction safety, "Int. J. Proj. Manage", vol. 24 no. 2, pp. 167–174.

Auld M., Herber J., Gordon D., Mcclintock D. (2001), The efficacy of construction site safety inspection, "Journal of Labor Economics", vol. 19 no. 4, p. 900.

Baxendale T., Jones O. (2000), Construction design and management safety regulations in practice - progress on implementation, "International Journal of Project Management", vol. 18, pp. 33–40.

Beheiry S.M.A., Chong W.K., Haas C.T. (2006), Examining the business impact of owner commitment to sustainability, “Journal of Construction Engineering and Management”, vol. 132 no. 4, pp. 384–92.

Bilec M., Ries R., Matthews, H.S. (2007), Sustainable development and green design - who is leading the green initiative?, “Journal of Professional Issues in Engineering Education and Practice”, vol. 133 no. 4, pp. 265–9.

BLS - U.S. Bureau of labor statistics (2002), Survey of occupational injury and illness. http://www.bls.gov/iif/oshsum.htm [10/12/2013].

BLS - U.S. Bureau of labor statistics (2008), Workplace injuries and illnesses in 2007, http://www.bls.gov/iif/oshwc/osh/os/osnr0030.pdf [10/12/2013].

Bordass B., Leaman A., Ruyssevelt P. (2001), Assessing building performance in use 5: conclusions and implications, “Building Research & Information, vol. 29 no. 2, pp. 144–57.

Bourdeau L. (1999), Sustainable development and the future of construction: a comparison of visions from various countries, “Building Research & Information, vol. 27 no. 6, pp. 354–66.

Cameron J., Hare B. (2008), Planning tools for integrating health and safety in construction, “Construction Management & Economics, vol. 26 no. 9, pp. 899-909.

Ceylan H. (2012), Analysis of occupational accidents according to the sectors in turkey, “Gazi University Journal of Science, vol. 25 no. 4, pp. 909-918.

CIRIA (1997), Experiences of CDM, Ciria report 171, Ciria, london.

Cole R.J. (2000), Building environmental assessment methods: assessing construction practices, “Construction Management and Economics, vol. 18, pp. 949–57.

Dewlaney K., Hallowell M. (2012), Prevention through design and construction safety management strategies for high performance sustainable building construction, “Construction Management & Economics”, vol. 30 no. 2, pp. 165-177.

Du Plessis C. (2002), Agenda 21 for sustainable construction in developing countries: a discussion document, Report for cib and unep–ietc.

Hämäläinen P., Takala J., Saarela K.J. (2005), Global estimates of occupational accidents, “Safety Science” vol. 44, pp. 137–156.

Hassanein A., Afify H. (2007), Contractors' perceptions of construction risks--a case study of power station projects in Egypt, “Cost Engineering, vol. 49 no. 5, pp. 25-34.

Hinze J. (2000), Designing for the lifecycle safety of facilities, in: Proceedings of the designing for safety and health conference, European Construction Institute, London, pp. 121-127.

Hinze J. (1997), Construction safety, Prentice-Hall, Upper Saddle River, NJ.

Hinze J., Pederson C., Fredey J. (1998), Identify root causes of construction injuries, “Journal of Construction Engineering and Management, vol. 1, pp. 67-71.

HSE (2013), HSE statistics website, number and rate of fatal injury to workers, 1993/94 - 2012/13, http://www.hse.gov.uk/statistics/fatals.htm [16/1/2014].

Huang X., Hinze J. (2003), Analysis of construction worker fall accidents, “Journal of Construction Engineering and Management”, vol. 129 no. 3, pp. 262-271.

ILO code of practice (1996), Recording and notification of occupational accidents and diseases, International Labour Office, Geneva.

Instituto Mexicano de Seguridad Social (IMSS) (2006), Información estadística en salud (Health statistics), http://www.imss.gob.mx/dpm/dties/indice.aspx [30/12/2013].

Kheni N., Gibb A., Dainty A. (2010), Health and safety management within small- and medium-sized enterprises (SMEs) in developing countries: study of contextual influences, "Journal of Construction Engineering & Management, vol. 136 no. 10, pp. 1104-1115.

Landman M. (1999), Breaking through the barriers to sustainable building: insights from professionals on government initiatives to promote environmentally sound practices, MA thesis, Tufts University, USA.

Leung M., Chan Y., Yu J. (2009), Integrated model for the stressors and stresses of construction project managers in Hong Kong, Journal of Construction Engineering & Management, vol. 135 no. 2, pp. 126-134.

Linstroth T. (2012), Sustainability as the new safety, "Environmental Design & Construction", vol. 15 no. 6, p. 30.

Loosemore M., Dainty A., Lingard H. (2003), Human resource management in construction projects: strategic and operational approaches, Routledge.

Lopez-Varcarcel A. (1996), Seguridad y salud en el trabajo en el marco de la globalización de la economía (Safety and health at work in the context of globalization of the economy), Ministry of Labour and Social Security of Spain, regional project safety and health at work in the processes of integration and globalization, Working paper 26, OIT.

Malek D., El-Safty A., Sorce J. (2010), The correlation between safety practices in construction and occupational health 2010, "Management Science Engineering", vol. 4 no. 3, pp. 1-9.

Matar M., Georgy M., Ibrahim M. (2008), Sustainable construction management: introduction of the operational context space (OCS), Construction Management & Economics, vol. 26 no. 3, pp. 261-275.

Matar M.M., Georgy M.E., Ibrahim M.E. (2004), Towards a more applicable set of sustainable construction practices, in: International conference: future vision and challenges for urban development, HBRC, Cairo, Egypt, pp. 1-12.

OECD nuclear energy agency (NEA) (1999), The role of the nuclear regulator in promoting and evaluating safety culture, http://www.oecd-nea.org/nsd/reports/nea1547-murley.pdf [9/12/2013].

OSHA – Occupational safety and health administration, (2009), Occupational safety and health act of 1970.

Pearce A.R., Vanegas J.A. (2002), A parametric review of the built environment sustainability literature, "International Journal of Environmental Technology and Management, vol. 2 nos. 1-3, pp. 54–93.

Rajendran S., Gambatese J. (2009), Development and initial validation of sustainable construction safety and health rating system, "Journal of Construction Engineering & Management, vol. 135 no. 10, pp. 1067-1075.

Roto P., Lappalainen J., Oksa P. (1993), Talonrankennustyöt. Suomalaiset työssä ii: työympäristö ja työterveys eri toimialoilla ja ammateissa, "Työ Ja Ihminen, vol. 3, pp. 91-104.

RRG (Reed research group) (2003), Where our readers stand on sustainability, "Building Design and Construction, vol. 11, 14–17.

Rubio M., Menendez A., Rubio J., Martínez G. (2005), Obligations and responsibilities of civil engineers for the prevention of labor risks: references to European regulations, "Journal of Professional Issues in Engineering Education & Practice, vol. 131 no. 1, pp. 70-75.

Sartori I., Hestnes A.G. (2007), Energy use in the life cycle of conventional and low-energy buildings: a review article, “Energy and Buildings”, vol. 39 no. 3, pp. 249–57.

Scheuer C.W., Keoleian G.A. (2002), Evaluation of LEED using life cycle assessment methods, National Institute of Standards and Technology (NIST), Gaithersburg, MD, USA.

Secretaria del Trabajo y Previsión Social (S.T.P.S), (2010), Información sobre accidentes y enfermedades de trabajo. Riesgos laborales por grupo de actividad económica 2010 nacional (Information on accidents and illnesses. Occupational risk per group of national economic activity 2010), http://www.stps.gob.mx/bp/secciones/dgsst/estadisticas/nacional%202001-2010.pdf [4/11/2013].

Shahbodaghlou F., Haven R. (2000), A model for a quality safety program, “Journal of Construction Education”, vol. 5 no. 3, pp. 260-271.

Shen l. Y., Wu Y.Z., Chan E.H.W., Hao J. L. (2005), Application of system dynamics for assessment of sustainable performance of construction projects, “Journal of Zhejiang University Science, vol. 6a no. 4, pp.339–349

Shi Q., Zuo J., Zillante G. (2012), Exploring the management of sustainable construction at the programme level: a Chinese case study, “Construction Management & Economics, vol. 30 no. 6, pp. 425-440

Spath J. (2004), How to get employees involved in the safety program, “Occupational Hazards”, vol. 66 no. 9, pp. 63-66.

Suraji A., Duff A.R., Peckitt S. J. (2001), Development of causal model of construction accident causation, “Journal of Construction Engineering and Management, vol. 127 no. 4, pp. 337-344.

Tiwary G., Gangopadhyay P. (2011), A review on the occupational health and social security of unorganized workers in the construction industry, “Indian Journal of Occupational & Environmental Medicine, vol. 15 no. 1, pp. 18-24.

Toole T.M. (2002), A comparison of site safety policies of construction industry trade groups, “Pract. Period. Struct. Des. Constr.”, vol. 7 no. 2, pp. 90–95.

Towse B., (2008), Safety is key to sustainability, “Heating & Ventilating Review”, July.

Vasconcelos B.M., Barkokébas B. (2008), Prevention of accidents through design: recommendations for the control of fall risk in construction, Brazil.

Wu P., Low S.P. (2010), Project management and green buildings: lessons from the rating systems, “Journal of Professional Issues in Engineering Education and Practice”, vol. 136 no. 2, pp. 61–70.

Znaczenie Systemów Bezpieczeństwa i Higieny Pracy w przemyśle budowlanym: Studium przypadku budowy w Hermosillo

Streszczenie:

Bezpieczeństwo i Higiena Pracy (BHP) są pojęciami nie w pełni zintegrowanymi z systemami zarządzania w przemyśle budowlanym. Niniejszy artykuł przedstawia wyniki badań prowadzonych na dwóch placach budowy w mieście Hermosillo, Sonora w Meksyku. Celem tych badań było zidentyfikowanie i ocenienie ryzyka zawodowego w czasie ich realizowania. W związku z tym, celem jest zademonstrowanie jak ważne jest włączenie praktyk bezpieczeństwa i higieny pracy do systemów zarządzania i tym samym potencjalne zapobieganie, zredukowanie i/lub wyeliminowanie ryzyka zawodowego i zagrożeń podczas wykonywania czynności na placach budowy. Studium przypadku posłużyło za wzór metodologiczny. Integracja zasad BHP z systemami zarządzania sprzyja podążaniu przemysłu budowlanego w kierunku wzorów zrównoważonego rozwoju i w konsekwencji zwiększa jakość życia pracowników zatrudnionych w tym sektorze.

Słowa kluczowe: Trwałość, Bezpieczeństwo i Higiena Pracy, Zrównoważone Systemy Zarządzania, budownictwo, zagrożenia w budownictwie.