

Integral Diagnosis of Occupational Health and Safety Management in Colombian Construction Companies

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Published online: 15 January 2018

To cite this article: Fabián Alberto Suárez Sánchez, Gloria Isabel Carvajal Peláez and Joaquín Catalá Alís. (2017). Integral diagnosis of occupational health and safety management in Colombian construction companies. *Journal of Construction in Developing Countries*, 22(2): 101–116. <https://doi.org/10.21315/jcdc2017.22.2.7>

To link to this article: <https://doi.org/10.21315/jcdc2017.22.2.7>

Abstract: Given the particular characteristics of the construction sector, its rate of accidents and contracted illnesses is high. Therefore, construction companies seek to protect the health of their workers through the design and implementation of occupational health and safety management systems (OHSMS). This paper presents the results of a study that aimed to perform a comprehensive diagnosis of the implementation of the requirements of the Colombian Technical Standard (Norma Técnica Colombiana, NTC-OHSAS 18001) in Colombian construction companies through a SWOT analysis. A survey of 25 questions to industry professionals in 5 capital cities was used for data collection. The survey was conducted in two ways: virtually with the help of the Google Docs platform and directly through written forms. A total of 209 questionnaires with valid answers were received. The findings show that a lack of commitment and a lack of knowledge about safety are the main weaknesses. On the other hand, the existence of occupational health and safety (OHS) staff and the promotion of OHS by Occupational Risk Administrators (ORA) are the main strengths. From this data, alternatives for improving OHS are proposed, such as greater investment in builders, increasing organisational culture, and adequate monitoring by the State.

Keywords: Construction industry, Occupational health and safety, risk, SWOT

INTRODUCTION

Construction is one of sectors that presents the highest rates of accidents in the world. A preliminary report from the United States Bureau of Labor Statistics (2013) states that 775 fatal accidents occurred in the construction sector within the United States in 2012, representing a rate of 9.5 such accidents per 100,000 workers. In Great Britain in the same period there were 39 fatal accidents as reported by Health and Safety Executive (2013), which is equivalent to a rate of 1.9 fatalities per 100,000 workers. In Colombia, there are few statistics relating to occupational accidents in construction. According to the latest data available from the Colombian Federation of Insurers (Federación de Aseguradores Colombianos [FASECOLDA], n.d.) 55 fatal accidents occurred in 2011; a rate of 6.8 deaths per 100,000 workers. As a result, apart from the physical and psychological consequences that arise for the worker, his family, and society (Cormack, Cross and Whittington, 2006; Dumrak et al., 2013; Santana, Fernandes de Souza and Pinto, 2013; Frickmann et al., 2012), different

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types of costs are also generated for enterprises (Hinze and Appelgate, 1991; Everett and Frank Jr, 1996; Manuele, 2011; Šukys, Čyras and Šakėnaitė, 2011). On the other hand, there are many causative factors that can lead to an accident occurring, but in general, accidents at work occur due to lack of knowledge or training, lack of supervision or lack of resources to carry out an activity safely, or alternatively, due to an error in judgment, carelessness, apathy or complete recklessness (Sawacha, Naoum and Fong, 1999). Against this background, many researchers have studied how to reduce workplace risk during the production process (Wang and Yuan, 2011; Thevendran and Mawdesley, 2004; Zou, Zhang and Wang, 2007). One proposal is an occupational health and safety management systems (OHSMS). Globally, the most commonly used systems are the Standard Occupational Health and Safety Assessment Series (OHSAS), which provide a good framework for safe construction operations (Zeng, Tam and Tam, 2008). Additionally, International Labour Organization (ILO) standards have exerted considerable influence on the laws and regulations of its member states (Niu, 2010).

A variety of OHSMS have been suggested or studied in different countries by a few authors. For example, Ai Lin Teo and Yng Ling (2006) advanced a methodology to develop and test the tools that auditors may use to assess the effectiveness of the safety management system of a construction firm in Singapore. Choudhry, Fang and Ahmed (2008) made an exploratory study of site safety management in a Hong Kong construction site. The authors studied aspects of safety management including safety policy and standards, training in safety-related topics and inspection of hazardous conditions. Kheni, Gibb and Dainty (2010) examined the influence of the contexts in which small- and medium-sized enterprises from Ghana manage occupational health and safety (OHS). Segarra Cañamares et al. (2017) studied how to implement occupational risk prevention and include it in the management systems of Spanish companies (both small- and medium-sized) operating in the construction sector.

Likewise, a host of frameworks to assess and promote OHS issues in the construction industry have been put forward by researchers, each of which has its own drawbacks (Mahmoudi et al., 2014). These frameworks include a variety of topics as key factors in the management of health and safety, as well as the necessary requirements for the implementation of an integrated management system (quality, safety and health, and environment). With regard to Colombia, the Colombian Technical Standard (Norma Técnica Colombiana, NTC-OHSAS 18001) (Instituto Colombiano de Normas Técnicas y Certificación [ICONTEC], 2007) is the standard adopted for specific requirements of an OHSMS.

A tool used in the process of continuous improvement is the SWOT (strength, weakness, opportunity and threat) matrix analysis, which originates from the business management discipline and has been widely applied to a broad array of disciplines (Yuan, 2013). SWOT is a well-established research tool, widely used in strategic planning (Shang and Pheng, 2014).

The aim of this study is to analyse how companies comply with the requirements considered in the NTC-OHSAS 18001 standard, which provides the guidelines for the implementation of the OHS management system in Colombia. Research was based on a survey given to construction professionals who carry out OHSMS in their construction work (Suárez, Carvajal and Catalá Alís, 2013).

Finally, a SWOT analysis was performed to provide alternative solutions to the current problems.

MATERIALS AND METHODS

Survey

The descriptive exploratory study was carried out via a survey of construction professionals, using a closed form with four possible answers: Yes, No, In Process, and Do Not Know or No Answer (DNK/NA), and the 25 questions were grouped into the following themes: knowledge, planning, implementation, monitoring and control; following the phases of the Deming Cycle (Plan-Do-Check-Act [PDCA]), which allowed an ordered evaluation of techniques and management systems in OHS employed during the production process in different areas and levels of the company.

For confidentiality reasons, the survey did not include any questions related to the demographic characteristics of the respondents. Likewise, personal responses were optional.

Population and Sample

Construction companies registered at the Cámara Colombiana de la Construcción (CAMACOL, 2012) were taken as population to calculate sample size. The sample value is calculated with the following formula used for finite and known populations (Bernal, 2010):

$$n = \frac{Z^2 * p * q * N}{(N * e^2 - e^2) + Z^2 * p * q} \quad \text{Eq. 1}$$

The following values were assigned in the equation provided: occurrence probability ($p = 50\%$), nonoccurrence probability ($q = 50\%$), sampling error ($e = 10\%$), confidence level of 95%, which in a two-tailed normal distribution has a reference value ($z = 1.96$), and total population ($N = 821$). The sample size n consisted of 87 Colombian construction companies. However, additional random responses were obtained which provided more reliable results.

The survey was conducted in two ways: virtually with the help of the Google Docs platform, and directly through written forms in five cities in Colombia: Bogotá, Medellín, Cali, Popayán, and Montería. The first three cities are the largest in the country in terms of population and economic activity, and they are located in the centre, northwest, and southeast of Colombia, respectively; the other cities are classified as intermediate and they are located in northwestern and southwestern Colombia. Thus, we sought to include a sample representative of the construction sector (Table 1).

The answers were evaluated and analysed with the statistical software Statistical Package for Social Sciences (SPSS).

RESULTS

A total of 209 questionnaires with valid answers were received. The percentage of answers for each city is presented in Figure 1.

Table 1. Surveyed Cities

City	Population	Location in Colombia
Bogotá	7,786,845	Centre
Medellín	2,441,123	Northwest
Cali	2,334,734	Southwest
Montería	434,950	Northwest
Popayán	275,129	Southwest

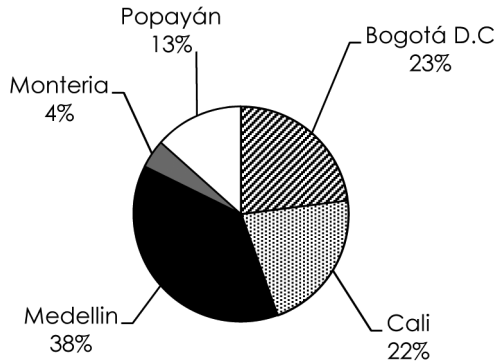


Figure 1. Percentages of Answers for Each City

The written survey had more responses (87.6%) than its virtual counterpart (12.4%). The types and number of professionals working in construction who participated in the survey are shown in Table 2.

Table 2. Profession and Number of Respondents

Profession	Number of Respondents
No answer	45
Architect	26
Builder	1
Public accountant	1
Agricultural engineer	1
Civil engineer	126
Mining engineer	1
Electrical engineer	2
Sanitary engineer	3
Mechanical engineer	1
Industrial safety technician	1
Construction technologist	1

To examine the implementation of the NTC-OHSAS 18001: 2007 Standard by Colombian construction companies, the answers provided by respondents were compared with the requirements of the standard in: OHS policies, legal requirements, framework for occupational safety and health, measurement and evaluation, and operational control. The results are presented in this section.

Occupational Safety and Health Policies

To find out about the existence of OHS policies a single question was asked, and the results are presented in Figure 2. The answers demonstrate 47.8% of companies have guidelines to protect the health of their workers. 8.6% of respondents selected "DNK/NA" about the question, and 22.5% said that the company does not have a related policy.

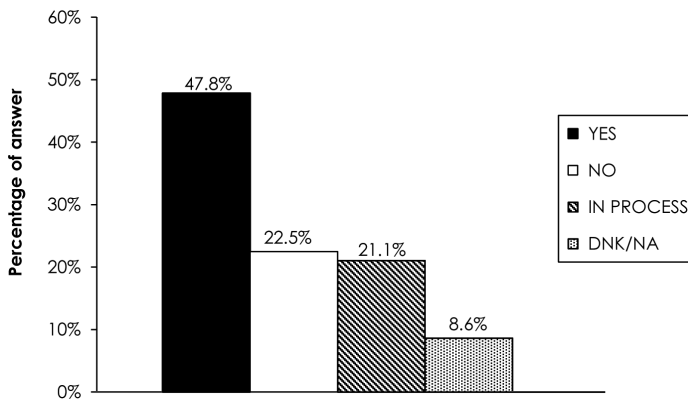


Figure 2. Existence of OHS Policies

Legal Requirements

Figure 3 summarises the results, expressed in percentages by type of answer to questions related to requirement of and compliance with OHS legal obligations, which are part of the NTC-OHSAS 18001 Standard. The first question asks about the existence of clauses in contracts with third parties (suppliers, support staff, contractors, etc.), to which 52.6% of respondents answered affirmatively. On the other hand, the percentage of "DNK/NA" answers (25.4%) is important, because construction professionals who administer works should know the OHS legal requirements. The second question related to knowledge of and compliance with existing regulations; in this regard, 50.7% of respondents answered affirmatively and 24.4% reported that they were "IN PROCESS" in terms of implementing the OHS rules. This shows that there is progress on this issue.

Structure for OHS

Figure 4 shows the percentages of answers to the questions related to the existence of the OHS structure required in the NTC-OHSAS 18001 Standard. To the question about the existence of an organisational chart that assigns responsibilities at all

levels of the organisation, 54.1% of the respondents answered yes. Regarding the existence of staff in charge of OHS activities, 77% of construction companies had this category of staff.

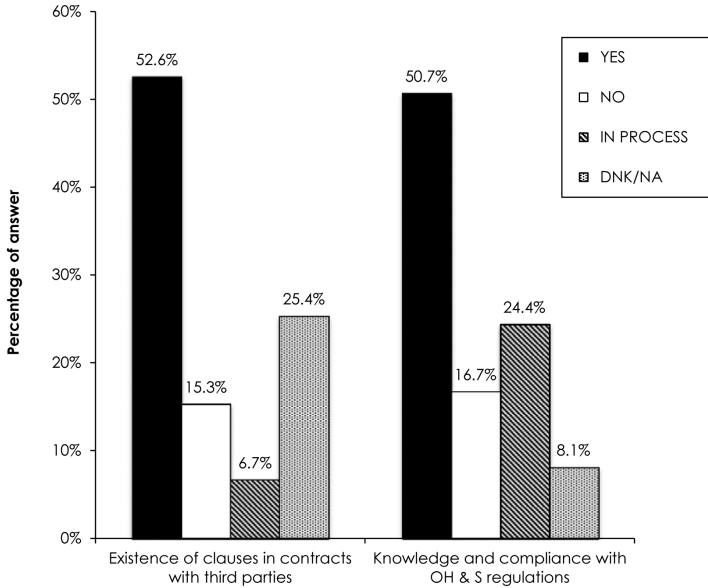


Figure 3. Percentages of Type of Answer to Questions Related to Legal Obligations

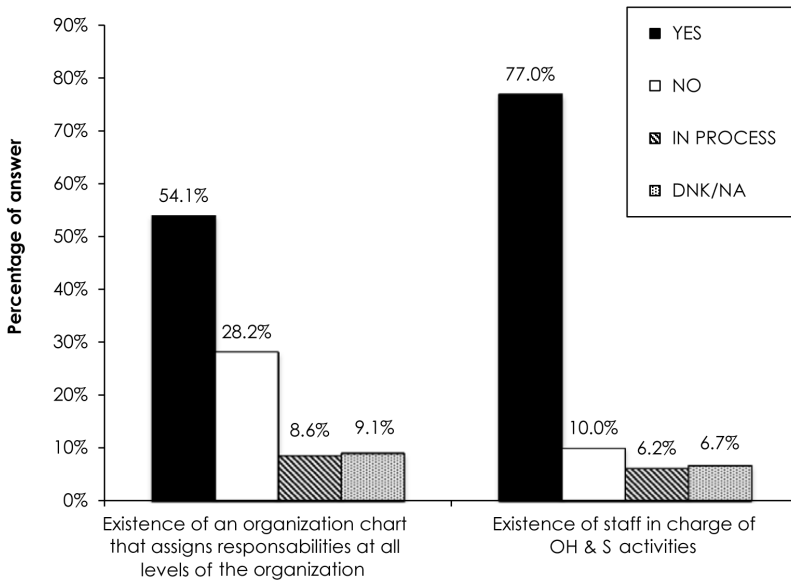


Figure 4. Percentages of Responses Related to the Existence of a Framework for OHS

Measurement and Evaluation

The percentages by type of response in the part of the survey relating to measurement and evaluation of the NTC-OHSAS 18001 Standard are presented in Figure 5. It is observed that 50.2% of the respondents answered "YES" to the statement "management makes corrections to problems in OHS" and 19.6% are in the process of implementing this. When asked if they had a procedure for investigating accidents, 38.3% answered "YES" and 25.4% "NO". Regarding the existence of an inspection programme to verify safety and health in building works, 40.7% of the respondents answered positively and 20.6% answered that they are "IN PROCESS" to have an inspection programme. In addition, 39.2% stated that they do perform a new assessment of the potential risks when there are changes in construction processes.

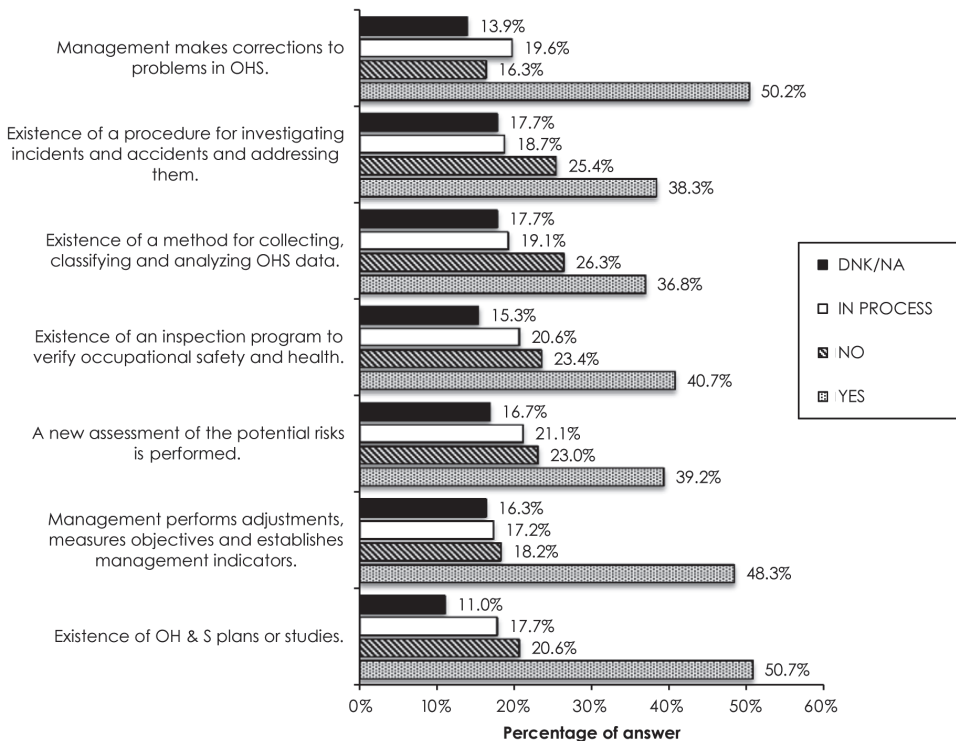


Figure 5. Percentages by Type of Response to the Questions Related to Operational Control in OHS

Operational Control

The percentages by type of response to the questions related to operational control in OHS included in the NTC-OHSAS 18001 Standard are presented in Figure 6. Only 64.1% stated that they have the capacity for an immediate response in case of an accident, and a similar proportion carry out appropriate maintenance of construction machinery and equipment (63.2%) and provide personal protective

equipment and collective protection elements (66.0%) to their workers. A higher percentage (73.2%) have OHS signage. Regarding the existence of a procedure for identifying and developing safe activities, a little more than half of respondents (57.9%) answered "YES". Finally, 35.4% of companies qualify their workers for construction activities and 60.3% train and update their workers' knowledge on OHS.

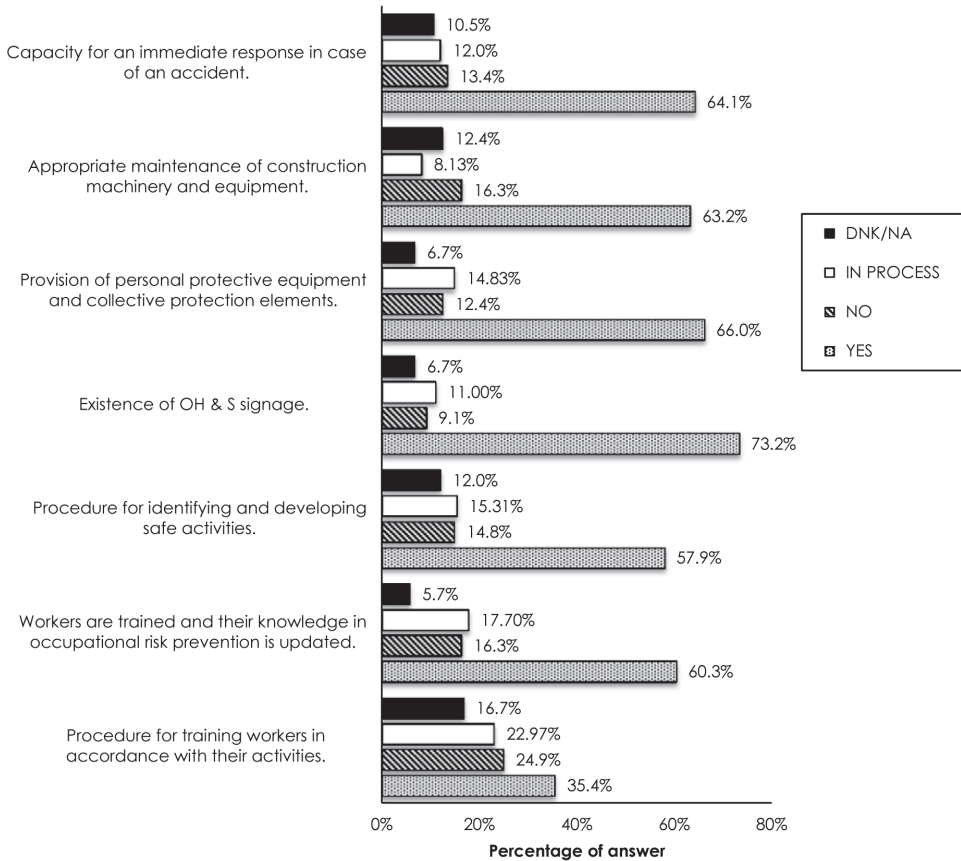


Figure 6. Percentage of Responses Related to Operational Control in OHS

DISCUSSION

The survey results reveal several shortcomings in the implementation of the occupational health and safety management system NTC-OHSAS 18001 Standard by construction companies in Colombia, which can be corrected through the appropriate use of available resources. Alternative solutions arise using a SWOT matrix and they are presented in this section.

Strengths

S1. Promotion of OHS by Occupational Risk Administrators (ORA)

To improve the lack of training of human resources (Figure 6), the State should enforce Law 1562 of 2012 on occupational risks and health (Congreso de la República, 2012) that requires ORAs to present an annual report to the Ministry of Labour regarding prevention programmes performed by its affiliates and their achievements.

S2. Existence of OHS Staff

According to the survey, the highest percentage of positive answers was given to the question concerning the existence of OHS personnel (Figure 3). This person or group of people is directly responsible for the correct implementation of the occupational health and safety management system and the union between workers and company directives necessary to achieve the objectives.

Weaknesses

W1. Stakeholders' Lack of Awareness

One of the biggest barriers to the implementation of OHS policies in the construction industry in Colombia (Figure 2) is the lack of awareness of stakeholders involved in the construction process, independent of their position in the organisation.

W2. Lack of a Business Structure in OHS

The structure of OHS in companies helps to give responsibilities and functions to members of an organisation at different levels and serves to achieve the goals outlined in a specific area through efficient communication. However, not all Colombian construction companies have an organisation that enables them to implement and monitor activities related to OHS (Figure 4).

W3. Lack of Knowledge of Techniques, Management Systems, and Occupational Health and Safety Standards by Company Personnel

Resolution 2413 of 1979 (Ministerio de Trabajo y Seguridad Social, 1979) was the first procedural act whereby occupational hygiene and safety for the construction industry was regulated. However, due to the lack of monitoring by government agencies, construction companies have not complied with the laws (Figure 3). Moreover, the construction sector has lacked knowledge of the techniques, management systems, and national and international standards used to improve working conditions through OHS.

W4. Dearth of OHS Data

Some construction companies do not have a reporting system for occupational accidents and diseases, mainly small and micro-sized companies, due to a lack of human and financial resources, which hinders decision making.

Opportunities

01. Growth of the OHS Culture

Due to the high accident rate demonstrated in construction in Colombia and all the consequences that brings to stakeholders, safety culture has been increased at all levels within companies. Techniques and OHSMS employed by foreign companies operating in the country provide a benchmark.

02. Increase in the Number of Training Centres

New requirements in OHS have encouraged the creation of educational institutes for the training and updating of workers in the field, strengthening the group consisting of the National Learning Service (Servicio Nacional de Aprendizaje [SENA]) and several universities that offer courses for staff training at different levels of organisations.

03. Different Options to Improve Work Safety

There are currently several OHSMS models worldwide (OHSAS 18000, BS 8800: 2004, ANSI/AIHA Z10-2005) as well as techniques (What-if Analysis, Hazard and Operability Study [HAZOP], and The Sequentially Timed Event Plotting Technique [STEP]) through which the causes of accidents can be removed or reduced.

Threats

T1. Lack of Monitoring by State Entities

The State has not fulfilled its functions as a controlling entity, and there have been no inspections of construction sites to verify the OHS conditions of workers by State agencies. At present, there is no administrative structure with resources available that allows for this monitoring.

T2. Little Investment for Occupational Safety and Health in Projects

For companies or persons that undertake a State or public contract in Colombia there is no obligation to assign part of the budget of a project to OHS. When hiring, some companies voluntarily require the contractor to include resources for this purpose in its proposal.

T3. Temporary Employment of Unskilled Workforce

Construction companies usually subcontract specific activities to third parties. Using temporary contracts for unskilled workers who work by hour, day or job allows for the evasion of the payment of contributions to the ORA. On the other hand, this situation avoids the continuous training of high turnover workers, which slows companies' spending on an investment without return. Table 3 shows a summary of the conditions described in this section.

Table 3. SWOT Analysis

Internal Conditions	External Conditions
<p>Strengths</p> <p>S1: Promotion of OHS by Occupational Risk Administrators (ORA)</p> <p>S2: Existence of occupational health and safety staff</p> <p>Weaknesses</p> <p>W1: Stakeholders' lack of awareness</p> <p>W2: Lack of a business structure in OHS</p> <p>W3: Lack of knowledge of techniques, OHSMS, and OHS standards by company personnel</p> <p>W4: Dearth of OHS data</p>	<p>Opportunities</p> <p>O1: Growth of the OHS culture</p> <p>O2: Increase in the number of training centres</p> <p>O3: Different options to improve work safety</p> <p>Threats</p> <p>T1: Lack of monitoring by State entities</p> <p>T2: Little investment for OHS in projects</p> <p>T3: Temporary employment of unskilled workforce</p>

Source: Adapted from Yuan (2013)

Strategies to Improve Implementation of the NTC-OHSAS 18001 Standard

According to this analysis, key strategies for better implementation of the NTC-OHSAS 18001 Standard in Colombian construction companies are proposed. The strategies included in SWOT consist of strengths to maximise opportunities and minimise threats, minimise weaknesses to exploit opportunities, and minimise weaknesses to prevent threats.

St 1. Increasing OHS Culture through Promotion

Many organisations including construction companies around the world are showing an increasing interest in the concept of safety culture as a means to reduce the potential for disasters, accidents, incidents or near misses in their daily tasks (Choudhry, Fang and Mohamed, 2007). For this reason, it is important to promote OHS culture with the help of the ORA through the continuous training and updating of workers.

St 2. Qualifying Workers in OHS with the Help of the Personnel Responsible

One reason why there is a high accident rate in construction in Colombia is due to workers' ignorance of existing tools to eliminate or reduce risky situations that generate those accidents (Suárez, Carvajal and Catalá Alís, 2013). With the help of site personnel responsible for OHS, who must be trained and updated on the subject, it is possible to eliminate this problem in all areas of the organisation.

St 3. Utilising an OHS-positive Atmosphere to Sensitise Stakeholders

Colombia is beginning to experience OHS culture (which is strongly established in other countries) due to the opening of markets through free trade agreements and the presence and operation of multinational companies in the country. This positive environment should serve to sensitise construction sector stakeholders to the need to implement an OHS management model in their companies and construction projects.

St 4. Use of OHS Training Centres to Qualify Workers

Given the increasing number of OHS training centres, multiple alternatives for workers to qualify are presented. This can generate healthy competition that benefits organisations interested in hiring these services, increasing quality, and reducing costs. Training is a self-motivating way to encourage workers to report occupational accidents and diseases, and to increase OHS data availability.

St 5. Creating Strategic Alliances between ORA and Companies to Achieve Objectives

Due to the low budget assigned for OHS by contractors and builders, to achieve objectives in this field, it is necessary to unite efforts. The union of resources (human, financial, technological, etc.) and the efforts of the ORA together with construction companies increases the possibility of reducing or eliminating diseases and accidents, with the supply of elements of personal and collective protection to quality workers.

St 6. Controlling Occupational Risks with the Help of Staff Responsible for OHS

Controlling occupational risks is a joint task that must be carried out internally by company staff and supervised externally by State agencies. However, the State, as already mentioned, does not currently execute its role as supervising agency, and responsibility for occupational health and safety lies with the human resources that companies allocate for this purpose.

St 7. Improving Working Conditions

One way to improve worker performance in the area of OHS is by offering good working conditions (good salary, training, provision of personal protective equipment, etc.), with job stability being very important, which allows the company to train their employees, expecting a return on investment in the short, medium

and long term through a decrease in occupational diseases and accidents which produce, among other effects, absenteeism, delays in the project schedule, costs of worker care, etc.

CONCLUSIONS

The aim of this descriptive exploratory study is to propose a way of diagnosing the current situation in occupational safety and health in the construction industry through surveys and SWOT matrix following the phases of the Deming Cycle (PDCA), which can be applied to other sectors of the economy by adapting questions according to needs. An analysis of the implementation of the NTC-OHSAS 18001 Standard in Colombian construction companies was conducted to assess OHSMS.

Our survey was carried out in two ways (virtually and directly through written forms) to construction professionals in five capital cities in Colombia, using a closed form with four possible answers: Yes, No, In Process, and Do Not Know or No Answer (DNK/NA), and 25 questions that were grouped into the following themes: knowledge, planning, implementation, monitoring, and control. A total of 209 questionnaires with valid answers were received.

The results show that 47.8% have OHS policies and an appropriate administrative structure to implement an occupational health and safety management system in the field (54.1%). Moreover, there is a tendency to improve safety at work by assigning staff to manage related activities (77%) and through the provision of personal protective equipment and elements of collective protection (66%). However, the first step forward must be to raise the current percentage (50.7%) of managers and project managers who know about and comply with OHS regulations and who are committed to protecting the health of their workers.

The strategies from the SWOT matrix help in the decision-making process by management related to safety in the workplace and workers' health. To avoid the high rates of accidents and their consequences it is necessary to introduce measures to reduce the frequency and severity of risk. Thus, although the primary characteristics used in risk monitoring are frequency and severity, the degree of residual risk (risky event's preventability) may have a significant effect on risk estimation and on the safety decisions made by managers (Azadeh-Fard et al., 2015).

Fortunately, there are several tools that have been studied by other authors, which can achieve these goals: the growth of occupational safety culture; a climate of improving safety; a host of methodologies, techniques, management systems, and standards for risk management and staff training at all levels of the organisation among others (Marhavilas, Koulouriotis and Gemeni, 2011; Leonaviciute, Dejus and Antucheviciene, 2016).

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