Journal of Safety Research 43 (2012) 381–388

Contents lists available at SciVerse ScienceDirect

Journal of Safety Research

journal homepage: www.elsevier.com/locate/jsr

Analysis of construction accidents in Spain, 2003-2008

Antonio López Arquillos [a,*], Juan Carlos Rubio Romero [b], Alistair Gibb [c]

[a] University of Málaga, E.T.S.I.Industriales, C/Dr. Ortiz Ramos, s/n (Teatinos), 29071 Málaga, Spain
[b] Cátedra de Prevención y Responsabilidad Social Corporativa, University of Málaga, Spain
[c] European Construction Institute, School of Civil & Building Engineering, Loughborough University, UK

ARTICLE INFO

Article history:
Received 16 January 2012
Received in revised form 2 July 2012
Accepted 30 July 2012
Available online 24 October 2012

Keywords:
Construction
Accidents
Severity
Rates
Variables

ABSTRACT

Introduction: The research objective for this paper is to obtain a new extended and updated insight to the likely causes of construction accidents in Spain, in order to identify suitable mitigating actions. *Method:* The paper analyzes all construction sector accidents in Spain between 2003 and 2008. Ten variables were chosen and the influence of each variable is evaluated with respect to the severity of the accident. The descriptive analysis is based on a total of 1,163,178 accidents. *Results:* Results showed that the severity of accidents was related to variables including age, CNAE (National Classification of Economic Activities) code, size of company, length of service, location of accident, day of the week, days of absence, deviation, injury, and climatic zones. *Conclusions:* According to data analyzed, a large company is not always necessarily safer than a small company in the aspect of fatal accidents, experienced workers do not have the best accident fatality rates, and accidents occurring away from the usual workplace had more severe consequences. *Impact on the industry:* Results obtained in this paper can be used by companies in their occupational safety strategies, and in their safety training programs.

1. Introduction

Accident rates in construction continue to be an international cause of concern. This concern is justified because construction has the highest casualty rates in many countries (Camino López, Ritzel, Fontaneda, & González Alcantara, 2008). There are significant differences in the submission of reports and work accident registration procedures in different EU countries, such as the definition of a workplace accident and consideration of road traffic accidents (Aires, Rubio, & Gibb, 2010). Harmonization of the data by Eurostat allows some comparison of the results of member states, but it is important to note that these comparisons between countries are still not completely reliable (Aires et al.).

An example is provided in Fig. 1 where we see the accident rates in construction across the European Union, Spain, and UK in recent years (Eurostat, 2010). Incidence rates in Spain are around twice those of the European average. On the other hand, the United Kingdom rates are very low compared to the rest of Europe. Although incidence rates have decreased in the last decade in the majority of European states, Spain has not decreased enough to reach the European average levels.

In order to identify solutions for accidents in construction, different researchers have investigated the problem in many countries. Examples of these studies for various countries include: Taiwan (Cheng, Leu, Lin, & Fan, 2010), Scotland (Cameron, Hare, & Davies, 2008), Turkey (Etiler, Colak, Bicer, & Barut, 2004; Mungen & Gürcanli, 2005), Portugal (Macedo & Silva, 2005), and South Korea (Im et al., 2009). A significant investigation in the UK (Brace, Gibb, Pendlebury, & Bust, 2009) identified that the underlying factors in fatal accidents and high-potential incidents can be grouped into three categories: (a) macro factors, relating to stakeholders such as society, education, industry, corporate organization and trades unions; (b) mezzo factors, referring to aspects such as project management, organization, and procurement; and (c) micro factors, meaning worker, workplace, and supervisor issues.

When an accident is analyzed, many variables and factors are present. For example, a study about contributing factors in construction accidents in the UK (Haslam et al., 2005) concluded that problems arising from workers or the work team were present in 70% of the accidents, workplace issues in 49%, shortcomings with equipment (including PPE) in 56%, problems with suitability and condition of materials (27%), and deficiencies with risk management in 84% of accidents.

The influence of the difference variables in the severity of the injuries must be considered. There are a number of research studies in this direction. For example, Sawacha, Naoum, and Fong (1999) showed that operatives between the ages of 16–20 were more likely to have accidents than others. Further analysis of the data in the same paper suggests that the level of accidents tends to decline steadily after the age of 28 to reach a low point in the mid-40s. In a similar way, Salminen (2004) concluded that young workers had a higher injury rate than older workers, however, the injuries of young workers were reported as less often fatal than those of older workers. In addition, Chau et al. (2004) showed that risks of injury for each worker depend on age, body mass index, hearing disorders, sleep disorders, and sporting activities. If you are young, or overweight, or have any hearing or sleep

* Corresponding author. Tel.: +34 951952538.
E-mail address: investigacioncatedra@gmail.com (A. López Arquillos).

0022-4375/$ – see front matter © 2012 National Safety Council and Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.jsr.2012.07.005

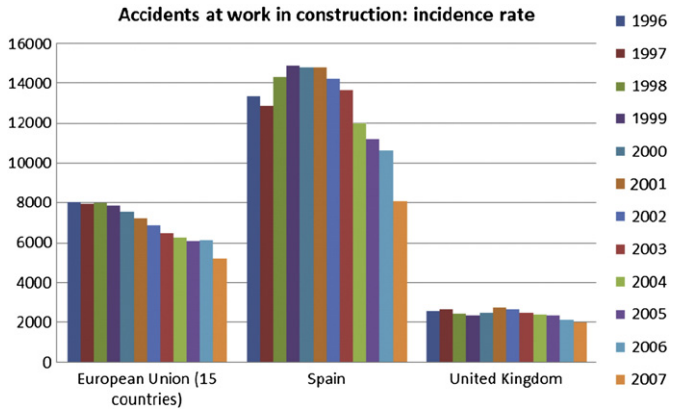

Fig. 1. Accidents at work in construction: incidence rate. Source Eurostat, 2010.

disorder and no sports activities, then your risk is higher than another person without these risk factors. However, it is necessary to remember that construction accidents arise from a failure in the interaction between workers, their workplace, and the materials and equipment they are using (Haslam et al., 2003).

In this paper, the research objective is to obtain a new extended and updated insight to the likely causes of construction accidents in Spain, in order to identify appropriate mitigating actions.

2. Methodology

2.1. Accidents data

Since 2003, the Spanish National Institute of Safety and Hygiene at Works must be notified of all accidents that result in an absence from work of one or more days. This is compulsory according to Spanish Law (BOE. Boletín Oficial del Estado [BOE], 2002; ORDEN TAS/2926/2002, de 19 de noviembre, por la que se establecen nuevos modelos para la notificación de los accidentes de trabajo y se posibilita su transmisión por procedimiento electrónico). Notification must be sent through the electronic system called DELT@, filling an Official Workplace Incident Notification Form. [Parte Oficial de Accidente de Trabajo]. For this study, the Ministry of Labour and Immigration supplied the anonymous data of all workplace accidents in the Spanish construction sector as defined by the National Classification of Economic Activities in Spain (CNAE 93.Rev 1) during the period 2003-2008. A total number of 1,163,178 Notification Forms were supplied. Although reporting is mandatory, it is possible that some cases remain unreported.

2.2. Analysis design

The analysis design for this paper was based on previous research by Camino López et al. (2008). First the study variables were chosen and then categorized in groups to assess the relationship between all the variables and the severity of the outcomes of each accident. Although main aspects of the methodology employed are similar to Camino Lopez et al., this research introduces some differences in the following aspects:

- Data periods of time analyzed are different.
- Data analyzed in the present study include, in line with the law, all the accidents reported in the construction sector between 2003-2008. In Camino Lopez et al.'s previous study (2008) it is possible that more accidents were not included, because from 1990-2000 reporting accidents through Delt@ system was not compulsory.
- Some of the chosen variables were not analyzed in the previous paper.
- In the results, the severity of the accident is shown in four different levels: light, serious, very serious, and fatal.

2.3. Variables and period of time

The authors' original idea was use a similar methodology to Haslam et al. (2005) studying shaping factors and originating influences. However, differences between data sets did not allow us to implement it properly. Haslam et al. analyzed fewer accidents (only 100 individual accidents) but more deeply and gathered site-based data entailing interviews with accident-involved personnel and their supervisor or manager, inspection of the accident site, and review of relevant documentation such as accident notification form. In our case, we only had access to the official accident notification form, but from 1,163,178 accidents.

In a preliminary approach we analyzed all variables included in the accident notification form (57 variables) elaborating contingency tables. In some variables the majority of the values in the contingency tables did not reach a statistical significance of 95% in order to reject the hypothesis of independence of variables, and we could not confirm the existence of more than a random influence for severity-variable. Accordingly, the majority of the 57 variables were rejected for this paper.

Therefore, variables chosen were categorized into five groups after Camino López et al. (2008). These groups are personal, business, material, temporal and geographic.

- **Personal variables** describe characteristics of the worker involved in the accident. Included in this group is variable age.
- **Business variables** describe aspects about the activity and its organization. Included in this group are: National Classification of Economic Activities (CNAE), company staff, length service, and the location of the accident.
- **Temporal variables** include day of the week, days of absence.
- **Material variables** include deviation from accepted practice, as a not expected event, and injury.
- **Geographic variables** used in this study describe the severity of the accidents in the different zones according to the climatic zone. (Table 1).

The period of time between 2003 and 2008 was elected for this study because, in this period, the National Classification of Economic Activities in Spain (CNAE 93.Rev 1) was not changed. Before 2003 and after 2008 there were some modifications to this classification.

2.4. Statistical analysis

Continuing with the methodology performed by Camino López et al. (2008) contingency tables were made and chi-square values were calculated to test hypotheses of the independence of the each variable with respect to severity.

Again following Camino López et al. (2008), the corrected standardized residuals (csr) were also calculated. When their absolute value was less than 1.96, they were marked with an asterisk because

Table 1
Summary of variables.

Variable Group	Variable
Personal	Age
Business	National Classification of Economic Activities (CNAE)
	Company Staff
	Length service
	Location of Accident
Temporal	Day of the week
	Days of absence
Material	Deviation
	Injury
Geographic	Climatic Zones