



Preventive activity in the greenhouse-construction industry of south-eastern Spain

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ABSTRACT

Preventive action in companies is one of the bases of ergonomic intervention. Therefore, in the present work, the preventive activity of greenhouse-construction companies in south-eastern Spain is characterized. A sample was taken by means of a questionnaire structured in four groups of variables: general characteristics of the company, characteristics of safety and health in the construction procedures, characteristics of prevention and management in safety and health, and characteristics of the coordination during the execution of the work. The results indicate that the prevention is very poor, not adopting any preventive-management model for internationally recognized work hazards so that the information and training in preventive matters of companies and workers is insufficient. In addition, the companies have been classified into three clusters, correlating the company size and prevention management of labour hazards, revealing that the companies with higher gross income and number of workers showed better prevention management.

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1. Introduction

Spain has among the largest surface areas of plastic-covered greenhouses worldwide, reaching some 45,000 ha (Castilla and Hernández, 2005), with extremely dense concentrations in south-eastern Spain, particularly in the province of Almería, with 26,500 ha, mainly for table vegetables (Fundación Cajamar, 2007). This intensified cultivation, has given rise to a greenhouse-construction industry, especially for light, low-cost structures (Soriano et al., 2004). The traditional greenhouse model being used in south-eastern Spain is called “*parral*” type, although in recent decades, this has been replaced by improved models, such as the “*raspa y amagado*” and the multispan type, which provide more precise climatic control, including automation (López and Pérez, 2006). Some 96.5% of the greenhouses in the area are called “*Almería type*” (Fernández and Pérez, 2004), with three main variants: flat *parral* (38.2%), “*raspa y amagado*” (55.0%) and asymmetric (3.3%), which have been developed over the last 40 years. In Almería, the companies that construct greenhouses are relatively small, with a mean of 13.46 workers per company (VV.AA., 2005).

Globally, the construction industry is the most dangerous sector in terms of job health and safety (Kartmam et al., 2000; Jannadi and Bu-Khamsin, 2002; Colak et al., 2004; Fang et al., 2004; Tam et al., 2004; Behm, 2005, 2008; Calderón, 2006; Marika et al., 2008; Zeng et al., 2008). Many studies have investigated the causes of construction accidents, such as the size of the construction

company, preventive coordination in the planning and execution phase of the work, and worker attitudes, (Hinze et al., 1998; Haslam et al., 2005), as well as safety management of the company (Dawson et al., 1988; Gun, 1993; Jaselskis and Recarte-Suazo, 1994; Blockley, 1995; Mohamed, 1999; Rowlinson and Matthews, 1999; Goldenhar et al., 2001; McCann, 2003; Tam et al., 2004; Haslam et al., 2005; Zeng et al., 2008). Thus the main factors affecting safety in construction companies include: the heads of the company having low awareness of the importance of safety; deficient training; poor safety awareness among safety coordinators and those who draw up projects; reticence to enact safety programmes; and the undertaking of hazardous tasks (Tam et al., 2004).

Also, many studies have examined the hazard-prevention design, i.e. integrating preventive measures for worker safety in the planning phase of the project, designed by architects and engineers (Gambatese, 1996, 1998, 2000; Hecker et al., 2004; Behm, 2005; Weinstein et al., 2005; Rubio et al., 2005; Toole, 2005; Van Gorp, 2007; Gambatese et al., 2007; Toole and Gambatese, 2008). In short, four paths have been proposed in relation to the incorporating prevention in the design: (1) The use of more prefabricated construction elements; (2) greater use of safer systems and materials; (3) increased application of engineering in construction; and (4) more thorough consideration and spatial investigation in the design.

In addition, several studies state that small companies have a greater frequency index of accidents because resources to avoid accidents are more limited (Suruda, 1992; Oleinick et al., 1995; Suruda and Wallace, 1996; Stevens, 1999; Beaver, 2003; Benavides et al., 2003; Guadalupe, 2003; Fabiano et al., 2004; Sorensen et al.,

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2007; Camino-López et al., 2008; Hasle et al., 2008). Within the construction sector, company size has been associated with falls of workers from heights, the main and most frequent cause of mortality (Sorock et al., 1993; Chi and Wu, 1997; Hinze et al., 1998; Janicak, 1998; Jeong, 1998; Kines, 2002; Larsson and Field, 2002; Huang and Hinze, 2003; Tam et al., 2004; Chi et al., 2005; Chia-Fen et al., 2005; Haslam et al., 2005; Hoonakker et al., 2005; Macedo and Silva, 2005; Müngen and Güranlı, 2005; Adam et al., 2009; BLS, 2008). Thus, the larger the company, the lower the accident incidence (Buskin and Paulozzi, 1987; Chi et al., 2005).

Many recent studies on work safety in construction have focussed preferentially on residential and industrial construction (Haslam et al., 2005; Zeng et al., 2008; Camino-López et al., 2008), but few specific studies treat greenhouse construction, these being limited to investigating methodology and typology (Matallana and Montero, 2004; Briassulis et al., 1997; Von Elsnér et al., 2000a,b; Peña et al., 2004; Pérez et al., 2008). There are no works available that analyse health and safety prevention or management and coordination systems in greenhouse-construction companies. One work on accident prevention in Swedish agriculture analyses 55 accidents in greenhouses (Lundqvist and Gustafsson, 1992), while a previous work concludes that the greatest accident risk involves the maintenance and repair of the greenhouse roof, as well as the use of chemical products (Lundqvist, 1982). In Spain, safety research in this field are scarce. Thus, when the Spanish normative on safety and health measures in construction works took effect (BOE, 1997), Callejón-Ferre et al. (1998) studied the implementation of these guidelines in the greenhouse-construction sector. Also, Callejón-Ferre et al. (2009) analysed the conditions of workers within the greenhouses in south-eastern Spain in general, without considering those directing greenhouse construction. Ponce (2005), reported great deficiencies in the sector, primarily in applying the normative together with the lack of means and training, mainly, but also the failure to keep records on accident rates.

Greenhouse-construction companies at times hire non-specialized workers, who lack training and experience, a situation which sometimes triggers accidents, as occurs in other sectors (Banfield et al., 1996; Cattledge et al., 1996; Gervais, 2003; Guadalupe, 2003; Benavides et al., 2003; Saha et al., 2004; Waehrer et al., 2007; Camino-López et al., 2008; Fabiano et al., 2008). All this, together with the fact that the greenhouse-construction systems are often quite rudimentary, has given rise to an average accident-incidence index for greenhouse construction of 141.8 for the period 2001–2005. The main causes of accidents are overexertion, falls from height, lacerating blows, and punctures from wire, tools, and other objects. The falls from height caused the most serious accidents.

2. Objectives

Due to the high accident rate in the greenhouse-construction industry of south-eastern Spain indicated in the Introduction, it becomes necessary to ascertain the situation of labour-risk management of these companies, as this is a determining factor for improving the safety and health of workers over the middle and long term. For this, the general goal of the present work is to characterize the preventive activity and labour-risk management of the greenhouse-construction companies in south-eastern Spain. The specific objectives of the paper are:

- i. To outline the structure of the general organization of the companies.
- ii. To assess the safety and health in the greenhouse-construction procedures.
- iii. To determine the activities of accident prevention and health management of the companies.

- iv. To specify the activities of coordination of health and safety during the building of the greenhouses by the companies.
- v. To correlate the size of the company with its prevention and management of labour risks, as well as to identify groups of companies having homogeneous characteristics in this prevention and management.

3. Materials and methods

3.1. Sampling characteristics

Greenhouse-construction companies working in Almería were sampled, since this is the province of south-eastern Spain with the greatest surface area of greenhouses (Castilla and Hernández, 2005; Fundación Cajamar, 2007). A simple random sampling technique was used with a sample size of 10 companies, this being 20% of the population previously censused. The sampling plan had two stages: first, a previously designed questionnaire was validated and, second, the sampling itself was performed. The information was collected by personal interview with the head or a representative of the company, this being complemented by direct observation and questions posed to workers on the job while constructing greenhouses.

3.1.1. Census of greenhouse-construction companies

The census of 2007 for companies of the Chamber of Commerce, Industry and Navigation of Almería was adopted, counting 50 greenhouse-construction companies.

3.1.2. Model of polling

For the design of the questionnaire, the information was organized and systematized based on prior research (Calderón, 2006), as well as the opinion of experts both in private industry as well as public administration. The definitive questionnaire was arranged in four blocks of 30 items each with the parameters and variables that characterize the greenhouse-construction companies:

- General data on the company (eight items).
- Characteristics of health and safety in the construction procedures (five items).
- Characteristics of health and safety prevention and management (eleven items).
- Characteristics of coordination activities of the company during construction (six items).

3.2. Variables studied

For the characterization of the preventive activity implemented by the greenhouse-construction companies, the study variables, both quantitative and qualitative are listed in Tables 1 and 2, arranged in four groups used in the questionnaire. Only in the first group—i.e. those describing general features of the company—are there four quantitative variables number of workers (*C*), number of work teams (*E*), annual activity of the company (*H*), and gross income of the company in the last fiscal year; all the other variables were qualitative. However, three of these quantitative variables were categorized for more detailed study and correlation. Tables 1 and 2 display all the variables and terminology, while for the qualitative and quantitative variables categorized, the categories and terminology are presented.

3.3. Data analysis

First, a data analysis was made to identify the data absent, and afterwards it was checked whether the data verified the condition

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