ELSEVIER

Applied Ergonomics 36 (2005) 401–415

APPLIED ERGONOMICS

www.elsevier.com/locate/apergo

Contributing factors in construction accidents

R.A. Haslam[a,*], S.A. Hide[a], A.G.F. Gibb[b], D.E. Gyi[a], T. Pavitt[b], S. Atkinson[a], A.R. Duff[c]

[a]*Department of Human Sciences, Health and Safety Ergonomics Unit, Loughborough University, Loughborough, Leicestershire LE11 3TU, UK*
[b]*Department of Civil and Building Engineering, Loughborough University, Leicestershire LE11 3TU, UK*
[c]*Manchester Centre for Civil and Construction Engineering, UMIST, P.O. Box 88 Manchester M60 1QD, UK*

Received 13 March 2004; accepted 19 December 2004

Abstract

This overview paper draws together findings from previous focus group research and studies of 100 individual construction accidents. Pursuing issues raised by the focus groups, the accident studies collected qualitative information on the circumstances of each incident and the causal influences involved. Site based data collection entailed interviews with accident-involved personnel and their supervisor or manager, inspection of the accident location, and review of appropriate documentation. Relevant issues from the site investigations were then followed up with off-site stakeholders, including designers, manufacturers and suppliers. Levels of involvement of key factors in the accidents were: problems arising from workers or the work team (70% of accidents), workplace issues (49%), shortcomings with equipment (including PPE) (56%), problems with suitability and condition of materials (27%), and deficiencies with risk management (84%). Employing an ergonomics systems approach, a model is proposed, indicating the manner in which originating managerial, design and cultural factors shape the circumstances found in the work place, giving rise to the acts and conditions which, in turn, lead to accidents. It is argued that attention to the originating influences will be necessary for sustained improvement in construction safety to be achieved.

Keywords: Injury prevention; Accident investigation; Risk management

1. Introduction

The poor safety performance of the construction industry continues to give international cause for concern. Although the record in Great Britain is reasonable by international standards, the industry still accounts for one third of all work fatalities, with a similar poor performance for injuries and ill health (HSC, 2003). While there has been a modest decline in fatalities over recent years (rate of 4 per 100,000 workers), when collated with those in all industries, construction accounted for 31% of all work related deaths in 2002/03. The majority of construction fatalities in this year resulted from falls from height (46%) and struck by a moving vehicle (15%).

Major injury rates in Great Britain for construction have, however, risen over the most recent two years for which data are available, from 356 per 100,000 employees in 2001/02 to 375 in 2002/03. Although this increase follows 3 years in which the major injury rate has shown a slight decline, an increase of 5%, back to the level recorded five years ago, is a matter of concern. The most common causes of major injuries were falls from height (31%); slips, trips or falls on the level (25%); and being struck by a moving/falling object (17%). Other papers in this special issue of *Applied Ergonomics* (e.g. Hoonakker et al., 2005; Chi et al., 2005) describe the situation in other countries, revealing a similar pattern.

Although figures for fatalities are accurate, surveys commissioned by the Health and Safety Executive (HSE) indicate a reporting rate by employers for other

*Corresponding author. Tel.: +44 1509 223042; fax: +44 1509 223940.
E-mail address: r.a.haslam@lboro.ac.uk (R.A. Haslam).

0003-6870/$ - see front matter © 2005 Elsevier Ltd. All rights reserved.
doi:10.1016/j.apergo.2004.12.002

reportable injuries as low as 40% (HSC, 2003). Thus, the published statistics are the tip of the iceberg. The safety problem described above has characterised the industry for decades suggesting that lessons from the past have still to be learnt. Accidents in the construction industry represent a substantial ongoing cost to employers, workers and society.

Appreciation of the causes of occupational accidents has benefited from research attention over many years (Heinrich et al., 1980). Contemporary commentators point to the systemic nature of safety failures and wide reaching contributory factors (Kletz, 2001). Reason (1995) highlighted the pathway from latent, organisational failures (e.g. poor design or planning decisions), to the conditions where active failures (workplace errors and violations) can occur. Rasmussen (1997) presented a review of alternative conceptual approaches to modelling risk, safety and accidents. From this, Rasmussen argued the case for an approach that recognises the complexity of socio-technical work systems, focussing more on the mechanisms generating organisational and individual behaviour in actual, dynamic work contexts, rather than narrow attention to errors in tasks and acts. Implicit in the ideas of Reason and Rasmussen, is the fundamental involvement of human factors/ergonomics in most safety failures.

Modelling of the causal processes of accidents and injuries in the construction industry is less mature, with previous research largely confined to the collection, analysis and interpretation of data derived from regulatory accident reporting schemes (e.g. Hinze and Russell, 1995; Hunting et al., 1994; Kisner and Fosbroke, 1994; Snashall, 1990). This approach is limited by problems with data collection (e.g. under reporting) and the broad classifications used for coding. Problems of this nature were reported again by BOMEL (2001) in a more recent analysis of RIDDOR data (HSE, 1996) available for Great Britain. Looking at the data collected by construction companies themselves, previous work by Gyi et al. (1999) found the quality of the reporting processes to be poor, coupled with a failure to collate and undertake effective analysis of the data that are collected.

HSE (1978, 1988) used case study procedures to examine fatal accidents and identified causes such as failure to ensure safe systems of work, poor maintenance, use of defective materials, and poor supervision and training. However, the reports concentrated on fatal accidents and it is probable there are differences in the aetiology of non-fatal accidents (Saloniemi and Oksanen, 1998). Whittington et al. (1992) is one of the few other studies that has attempted to undertake in-depth analysis of accidents in the industry. Their findings identified a range of headquarter, site and individual factors in accidents examined, approximately in the ratio 1:2:1. Whittington et al. acknowledged limitations of their work due to the relatively small number of accidents investigated (30) and incomplete information in the accident records. In addition, there have been important changes affecting safety management since Whittington et al.'s research, particularly in connection with the implementation of European Directive 92/57/EEC, requiring attention be given to safety within construction design and management processes (HSC, 2001).

In a UMIST study, examining behaviour modification approaches to improving construction safety, Duff et al. (1994) developed a safety audit checklist, used to monitor safety performance of construction sites. Further work by Suraji et al. (2001) at UMIST led to a model of risk factors for accidents in construction operations. The UMIST model distinguishes between problems with operator actions, site conditions and construction practices, and linkage of these with project, contractor and process management influences. In recognising that project concept, design and management factors are frequently an origin of site based failures, Suraji and Duff's approach has been a significant development on other theoretical 'root cause' models that confine their attention to site personnel, their behaviour and actions (Gibb et al., 2001; Suraji and Duff., 2001).

In summary, while there is good understanding of the extent and pattern of accidents in the construction industry, there has only been limited investigation regarding the full range of contributory managerial, site and individual factors. With this background, the research presented here sought to describe the wide range of factors involved in construction accidents. Specific aims were to:

1. identify the immediate events in a sample of 100 non-fatal construction accidents that either caused or had the potential to cause injury;
2. collect information on the circumstances that allowed these accident events to occur;
3. collate this information with the findings from previous focus group research, to explain the processes of accident causation, including the contribution of management, project, site and individual factors;
4. suggest the lessons that should be learnt to improve construction safety.

As presented at the Third Ergonomics in Building and Construction Symposium, Seoul, August 2003, the intention of this paper is to provide an overview of the findings and recommendations from the full research (Loughborough University and UMIST, 2003). The sections which follow present details of the research investigations and a summary of descriptive results from studies of individual accidents. A model of causal influences is then proposed summarising the research