

Construction Safety

*A Research Report by the BOMEL Consortium,
Working to contract with HSE.*

Introduction

The fatal accident rate for construction workers is amongst the highest of any industry in the UK. Complex and detailed regulation already exists, as does information on best practice. HSE are therefore examining the relative effectiveness of all prevention activities and researching the possibility that other kinds of intervention could make a difference.

The report of the first phase of this research work is summarised here along with our comments.

The two main aims of the research work were:

Aim 1 – to use RIDDOR and HSE inspection reports as a source of data for understanding the underlying causes of accidents on construction sites.

Aim 2 - a quantitative analysis of the opportunities for improved prevention measures.

Our Comment on Aim 1.

Reports were made by trained, specialist HSE inspectors. To that extent they will have been factual and thorough. However, they will have been influenced by a whole host of prejudged issues, fashion and policy constraints. For example, the recording of issues such as schedule slippage and whether different trades were occupying the same stations or sharing equipment, first languages spoken by managers and victims...will have been recorded in an unsystematic way. Emphasis on the presence or absence of risk assessments will have featured at some times, but their actual content will have been more closely inspected at other times. Communications with insurers may not have been asked about. Reports and their implications will of course be dominated by falls from height, the conclusions drawn may not be appropriate for all kinds of loss.

Our Comment on Aim 2.

The development of an influences and opportunities network is a new tool in HSE policy setting, and if successful, should assist with the development of accurate and effective measures to improve safety in construction and many other areas. The research so far, has gone a long way towards establishing that this strategic approach has great potential, but some questions remain, and will almost certainly be the subject of more detailed research work over the coming year.

The report begins by highlighting widely recognised pressures on construction which include: inadequate planning, insufficient allowance for safety, undue pressure on schedules, lack of training, uninformed clients and so on... but without detailed analysis, their impact on safety cannot be presumed, and actions to correct them may have none of their intended effect.

Our Comment

Many of these factors may or may not currently be considered by insurers when assessing potential exposure and the need for the policy holders to inform insurers of significant change during the period of cover. The research work reported here could identify key issues that have an effect on safety performance.

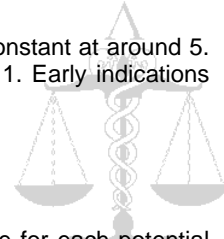
Industry specific issues such as employment trends will be influenced by macro as well as local factors such as changes in employment law, the presence of other building work in the area and taxation policy.

Actual risk is therefore sensitive to issues that are outside the usual scope of H&S risk assessment. The question is, how sensitive? The aim of this work is therefore to identify the most potent drivers for safety, and to suggest by implication, which areas offer the greatest opportunity for improving prevention. HSE did not limit the scope of this work to areas that are traditionally within their own remit, the case for an interdepartmental understanding and action was a permitted aim of the work.

Findings, of General Interest

- ❑ A recent increase in construction industry fatalities has prompted increased scrutiny by politicians, in fact the number of major accidents appears to have reduced during the period of concern, suggesting that the outcome of accidents has of late, been more severe, perhaps a function of access to first aid and emergency care?

- ❑ Falls through fragile roofs and falls from scaffold by roofers and scaffolders appear to dominate the fatality statistics, with small sites and small companies at the fore.
- ❑ Joiners and electrical contractors dominate the statistics (per 100,000 workers) for major accidents (not including death).
- ❑ Falls from mobile ladders account for the vast majority of major injuries. The underlying cause of these is usually reported as “failure to control risk” or “unsafe transient work”.
- ❑ The fatal injury rate per 100,000 workers, between 1995 and 1999 was fairly constant at around 5. For comparison, agriculture ranged between 8 and 11, manufacturing around 1. Early indications for 2001 suggest an increase, but this remains to be seen.



Description of the influence network

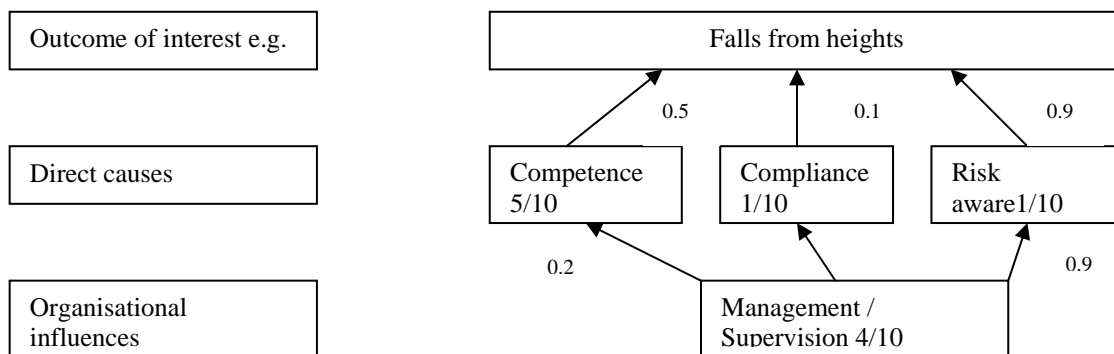
The influence network is based on the combination of two measures of significance for each potential influence. An analogy would be that risk is usually rated by two measures; frequency and severity. The two measures used here are:

- ❑ Usual practice, rated against the standard of best practice i.e. a mark out 10 for usual practice.
- ❑ Significance of that standard in its effect on other practices and ultimately in preventing injury. I.e. if the best practice was applied what difference would it make.

An example, management / supervision was first of all defined in terms of its ideal components. Once perfection had been defined, based on the experience of an expert panel, it was found that in general, management / supervision was usually practiced at a level of 4 out of 10. The effect of management / supervision on issues such as Competence, Fatigue, Compliance with Regulation ...was then similarly rated by the expert panel. Finally the significance of these more direct influences on the causes of accidents was determined by analysis of incident reports.

Full descriptions of the standards of best practice are available (all 37 of them) upon request.

The example is diagrammatically represented below:



The numbers used here are for illustrative purposes only. The above part of the model has shown that risk awareness (or lack of it) is the key/dominant immediate cause of falls from heights. Management / supervision is not usually of high quality and risk awareness is as low as possible. The effect of management / supervision on risk awareness is very strong. Although competence (or rather the lack of it) is also a major direct cause, management / supervision has little effect on it. It would therefore seem most appropriate to target the lack of risk awareness by means of managers and supervisors. Competence might be tackled through training policy and recruitment practices.

Our Comment

The linear relationships used here may not allow for the strong interaction between factors on the same level, for example, competence and risk awareness may have a direct influence on each other but this is outside the influence of management / supervision and is not directly modeled in this approach. Other organisational influences, such as training, would provide a suitable link between competence and risk awareness.

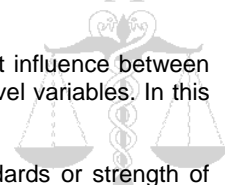
- ❑ The influence network considers four levels of causation:
 - ❑ Environmental influences such as Political Influence, Social influence, regulatory influence, market influence...
 - ❑ Policy level such as contracting strategy, company culture, profitability....
 - ❑ Organisational level, such as training, equipment purchasing, pay and conditions....

- Direct level, competence, situational awareness, inspection of equipment...

0.9

Of these, the direct level corresponds with the standard data available in RIDDOR and inspection reports and allows an iterative refinement of practice rating and significance rating for each factor in the model. In our example, it might be expected that the quality of management/supervision would be strongly influenced by company culture and profitability, which in turn would depend heavily on market forces. If management / supervision was found in the analysis to be the key factor in the cause of accidents then the proper target for action at the policy level might therefore be company culture. At the market level, some thought might be given to increased client responsibility, licensing, links to planning authorities or permits.

- The model was validated against all available information. Problems of indirect influence between factors on the same level were minimized by appropriate selection of higher level variables. In this way the hierarchical structure of the model was retained.
- Once created, the model has a very powerful attribute. Changes in the standards or strength of interaction of each factor can be directly modeled to determine the effectiveness of that change on the outcome of interest. Combinations of changes can be similarly tested. Optimum interventions can be modeled. This is perhaps only the second time that accurate/validated modeling of interventions has been available to policy makers at HSE.



Findings of the influence network

- Sensitivity studies show that the market (availability of finance, return-on-investment schedules and profit/penalties, sudden changes in types of building work...) is the overriding influence on safety performance.
- Changes at the Direct level alone will not on their own, deliver the sustainable improvements that are sought.
- The lowest standards (rated 1 to 3 out of 10) were found as follows:

At the direct level

Team working, situational awareness, quality of communications, compliance with regulation, availability of suitable resources, inspection and maintenance.

At the organisational level

Recruitment and selection, training, information and management feedback, communications, safety culture, inspection and maintenance policy and, design for safe construction.

At the Policy level:

Contracting strategy, ownership and control, company culture, and safety management.

At the environmental level:

Market influence and social influence

Social influence included the image of building as an occupation, resulting in adverse selection, deskilling and lack of apprenticeship, and widespread demographic changes such as immigration/emigration.

The greatest direct contributions to accidents were lack of competence, lack of team working, lack of situational awareness, quality of communications, (lack of) compliance with Regulation and the working environment.

Lack of competence was most strongly influenced by recruitment practices, training and pay.

Lack of situational awareness was most strongly influenced by training, procedures, communications and pay.

Lack of team working was most strongly influenced by management/ supervision and safety culture, followed by training, recruitment and selection, planning, feedback and pay.

Clearly training and pay have a powerful influence on the most critical causes of accidents.

Levels of training are most strongly influenced by contracting strategy, company culture and profitability.

Levels of pay are most strongly influenced by contracting strategy and profitability

Company culture is most strongly influenced by the regulatory environment, market forces and social pressures.

Contracting strategy is most strongly influenced by market forces.

Profitability is most strongly influenced by market forces.

Ultimately the strongest influence on accidents is therefore market forces. Money. This simplistic approach to the findings however does not account for the possibility of the significance of some factors being amplified by multiple references from one level to the next.

Our Comment

It seems surprising that the analysis showed company culture to be most strongly influenced by Regulation. The report defines company culture as *assumptions about the way work should be performed; what is and what is not acceptable; what behaviour should be encouraged and discouraged*. There are many possible explanations for this finding, which would have the effect of encouraging more regulation/enforcement. One suggestion is that the influence network should be refined by wider consultation.

It is not straightforward to convert the network into a risk rating. The best guess reported here assumes a logarithmic relation between total network score (sum of (weighting x rating)) and, risk. This aspect of the analysis could be improved by further research work, in our view the relationship between rating and risk would be more closely modeled by a hysteresis curve.

In terms of risk differentiation, insurers may be interested in identifying the key policy and organisational variables, (contracting strategy, company culture, training policy, comparative rates of pay...) though these may be difficult to quantify without further analysis.

BOMEL recommendations

- 1) The construction industry should concentrate its efforts into a change of safety culture.
- 2) Detailed analysis of RIDDOR data should continue, to allow effort to focus on high-risk activities. The influence network will clearly show how to achieve performance targets for these areas of high interest.
- 3) Industry groups and companies should use the benchmark standards to identify local weaknesses.
- 4) Designers need greater understanding of the implications of design for safe construction and use of buildings.
- 5) Safety improvements should be presented to investors as a means of preserving schedule and cost targets i.e. investment in safety at least repays its cost.
- 6) Health outcomes should be similarly analysed.

Our Summary

The influence network has demonstrated its potential to accurately identify key influences on safety performance. Its use in identifying accurate and effective interventions offers considerable potential. Some of the findings will be of value to insurers.

The validation of the model in part relies on data from inspection reports, which has its limitations. It is also notable that fire, road traffic accidents and visitor casualties are not recorded on RIDDOR or Inspection reports. The model also relies on expert view of best practice, but it is not generally known how effective best practice would be, were it manifest.

For the next round of refinement of the model, it would be of value to include the influence of risk transfer and risk retention at each level of the hierarchical model. It is likely, both in theory and from anecdotal reports, that these concepts have a strong influence on policy and organisation, especially where risk transfer is available at very high levels for comparatively little cost. Increased retention of risk by the client is under consideration, but will need to retain a balanced view of business constraints. A significant question is whether fragmented insurance cover encourages fragmented ownership (lack of clarity of ownership) of risk.

Issues such as superposition of disparate trades in time and space could also be usefully added to the analysis when a broader spectrum of experts is used to refine the model.

Consideration of risk management has been limited to prevention, in this study. A more complete analysis of risk would allow prevention to be influenced by mitigation and compensation aspects of risk management. This would bring in influences such as health care, welfare and planning decisions and would allow the risk of disease such as Hand Arm Vibration Syndrome or dermatitis, to be more usefully modeled.

This analytical approach to identifying sensitive and accurate intervention could be transferred to many aspects of government activity, not just to the deployment of HSE resources.

