SAFETY KNOWLEDGE AND ITS INFLUENCE OVER ACCIDENTS IN THE WORKPLACE

Jonathan D. Moizer
Department of Management and Organization
University of Stirling
Stirling
FK9 4LA

Tel: 01786 467325
Fax: 01786 467329
email: jdm2@stir.ac.uk

EXTENDED ABSTRACT

Aims and Objectives

The paper aims to describe an approach to identify suitable policies to deal with manufacturing workplace accidents, both their causes and effects. Particular emphasis has been put on the retention and application of safety knowledge by workforces, in conjunction with both reactive and proactive safety policies. The paper shows the possibility that safety in the workplace can lead to improved profits.

The objectives are to explain the use of a systems dynamics model to simulate accident generation in the workplace. The model will be customised and tested within several manufacturing concerns. This will encompass modelling accidents retrospectively in the host organisations, and using the model to identify the most equitable strategies to reduce future accidents rates, thus improving profitability.

Overview of the Research

Systems thinking and practice are essential tools for better safety management (Waring, 1990). Common causes of accidents are human error and technical failure. These are usually emergent symptoms of an organisational system that has failed. They may form only part of a causal explanation.

The research uses system dynamics modelling to identify and evaluate the undesirable properties, i.e. workplace accidents, in order to enable measures to be designed into a system which will have the effect of eliminating or at least reducing these levels. Particular attention has been paid to workforce safety knowledge, and peoples perception of risk. The growth or decline in overall workplace safety knowledge is modelled. Complimentary to this is an examination of the resources dedicated to both reactive and proactive approaches to the control of hazards. These being, accident reporting and investigation, and safety auditing respectively. The leverage exerted over the safety system by safety knowledge and hazard control is evaluated.

A generic safety model has been developed using causal diagrams. It has been converted into a system dynamics form, quantified, and tested for robustness. The generic safety simulation model was introduced to interested parties at several manufacturing sites in the United Kingdom. Real world data is presently being collected from a number of sites across several industrial sectors.

Reference Behaviour or Pattern

The reference behaviour pattern is a plot over time which graphically illustrates the principal aim of the model (High Performance Systems Incorporated, 1994). It shows 'what is', i.e. accidents remain at a static level over time, and 'what should be', i.e. where accidents levels should be. The purpose of the modelling effort is to 'close the gap'. Figure 1 illustrates this.

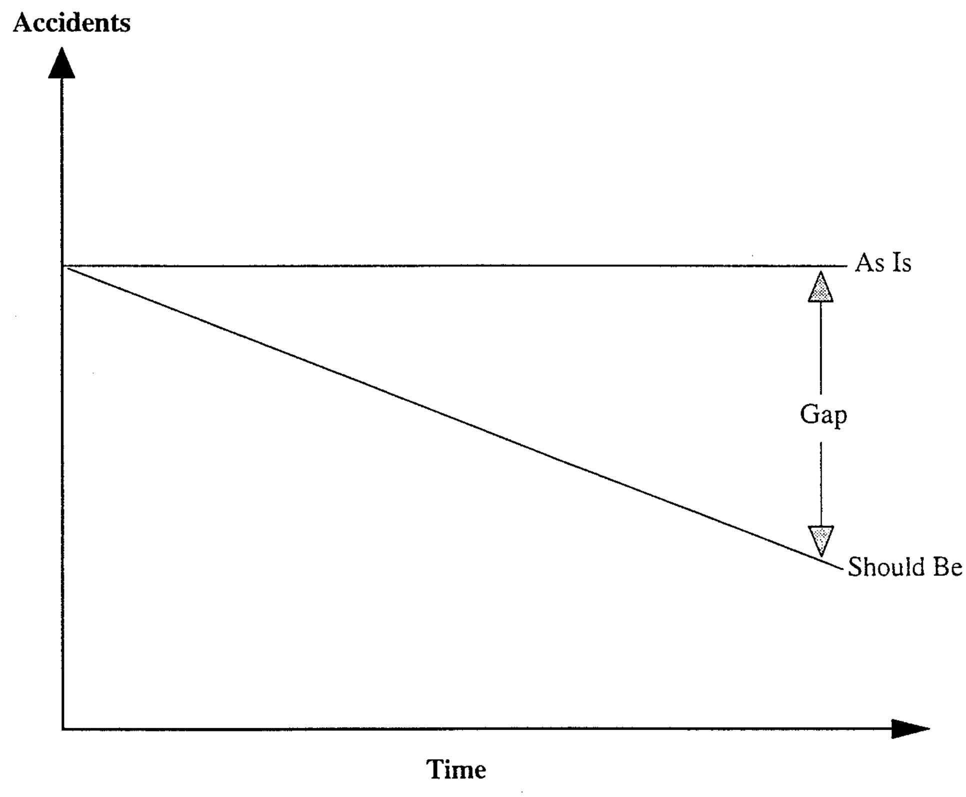

Figure 1 Reference Behaviour Patterns: As Is and Should Be

Development of the Simulation Model

The model which has been developed illustrates how system dynamics can be used to evaluate workplace safety, and to experiment with different options for re-engineering the safety management process. The causal diagram in Figure 2 identifies a total of four feedback loops within the designed system. The relationships between staff safety knowledge, workplace hazards, accident investigation, safety auditing and profit are highlighted.

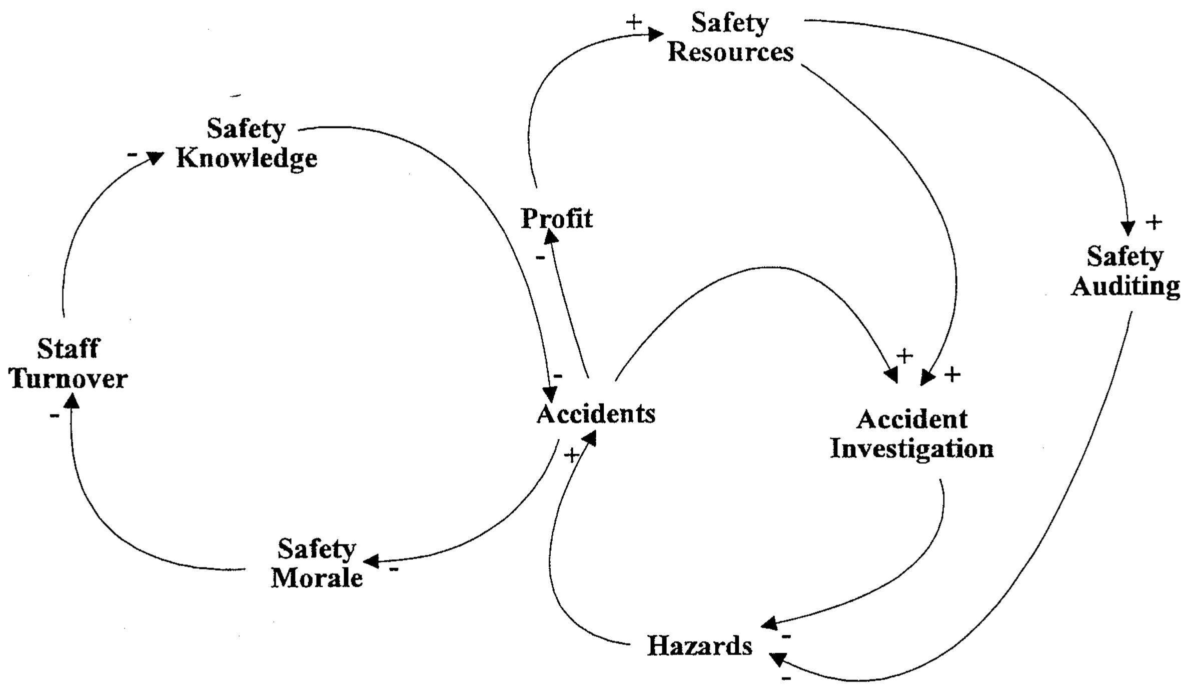

Figure 2 Preliminary conceptual model

The causal diagram was used to conceptualise the model. Subsequently, it was transformed into a system dynamics form.

The Simulation

The model is set up to run over a three year period in weekly time-steps. A sensitivity analysis has been conducted on the model to test for robustness. A number of key variables have been modified at the beginning of and during the simulation runs. The model has proved to recover when presented with differing inputs. It has on all occasions returned to a fully balanced state, running in equilibrium.

The results of three alternative hypothetical simulation runs will be presented. Three safety policies have been evaluated separately. The first involves measurement of the effect of safety knowledge, the second examines the role of accident reporting and investigation, and the last the effect safety auditing has upon accidents.

Each component or variable has the potential to exert leverage over the model, either alone or synergistically. This may influence the behaviour of the model, thus, identifying suitable strategies. The weightings of key policy variables will be re-set differently for each new simulation.

The behaviour of the following components of the model will be evaluated, these are accidents, safety knowledge, hazards, and accident and lost production costs. These need to be explained briefly.

Accidents

An accident can be defined as "an unplanned and uncontrolled event which has lead to or could have caused injury to persons, damage to plant or other loss (Stranks, 1992).

Safety Knowledge

A number of human factors related to accident causation have been grouped under the umbrella of 'safety knowledge'. An individuals perception of risk is the principal factor affecting the way people behave in a potential accident situation (Stranks, 1994). Psychological factors such as attitude, perception, memory, motivation, and training and skills affect the way in which people perceive risk.

Hazards

A hazard can be defined as something which has the potential to cause harm (Health and Safety Executive, 1992).

Accident and Lost Production Costs

For every accident that occurs there is both a direct or indirect cost (Stranks, 1992). Direct costs include liability insurance premiums and enforcement authority fines. Indirect costs include lost production, damage costs, and training and supervision costs.

Summary and Further Work

The results show that the safety knowledge, proactive and reactive hazard control policies all offer varying degrees of leverage over accident rates and the subsequent costs they incur. A methodology for obtaining real world data has been devised and is currently being adhered to in several industrial settings. It is hoped that this research will have practical use in the planning of safety strategies in manufacturing workplaces.

References

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