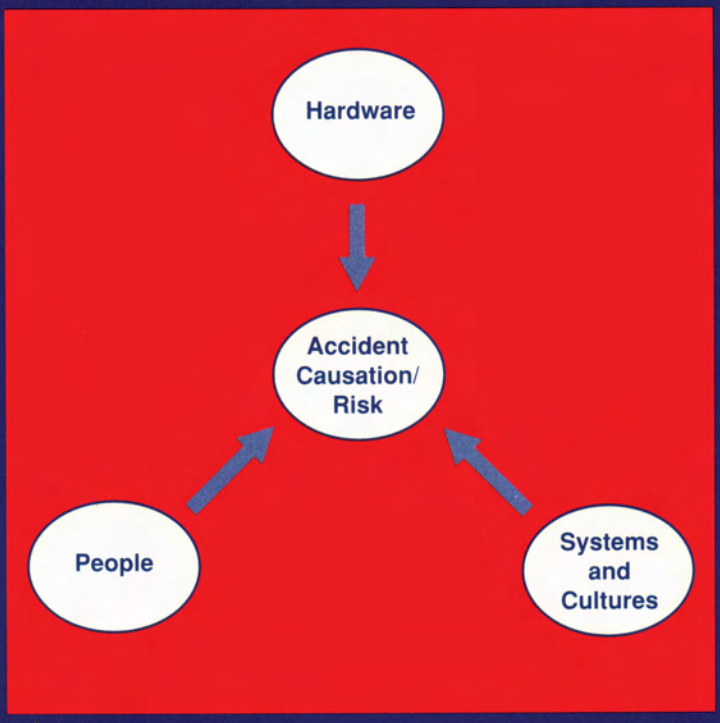
RISK ASSESSMENT

The Human Dimension



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Author's Notes

1 This book is designed to be read from front to back. It is not a reference book and is designed to be more like a novel; start at the beginning and read to the end. This includes the Preface and Glossary which set the scene for the book. Consequently, the chapters are not self-contained but build one on the other.

2 Accidents are terrible things and no one thinks that an injury or an explosion is about to happen. This book has some case studies in it. I was not connected with any of these and I use them only to illustrate certain points. I am not attributing blame to anyone, and I do not wish people who were involved to be hurt any more by the discussion. But these incidents have occurred and I want to make use of that fact in a manner which I hope will be helpful.

3 I have been fortunate to write this book with funding from the Health and Safety Laboratory's Investment Budget. The Health and Safety Laboratory is an agency of the UK Health and Safety Executive and I am employed by HSE. But this book is a **personal account** of my views of risk assessment. It is not published by HSE but by The Royal Society of Chemistry, of which I am a Fellow, to emphasise its professional nature rather than its official nature.

4 Of course, I am indebted to many people who have helped me with this book. I have had many interesting discussions with friends and colleagues about its contents. I have found these both stimulating and rewarding. I would, in particular, like to mention three people, Pat Twigg, Martin Anderson and John Birtwistle.

Preface

In writing this book I am very aware that we are all engulfed in paper! Every day there is more to read and it is a real problem. I do believe that the average safety professional, student, scientist, engineer or whoever, is expected to know about a range of subjects which is wider than ever and to absorb an ever increasing number of written words. So in writing yet another book what am I trying to achieve? Well brevity (of course) and clarity. I hope this book will be short and clear. To achieve this I have used a bullet point style where possible and lots of diagrams. Some people like pictures and some people don't, but I am in the school of thought which believes that a picture is worth a thousand words.

Also I hope to have something to say which is interesting. My starting point is risk assessment. By this I mean quantified risk assessment as used in the chemical and process industries. The traditions of risk assessment are to do with engineering reliability, statistics, failure rates, consequence models of gas dispersion, pool fires and fireballs. All this sounds a lot like science so it must be right. If it's not right then clearly a bigger computer is needed or some more experiments need to be carried out to ensure the models are okay.

But what about human error? That's important too. People make mistakes. They forget things, misunderstand things and sometimes do something unexpected. Risk assessment can take these human errors into account. What operators need to do is broken down into component steps, and error probabilities assigned to each step. These human error probabilities can be factored into the risk assessment.

Over the past 10 or 15 years, however, the complexity of risk assessment has grown and grown. New ideas have come forward or old ones have been applied in new ways or argued with new conviction. Let me mention some of these.

Safety culture and attitudes to safety have been given a lot of consideration. The view is widely held that a good safety culture is essential to the safe running of complex plant and that a good safety culture is reflected in positive employee attitudes to health and safety issues and strong safety management. These in turn lead to low accident rates.

Safety management systems and the failure of such systems have emphasised the importance of management control in ensuring that proper

health and safety standards are maintained. The emphasis in accident causation has been shifted away from individuals doing jobs towards the organisations within which they work and the systems within which they operate. This is reflected in the concepts of the sociotechnical system and systems failures, which have looked widely at why things go wrong. These holistic, or systemic, approaches have considered the allocation of resources, decision making and communication problems as potential causes of accidents in the workplace.

The concepts behind latent failures and active failures have been widely accepted, and contribute to our understanding of accident causation. These ideas, developed by Professor Reason, consider the faults such as poor design which lie hidden (or latent) in an organisation and which, in conjunction with the active or immediate causes of an incident, give rise to failures.

Finally, there are the ideas put forward by the 'high reliability theorists' who believe that serious accidents with hazardous technologies can be prevented through intelligent organisational design and management. This position is often contrasted with the 'normal accident' theorists who believe that accidents are normal and inevitable in complex organisations.

The inspiration for this book comes from the question, "Where does all this leave quantified risk assessment?" If accident causation is so multifaceted, and if causation can go so far back, how is it possible to model such processes at all, let alone in a quantitative manner?

And things get worse! There are important issues concerning the perception of risk, and what constitutes acceptable (or tolerable) levels of risk. It is argued that the best way of viewing acceptable risk is as a decision-making problem and that acceptable risk must be considered in terms of what level of risk is acceptable to whom, when and in what circumstances. In addition risk perception is, at least in part, dependent on personal and group-related variables. These group-related variables are discussed within the social, economic, political and cultural environment within which peoples or individuals live and think. One key idea is that risk is a culturally defined concept. Thus it is widely recognised that the assessment of risk necessarily depends on human judgements and the extent to which risk is a subjective or an objective and measurable 'quantity' is not clear cut. Indeed, there is a wider debate over the contention that social, cultural and political conditions influence and/or determine knowledge and ideas about what is truth i.e. that truth, be it cultural or scientific, need not be objective.

Figure 1 illustrates the above discussion and also defines a 'map' for the book. In the middle of the map is accident causation and risk assessment. There are three main flows into the centre. At the top are technical hardware failures and reliability engineering (Hardware). On the left side are human failures as direct causes of accidents (People) and on the right failures of safety management which arise from the human causes that are

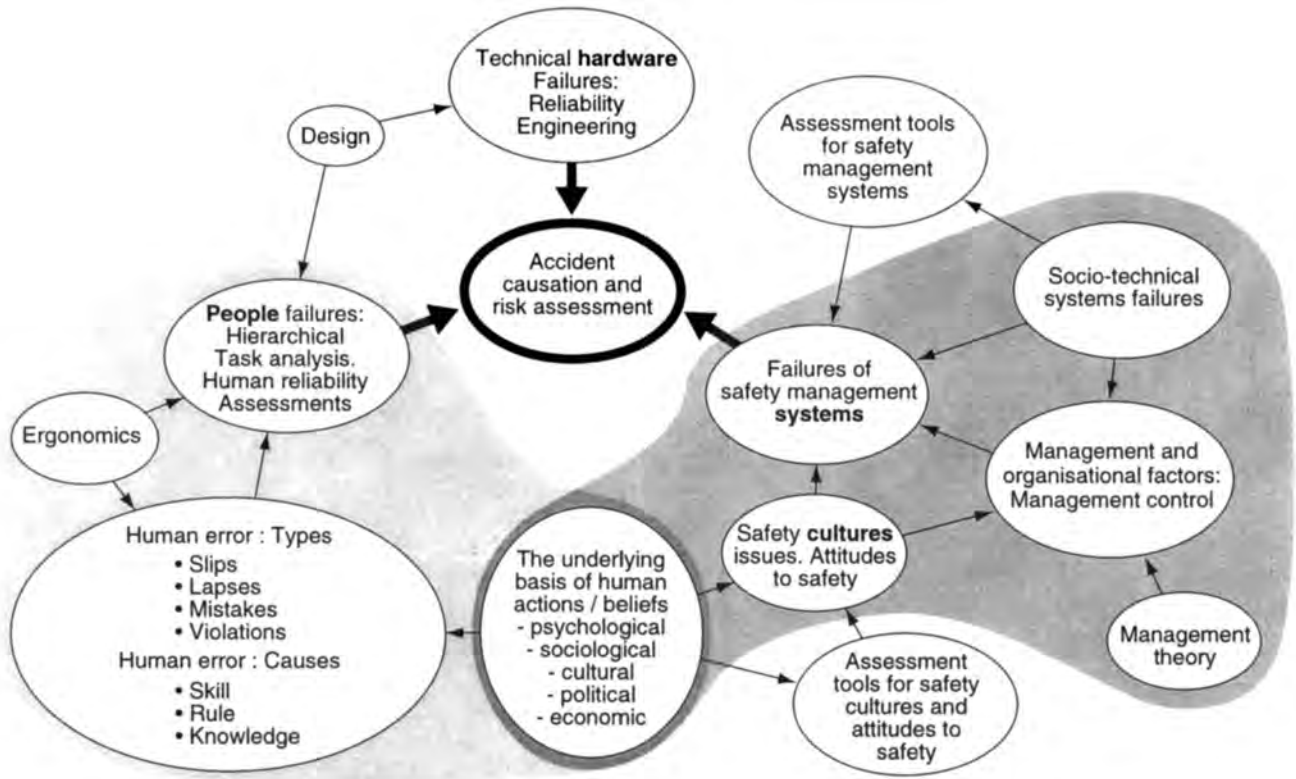

Figure 1 *A map of the Book: Risk Assessment - the Human Dimension. In the middle of the map is accident causation and risk assessment. There are three main flows into the centre. At the top are technical hardware failures and reliability engineering (Hardware). On the left side are human failures as direct causes of accidents (People) and on the right failures of safety management systems and cultures which arise from the human causes which are underlying rather than direct (Systems and Cultures)*

underlying rather than direct (Systems and Cultures). Figure 1 has some other features. It attempts by use of arrows to show how the various areas are interrelated. An arrow can be 'read' as meaning 'has an effect on' or 'influences' or 'underpins' or 'is related to'. Thus safety culture has an effect on safety management. One aim of the book is to explore the nature of these relationships. Another feature of Figure 1 is that it is wrong! Some arrows are missing. For example, sociotechnical systems influence human failures, and no doubt other arrows are missing. Furthermore, the influences are shown as one way: I have not complicated the figure with double-headed arrows denoting the many reciprocal relationships and feedbacks that in reality flow between the areas represented. But the purpose is to show a model which without being overly complex does shed some light.

The areas related to human failures as a direct cause and human failures as an underlying cause (failures of safety management) are shown as overlapping and are linked via an understanding of the fundamental basis for human actions and beliefs. The figure also shows that many other academic disciplines are relevant here – not just psychology and sociology but ergonomics, reliability engineering, management and organisational theory and systems theory. To say that health and safety is a multi-disciplined science would seem to be an understatement, because many of these disciplines are multi-disciplined themselves and are underpinned by mathematics, physics and chemistry for example.

So Figure 1 is a map of the book which is presented as five chapters. Each chapter will try to further develop either the whole map or part of it. The map of the book is used as a symbol throughout the book to tell you exactly what is the topic area under consideration.