

Book reviews

Human factors in hazardous situations reviewed by S Schwartz, Department of Psychology, University of Queensland, St. Lucia, Queensland 4067, Australia.

Artificial intelligence and cognitive sciences reviewed by KJ Gilhooly, Department of Psychology, University of Aberdeen, Aberdeen, Scotland.

Human factors in hazardous situations by D E Broadbent, A D Baddeley and J T Reason (eds.), Clarendon Press, Oxford, 1990, pp 146, £35.00.

AS332 helicopters are fitted with two altimeters, one for each of the two pilots. For reasons known only to the aircraft's designers, the two altimeters have differently arranged scales. Even worse, a clockwise turn of the barometric setting control of one altimeter *decreases* the setting while the same action *increases* the setting of the other. In the present volume, R. Green describes these instruments, stating that "It requires no knowledge of [the] ergonomics of man-machine interface design to see what is wrong with the . . . altimeters . . . or to imagine the nature of the accident that they could bring about". Most readers would agree. Nevertheless, for a combination of reasons (not the least of which is the cost of replacements), these altimeters remain very much in use. What is puzzling is how such instruments came to be fitted in the helicopters in the first place.

Although this collection of papers from a 1989 Royal Society meeting on human factors in hazardous situations does not supply a definitive answer to this question, it contains several intriguing possibilities which may have important implications for knowledge engineers.

Human factors is the study of person-machine interactions. The province of engineers, operations researchers, psychologists and others, the field's main objective is to improve the way in which people and machines work together. The breadth of the field is reflected in the disparate topics covered in this volume's 14 papers: the effects of respiratory viruses, circadian rhythms and medication on performance; the design of auditory alarms, procedural *versus* declarative information, and much else. Only one paper, by J Fox, is explicitly concerned with knowledge engineering.

Fox begins with two unobjectionable assumptions—that computerized decision support systems for safety critical decisions should be flexible (so that they do not fall to pieces when something unexpected happens) and accountable (so that human decision makers can follow their line of reasoning). He argues that the traditional expected utility approach to decision making is relatively inflexible and often opaque; it is also an incomplete specification of how decisions should be made. In its place Fox advocates the use of "symbolic decision procedures" which contain expected utility as a special case. Because such symbolic procedures include a specification of when and how decision rules should be used, they are more flexible than expected utility and, because they operate via first-order logical inference rules, symbolic procedures are also easier to understand. Fox illustrates his approach with medical examples, but the methods he describes are broadly applicable.

Although none of the other papers is explicitly concerned with expert systems design, the related issues of accountability and feedback come up time and again. For example, D A Norman describes the American pilots who were unaware of a potentially serious fuel leak because the automatic pilot had compensated for the uneven weight loss by "tilting" the plane away from the heavier wing. Because the automatic pilot did not provide feedback to the crew (nor was it accountable in the sense of being able to explain its actions) the crew remained unaware of the problem until they actually switched the autopilot off.

Even when the importance of feedback is acknowledged, providing it is not always easy. If expert systems are to contain rules they must come from somewhere, and domain experts are the obvious choice. Yet, human experts are not always able to say how they go about solving a problem

or performing a skill. Indeed, as D E Broadbent shows in his paper, under the right conditions, people may become adroit at performing a task without being able to verbalize how they manage it. Under other conditions, people can learn to answer questions about a task correctly without being much good at the task. This leaves hapless knowledge engineers in something of a quandary. If they rely on experts to provide a knowledge base, they may wind up providing false, or at least useless feedback. On the other hand, there is often no alternative source of expert information. Fortunately, Broadbent reports that the way in which knowledge is probed determines the value of the response. His discussion of the interaction between task domains and methods for assessing expertise is worthwhile reading for any knowledge engineer.

Accountability and feedback are particularly important when something unexpected happens in a complex domain. Standard methods are rendered inappropriate and adaptability becomes crucial. D Dorner suggests that decision makers acquire a system of local rules that allow them to cope with specific problem situations when they occur. But the very existence of such local rules presupposes some level of preparedness. J Reason advocates continuous system monitoring; any sign of stress causing the system to switch to emergency mode. To the extent that this means invoking some predetermined emergency plan, it also requires that the unexpected event must somehow be anticipated. At the very least, expert systems should be self-conscious enough to be aware of their own limitations.

A combination of feedback and accountability in an interactive environment where the human decision maker is continuously kept informed of what the system is doing, and why, seems the safest way to avoid catastrophic errors. Yet, one still cannot help but wonder whether any fault detection system, any risk reduction system or any expert system presently in use would have warned the designers of the AS332 helicopter not to include two different types of altimeter. As some of the horror stories described in this book make clear, we are still a long way from codifying simple common sense.

Artificial intelligence and cognitive sciences by J Demongeot, T Herve, V Rialle and C Roche (eds.), Manchester University Press, Manchester, 1988, pp 407, £39.50.

While the title of this book is very broad and may suggest some sort of attempt to discuss the inter-relationships between cognitive science and artificial intelligence, the reader consulting this volume will instead find a rather loosely structured set of conference papers. This is the book of a conference held in Grenoble in 1987. It has 29 chapters written by some 50 authors, of whom 48 are based in France and two in Switzerland. Thus, the book provides an impression of French AI which may not usually find its way to UK readers. However, the chapters are very compressed, and as a result they are not easy to understand if the subject background is not already familiar. In addition, I am afraid that something may have been lost through translation in a number of cases.

The chapters are grouped into three sets, one focussing on object-oriented representation, one on (real and artificial) neural information processing, and one on medical expert systems. There is no more than a token integration between the sets (or indeed, within the sets). Of the papers, three stand out as being particularly interesting: the first is a paper by Axelrod on the importance of considering the complexities of real neural processing as against the unrealistic simplifications of currently popular artificial "neural networks"; the second is a paper by Tiberghien, which nicely compares and contrasts natural and artificial memory systems; and the third is a description by Chauvet of a medical diagnosis system with a built-in learning component which improved its own performance.

Overall, however, despite some useful chapters, I doubt whether any individual would wish to purchase this book. It is a possible library purchase, but I suspect that it would be rarely consulted.