

Book Reviews

Cognition and Safety: An Integrated Approach to Systems Design and Assessment. Oliver Straeter, Aldershot: Ashgate, 2005, ISBN 0 7546 4325 5 (hardback), pp. xv + 271.

Complex systems, such as nuclear power plants and transport systems, place significant demands on human performance with respect to the objective of safe operation. Accidents and incidents continue to demonstrate the safety-criticality of human activities at all working levels, from the operational to the regulatory level. As a result, there is a clear need for improved understanding and support of cognition in these systems. *Cognition and Safety* by Oliver Straeter presents an approach to system design and assessment from a cognitive perspective that integrates the valid findings of mainstream approaches while offering new insights. The book is of interest to researchers and practitioners in human factors, psychology, and other disciplines concerned with design and assessment of hazardous systems.

The stage-based information processing model of cognition has long provided a basis for the study of human-machine systems. Straeter discusses its limitations and puts forward an alternative model of cognition that provides the basis for the approaches presented in the book. This model, the cognitive processing loop, includes an experience-based connectionist representation of the internal world and integrates cognitive modeling, experimental results, and neurophysiologic findings. Cognition is characterized as tertiary in that it entails activation and nonactivation of cells in a network as well as the influence of the endocrine system, which provides a general trigger to the emotional component of cognitive processing. A key feature of the model is dynamic binding in which *ad hoc* dependencies are created between cognitive entities. Dynamic binding contrasts with the generalized representations of processing in stage-based models in which a cognitive act entails information flow in a predefined relation of functional blocks that transform the concepts. In the classical approach to design and safety assessment, the operator is represented as a component with a specified function in the system and as a rather passive processor

of information. The cognitive processing loop model represents a wider spectrum of cognition, including active aspects, and provides a better account of the influence of context. It can be applied to all working levels and, in contrast to many existing human factors methods, can be used proactively.

The processing loop is used as a basis for discussing cognitive systems design. The approach described is consistent with the valid aspects of the technomorphologic models of cognition (those based on an analogy with technology, including the stage-based model). However, it also supports treatment of several issues that are either not addressed or not fully addressed in current design practice, such as heuristics in decision making, the role of attention and consciousness within cognition, and the interrelation of psychological and emotional issues. These and other characteristics of cognition reflected by the processing loop have important safety implications.

Straeter provides a historical overview of the assessment of cognitive reliability and goes on to describe application of the cognitive processing loop to safety assessment. An important issue is the link between the processing loop and dynamic situational conditions. This link is essential to an understanding of errors of commission, which are known to be important contributors to risk. In contrast to the classical treatment of cognition in safety assessment, which includes use of event trees and fault trees, Straeter advocates dynamic risk modeling using the cognitive processing loop as the human performance model.

A method developed by the author called connectionism assessment of human reliability (CAHR) is presented. CAHR combines human reliability assessment with incident analysis, thereby basing assessment on realistic experience. Since its development in the 1990s, CAHR has undergone further development for event analysis and other practices in human factors.

Several specific applications of the cognitive processing loop approach are described. These include communication, practitioner acceptance of automated systems, change management, incident

analysis, and human reliability assessment. Applications are discussed in relation to nuclear power plant operation, driving, and air traffic management.

What are the principal contributions of this book? The staged information processing approach has dominated the study of cognition in the safety sphere for many years. In response to the shortcomings of this model, Straeter puts forward a cognitive processing loop approach that includes a connectionist representation of the internal world. The processing loop differs radically from earlier information processing models, encompasses the valid findings of mainstream approaches, represents a greater range of cognitive behavior, and can be used proactively. Straeter's model provides a homogeneous basis for design and assessment of hazardous technological systems and addresses all operational levels.

The application of connectionism to the study of cognition in the safety domain is a highly significant development. The ground-breaking work reported in *Cognition and Safety* will be of importance in the design and assessment of future work environments.

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Environmental Security and Environmental Management: The Role of Risk Assessment.
Benoit Morel and Igor Linkov (Eds.),
Dordrecht, Netherlands: Springer. 2006. 336 pp.

In this book, Dr. Benoit Morel and Dr. Igor Linkov collected and edited papers that were a basis of the NATO Advanced Research Workshop on “environmental security and environmental management” that was held in Eilat, Israel, in April 2004. The Society for Risk Analysis co-sponsored the workshop and two previous workshops on a similar topic. The Society for Risk Analysis (SRA) assisted the organizers to develop their technical programs and promoted awareness of and participation in the event among society members and the scientific community.

In background, the NATO Advanced Research Workshops are expert meetings of few participants where an exchange of views at the frontiers of a subject aims at identifying directions for future action. The meetings are organized by scientists from NATO countries and scientists from NATO's “partner” or “Mediterranean dialogue” countries. The Eilat workshop was conducted within auspices of the “Environmental Security” subseries of the NATO

“Security through Science Series,” whose other subseries are “Chemistry and Biology,” “Physics and Biophysics,” “Information and Communication Security,” and “Human and Social Dynamics.”

In Eilat, there were 34 participants of the workshop, spanning government and nongovernment organizations, the private sector, and academia. The participants were based in Jordan, Turkey, Israel, Greece, Belarus, Belgium, the United States, Spain, the United Kingdom, and Egypt.

There are three parts of the book, each consisting of seven original chapters and a summary chapter that reflects discussion at the Eilat workshop. The three parts of the book are: Environmental Security, Environmental Management, and Case Studies.

In the first part, Belluck, Hull, Benjamin, Alcorn, and Linkov define “environmental security” and identify opportunities for risk assessment. They suggest that risk assessment and management frameworks may not be portable across nations and cultures. Morel specializes the topic of environmental security to the Middle East. He describes the pain of environmental neglect since the onset of the second Intifada in 2000. Brauch looks to solar desalination technology to fuse cooperation in the Gulf of Aqaba. He invents a 10-step recipe for cooperation that owes to conceptual ideas to which he attributes 60 years of peace in Europe following World War II. Ganoulis relates the topic to transboundary river basins and water resources in the Mediterranean. He describes multicriteria decision analysis as a tool for conflict resolution in this context. Maxwell describes comparative risk assessment of Mesopotamian marshlands. He outlines the dependence of these marshlands on increasingly restricted flows from Syria, Turkey, and Iran. Lipchin relates the topic to sustainable water management of the Dead Sea Basin. He describes a major data collection of physical and social dimensions of water use. Belluck, Hull, Benjamin, Alcorn, and Linkov question how criteria of risk acceptability are related to the topic. They explore how the thresholds of unacceptable risk may be infrastructure and context dependent. In the summary chapter, Morel and Morel prioritize the most urgent environmental problems of the region. They find that population pressures expected over the next 10–20 years call for adaptation strategies to begin as soon as possible.

In the second part, Koren and Butler perform an analysis of phenomena arising among the built environment, ecosystems, and human health. They propose an integrated consideration of human

health and ecological risks. Yeh and Small focus on the distribution of fine particulate matters. They describe the rapid development of Middle East cities as bringing serious health threats. Kiker, Rivers-Moore, Kiker, and Linkov describe gaming of environmental management decisions. They model ecosystem/habitat/organism/chemical combinations for the benefit of discussion among managers, scientists, and stakeholders. Schlink, Herbarth, Kindler, Krumbiegel, Strelbel, and Engelmann make a mapping of relative environmental risk. They describe the use of maps to highlight hot spots to authorities and to seek causal explanations of the considered risks. Rao relates to the cultural and behavior contexts of risk assessment. He is aimed toward a mathematical framework to account for risk culture in the development of local risk assessments. Menoni argues that a universal prototype of risk assessment is counterproductive to diverse problem domains. He is concerned that a lack of legislative and political pressure in some fields leads to underestimation and relative ignorance of important sources of environmental risks. Seager, Rogers, Gardner, Linkov, and Howarth couple public participation and expert judgment to address risks of contaminated sediments. They advocate multicriteria decision analysis as a negotiating tool in this context. In the summary chapter, Ganoulis and Simpson convince us of the interrelationships of environmental management and regional security. They describe regional cooperative networks of environmental scientists and managers for communication, data sharing, and common and joint actions.

In the third part, Haruvy performs economic analysis of aquifer pollution by agricultural reuse of wastewater. He assesses the economic costs by varying in several scenarios the salinity levels and the water supply sources. Arlosoroff deals with the risks that are associated with water scarcity. He is confident that water demand management can enhance socioeconomic prosperity and growth even with limited water quantities. Levner looks at integrated risk management of water resources in the Jordan River Basin. He demonstrates a multicriteria tool that accounts for the interests of several countries and that allocates water quantities to mitigate environmental risks for all of the countries. Zaidi, Steinhausler, Mustafaev, and Dunker provide an overview of radiological risks in central Asia. They attribute radioactivity in the Caspian region to global fallout, subsequent river runoff, and oil-gas extraction. Chahoud describes the relationship of air quality and public transportation in Damascus. He seeks a sustainable

public transport system that realizes fuel savings, energy efficiency, and reduced emissions of greenhouse gases. Andrijevskij, Lukashevich, and Trifonov explore the impacts of waste heat discharge from power plants to coastal environments. They demonstrate a computer code to forecast the dynamics of the ecological systems in risk assessments. Goncharov takes on the issue of biological risk assessments with ionizing radiation and heavy metals, describing that synergistic and antagonistic effects of irradiation doses are influential at low rather than high doses. In the summary chapter, Zaidi and Ganoulis develop the case for a network of experts to support environmental risk assessments in the Middle East region. They describe three needed layers of cooperation as the information network, the knowledge network, and the practice network.

The editors suggest that the concept and definition of “environmental security” is imprecise and evolving, that the workshop and book are part of a search for its meaning and efficacy in science and engineering and public policy. The editors suggest that environmental security can relate to any of the following: (i) security issues that arise from environmental constraints or needs, (ii) a sustainable relationship of regions or states to natural and environmental resources, and (iii) the fact or urgency of a cooperation of regions and states to address their joint environmental problems. The workshop and book are principally concerned with informing of environmental security by the paradigms of risk assessment and management.

There are several observations motivated by the overall coherence of the parts and their chapters. First, “environmental security” as the theme of the book is beneficially shaped by decades, centuries, and even millennia of philosophy, theory, and methodology of the profession of water resources engineering, and management across many geographies and cultures. An available sample of such knowledge is the journal *Water Resources Research* from the last several decades. Second, the book is timely to remind scientists and engineers of the needed holism of approaches that include risk assessment, environmental management, and regional and national security. Such holism is prevalent in at least two disciplines that are closely allied to risk analysis, namely, systems engineering and multiple criteria decision making. Third, the book is unique in providing us in a digest form the scientific and technical view of the problem of environmental security from the inside of the Middle East region looking outward to the world at large. The breadth

and depth of the contributors and their chapters is admirable in this regard. Fourth, the book is commendably practical and hopeful in offering the parlance of risk assessment and management as a foundation for international and intercultural and interdisciplinary dialogue on the problem of environmental security. The NATO series theme of “security through science” maintains its integrity throughout the book’s addressing of the topic of “environmental security” from a perspective of risk assessment and management.

The book will be of particular interest to practitioners of environmental risk assessment and management in regions where there is international and other conflict. As well, the book will be of interest to risk analysts and environmental managers in other

parts of the world, who will find perspectives that may be uniquely obtainable from within such a crucible of international conflict as the Middle East region. The audience of *Risk Analysis* should expect further opportunities to contribute to and benefit from similar joint technical activities of NATO and the Society for Risk Analysis that may be forthcoming on the topics of “environmental security,” “risk assessment and management,” and “security through science.”

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