

RISKS IN MODERN SOCIETY

TOPICS IN SAFETY, RISK, RELIABILITY AND QUALITY

Volume 13

Editor

Adrian V. Gheorghe

Old Dominion University, Norfolk, Virginia, U.S.A.

Editorial Advisory Board

P. Sander, Technical University of Eindhoven, The Netherlands

D.C. Barrie, Lakehead University, Ontario, Canada

R. Leitch, Royal Military College of Science (Cranfield), Shrivenham, U.K.

Aims and Scope. Fundamental questions which are being asked these days of all products, processes and services with ever increasing frequency are:

What is the risk?

How safe is it?

How reliable is it?

How good is the quality?

How much does it cost?

This is particularly true as the government, industry, public, customers and society become increasingly informed and articulate.

In practice none of the three topics can be considered in isolation as they all interact and interrelate in very complex and subtle ways and require a range of disciplines for their description and application; they encompass the social, engineering and physical sciences and quantitative disciplines including mathematics, probability theory and statistics.

The major objective of the series is to provide series of authoritative texts suitable for academic taught courses, reference purposes, postgraduate and other research and practitioners generally working or strongly associated with areas such as:

Safety Assessment and Management

Emergency Planning

Risk Management

Reliability Analysis and Assessment

Vulnerability Assessment and Management

Quality Assurance and Management

Special emphasis is placed on texts with regard to readability, relevance, clarity, applicability, rigour and generally sound quantitative content.

The titles published in this series are listed at the end of this volume.

Risks in Modern Society

Edited by

Hans-Jürgen Bischoff

*ISSA Section Machine and System Safety,
Mannheim, Germany*

 Springer

Hans-Jürgen Bischoff
ISSA Section Machine and System Safety
Mannheim, Germany

ISBN 978-1-4020-8288-7

e-ISBN 978-1-4020-8289-4

Library of Congress Control Number: 2008922070

© 2008 Springer Science+Business Media B.V.

No part of this work may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, microfilming, recording or otherwise, without written permission from the Publisher, with the exception of any material supplied specifically for the purpose of being entered and executed on a computer system, for exclusive use by the purchaser of the work.

Printed on acid-free paper.

9 8 7 6 5 4 3 2 1

springer.com

Table of Contents

Foreword by Norbert Weis and Hans-Jürgen Bischoff	ix
To the Reader	ix
About the Authors	xvii
1. Introduction	1
<i>Hans-Jürgen Bischoff</i>	
1.1 Major Social Changes	4
1.2 Major Societal Changes	5
1.3 Risk Profiles in Modern Work Life	11
1.3.1 Comprehensive Risk Paradigm	11
1.3.2 Risk Management Model	11
1.3.3 Typification of Risks	12
1.3.4 Precautionary Principle	13
References	15
2. Challenges to Global Governance in the Changing World of Work	17
<i>Jorma Rantanen</i>	
2.1 Changing World of Work and Constant Development of Technologies	17
2.1.1 Globalization	17
2.1.2 New Trends in Economic Structures and Conditions of Work	19
2.1.3 Fragmentation of Work Life	20
2.1.4 Modern Insecure Work Life	21

2.1.5	The Situation in Enterprises	22
2.1.6	Changes in Occupational Structures	24
2.1.7	Work Contracts and Employment	25
2.1.8	Ageing Workers	25
2.2	Challenges to Global Governance	26
2.2.1	New Arenas for Risk Management	26
2.2.2	New Balance in the Governance of Risks	30
2.2.3	International Actions for Global Governance	34
2.2.4	Need for Broader Approach	35
2.2.5	Global Compact	39
2.2.6	OECD Principles for Corporate Governance	40
2.2.7	Governance of Global Work Life by the International Labour Organization, ILO	42
2.2.8	Occupational Safety and Health as Global Common Goods	44
2.2.9	Occupational Safety and Health Risk Management in View of Global Governance	48
2.2.10	WHO Global Governance of Pandemics and Global Epidemics	51
2.2.11	Governance of OSH Risks at the Enterprise Level: Safety Culture and Systems Approach	51
	References	57
3.	Risk Governance: Combining Facts and Values in Risk Management	61
	<i>Ortwin Renn</i>	
3.1	Risk in a Broader Context	61
3.2	The Phase of Pre-Assessment	65
3.3	Risk Assessment	69
3.3.1	Steps of Risk Assessment	69
3.3.2	Generic Challenges for Risk Assessment	72
3.4	Risk Perception	76
3.5	Risk Appraisal	80
3.6	Risk Classification	83
3.7	Evaluating Risks	87
3.8	Risk Treatment within the Frame of Risk Management	95
3.8.1	Designing Risk Treatment Options	95
3.8.2	Basic Risk Treatment Strategies	100
3.9	Stakeholder Involvement and Participation	107

3.10 Risk Communication	113
References	118
4. Governance of Occupational Safety and Health and Environmental Risks	127
<i>Siegfried Radandt, Jorma Rantanen and Ortwin Renn</i>	
Introduction	127
4.1 Occupational Safety (by Siegfried Radandt)	127
4.1.1 Introduction	130
4.1.2 Occupational Risks	130
4.1.3 Ergonomic Problems	132
4.1.4 The Complexity of Risks	147
Annex 1 – Terms According to ISO Guide 73 and ISO Guide 51	173
References	184
4.2 Occupational Health (by Jorma Rantanen)	185
4.2.1 Occupational Health Risk Panorama	185
4.2.2 Global Burden of Occupational Diseases	187
4.2.3 Occupational Morbidity	189
4.2.4 Assessment of Occupational Health Risks	191
4.2.5 Diagnosis of Occupational Diseases	194
4.2.6 Future Trends – New Occupational Morbidity	205
References	208
4.3 An Application of Risk Governance to Environmental Risk (by Ortwin Renn)	211
Preface	211
4.3.1 Introduction	212
4.3.2 Ethical Foundations of Human Interventions into the Environment	215
4.3.3 A Decision-Analytic Approach to Environmental Risk Governance	234
References	252
5. New Emerging Risks	259
<i>Siegfried Radandt and Ortwin Renn</i>	
5.1 New Risks (by Siegfried Radandt)	259
5.1.1 Nanotechnologies	261
5.1.2 Mechatronic Systems	266
References	269

5.2 Strategies and Methods, the Precautionary Principle in Particular: Application to Integrative Risk Governance (by Ortwin Renn)	269
5.2.1 Introduction	269
5.2.2 The Precautionary Approach as Part of Integrative Risk Governance	272
5.2.3 Stakeholder Involvement and Participation	274
5.2.4 Conclusions	278
References	280
6. How to Develop a “Safe Society”	285
<i>Domenico Geraci and Leonard Sassano</i>	
Introduction	285
6.1 Developing a “Safe Society” (by Domenico Geraci)	286
6.2 Structure of a “Safe Society” and the Roles of Various Actors (by Domenico Geraci)	289
6.3 Structure of Safety (by Domenico Geraci)	292
6.4 Practical Examples from Italy and Canada	296
6.4.1 Health and Safety Integrated into School Curricula (by Domenico Geraci)	302
6.4.2 Safe Communities, Canada (by Leonard Sassano)	306
6.4.3 CEO Health and Safety Leadership Charter, Canada (by Leonard Sassano)	306
References	308
7. Lessons Learnt – Road Ahead: Summary and Proposal for Golden Rules in Health and Safety	311
<i>Alfred Sutter</i>	
7.1 Global Governance (Chapter 2)	311
7.2 Risk Governance (Chapter 3)	314
7.3 Corporate Risk Governance (Chapter 4)	316
7.4 New Emerging Risks (Chapter 5)	321
7.5 How to Develop a “Safe Society” (Chapter 6)	323
7.6 The Road Ahead	326

Foreword

The International Section on Machine and System Safety was founded in 1975 to deal with questions on occupational risks in this field at the international level. It is a member of the Special Commission on Prevention of the International Social Security Association (ISSA). The Special Commission is a body within ISSA that focuses on work-related risks. It has 11 international Sections as members.

ISSA was founded in 1927 with its headquarters in Geneva. It is working worldwide in over 150 countries with nearly 370 member institutions from all fields of social security. The Section on Machine and System Safety, when it was founded, had its focus on machine safety, particularly on the manufacturing of safe machinery, on assisting developing countries to be able to buy safe used machinery, and on delivering clear operating instructions. Our members and partners are:

- institutions for safety and health at work;
- insurance companies dealing with work-related risks;
- research institutions; and
- various enterprises, e.g. manufacturers, importers and users of machines and systems/installations.

We thus bring together the experiences of our members and partners. The role of the operators soon grew in importance, and their capability for handling machinery became an important factor for the safety and success of enterprises. The growing importance and complexity of handling different man-machine-environment situations created new challenges and led to enlarging the Section's tasks to machine and system safety.

Our next more complex task was to define the integration of risk management in the area of occupational safety and health (OSH) into an organiza-

tion's overall risk management programme. This we discussed at our "Conference 2000 – Future – Work – Prevention – What can risk management contribute?" (Lucerne, Switzerland).

A group of experts, many of them presenters at this conference, worked in our project group "risk management". The group is now presenting this book which describes our basic philosophy, based on an integrative, holistic approach to risk management and risk governance.

The Section plans as next steps – in co-operation with individual experts and renowned organizations in the respective fields – to deal with more specific topics and to focus on practical application.

Our second aim is to produce or collect "toolkits" addressing questions related to machinery and equipment safety; occupational health protection and promotion; a stable financial situation; quality, control and productivity and environmental protection, just to mention a few. Each field has to be co-ordinated by experts in that particular field.

Thirdly, we shall deal with specific areas, such as protection against explosions, hazardous materials including their transport, maintenance; (electronic) commands for automated machinery; work-related health hazards and environmental loading.

Selected individuals from the expert group act as the responsible authors for the chapters of the "risk book". Although they all come from organizations or institutions with experience in occupational or environmental risks, the authors here express their personal expert opinion.

The authors are (in alphabetical order, with the main responsibility for the chapters):

- Hans-Jürgen Bischoff, General Secretary of the ISSA – International Section Machine and System Safety, Mannheim, Germany (Chapter 1)
- Domenico Geraci, Istituto Superiore per la Prevenzione e la Sicurezza del Lavoro, Rome, Italy (Chapter 6)
- Suvi Lehtinen, Finnish Institute of Occupational Health, Helsinki, Finland (copy editor)
- Siegfried Radandt, Technical Consultant of the ISSA-Section Machine and System Safety, Brühl, Germany (Chapters 4.1, 5.1)
- Jorma Rantanen, International Commission on Occupational Health, ICOH, Helsinki, Finland (Chapters 2, 4.2)
- Ortwin Renn, Technical University, Stuttgart, Germany (Chapters 3, 4.3, 5.2)
- Leonard Sassano, Industrial Accident Prevention Association, Toronto, Canada (Chapter 6, examples)

- Alfred Sutter, Schweizerische Unfallversicherungsanstalt (Swiss Accident Insurance Fund), Lucerne, Switzerland (Chapter 7)
- Peter Wüthrich, retired member of the Executive Board, Schweizerische Unfallversicherungsanstalt (Swiss Accident Insurance Fund), Lucerne, Switzerland (expert reader)

Mannheim, May 2007

A handwritten signature in black ink, consisting of a large, sweeping diagonal stroke that curves downwards and then levels off into a horizontal line.

Norbert Weis
President of the Section

A handwritten signature in black ink, featuring a complex, stylized initial 'H' followed by several loops and a long, horizontal tail.

Hans-Jürgen Bischoff
Secretary General

To the Reader

Three main issues have inspired us to prepare this book on *Risks in Modern Society*.

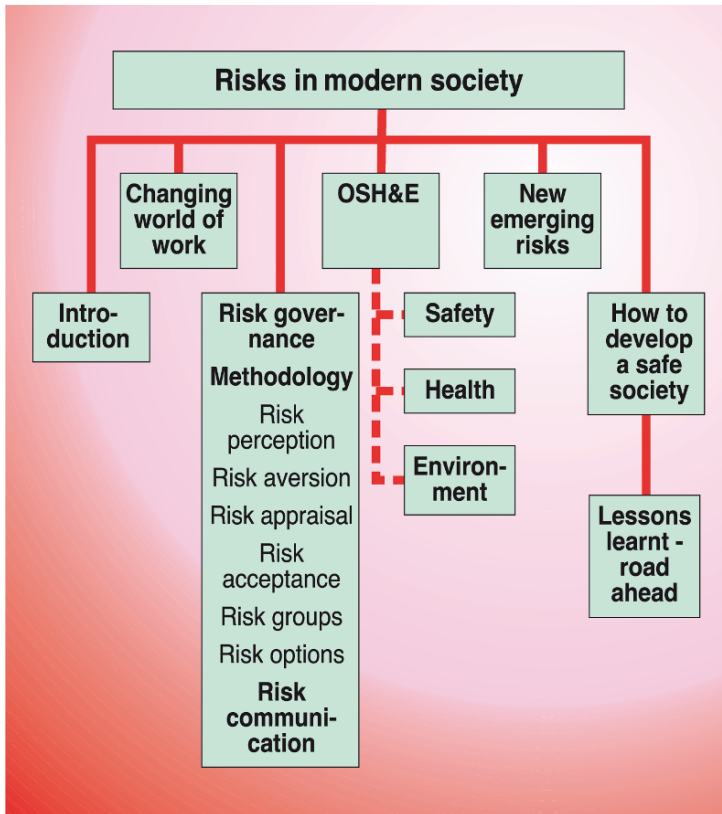
1. We are living in a globalized world where the work life is strongly influenced by phenomena arising from globalization. Safety, health and environmental health have not become obsolete, and there is a growing need to pay more attention to issues related to them.
2. Occupational safety and health is a public good. There are innumerable actors in this area, and their roles need to be defined.
3. New risks are emerging in the general environment and in specific work environments, bringing with them new safety and health problems that need to be adequately addressed.

The main goal of this book is to describe the complex issue of risks in a changing world, and how to find solutions through risk management and risk governance – for the benefit of all: employees, employers, other stakeholders, as well as shareholders and the society in general.

The main task of the ISSA Section on Machine and System Safety is to help create ways to reach, maintain and improve safety and health at work. Even though we focus mainly on occupational safety and health in this book, we also consider the political, cultural, natural and economic environments surrounding it. This complex structure must be examined when reviewing risk management and risk governance fundamentals.

Our risk book is therefore targeted mainly at well-educated risk managers in enterprises, at officials in insurance companies, science journalists, as well as providers of occupational safety and health services.

The complexity of *Risks in Modern Society* is broken down into the following chapters:



Chapter 2 describes the new challenges in more detail: how to steer and control risks; how to deal with the extension from the local to the global level; dealing with the relationship and the challenges between individual freedom, on the one hand, and collective goods on the other hand; describing the importance of well functioning communication for the economy, in particular, when promoting the outsourcing process; describing changes in the nature of risks leading to changes in, e.g., working conditions.

In Chapter 3 we discuss in more detail the risk governance approach and its importance for our main topic: occupational safety and health.

Chapter 4 deals with occupational safety, health and environment issues, with a specific section on each. Section 4.1 on safety discusses the complex world of work and its implications to occupational safety. The classical steps of risk management are applied to occupational accidents and other work-related incidents. Another key point is the stress and strain model and its – positive and negative – effects on human performance in the world of work.

Section 4.2 on health describes occupational health risks and provides systematic approaches for solutions. We also discuss the so-called “new-old” risks; these are classical risks which will appear in new forms, or which are returning, or which are still new in certain parts of the world.

Section 4.3 on environment deals with the governance of environmental risks. An evaluation is presented on the trade-offs between the environment and occupational safety; between environmental protection and the economy; and between individual and collective aspects and interests. The emphasis is on the global and governmental levels but company responsibilities are also discussed.

In Chapter 5 we discuss new and emerging risks giving some examples and discussing how to deal with such new risks when there are deficits – mostly insufficient or no knowledge to predict, identify, assess and manage them. Influencing the risk target or, if this is not possible, the risk agent is one example. Also transboundary effects have to be considered when proposing new methods to govern certain new risks. As very often a lack of sufficient knowledge is responsible for not being able to apply the “classical” risk management method the growing importance of and need for research and knowledge management (generating, assembling and disseminating knowledge) shall be broached. How to make use of the Precautionary Principle as a possible strategy in dealing with new and emerging risks is discussed in some detail.

In Chapter 6 we focus on how to develop a “safe society”. We describe what we mean by a safe society; considering the differences in the levels of safety among countries; the need for a dynamic concept in which societal structures need to be built to avoid risks as much as possible – this means that risks are to be optimized rather than minimized. Some examples are given to show possible approaches and effects. The first example is on the integration of health and safety into the school curriculum, hence the education process. The example shown is from Italy and is the application of an approach developed by the European Union. The second example concerns safe communities. The example described is from Canada, based on a concept from the World Health Organization (WHO). The third example describes a CEO (Chief Executive Officer) Health and Safety Leadership Charter, developed and launched in Canada in 2005.

Chapter 7 contains a summary of Chapters 2 to 6, but also some prospects for dealing with risks in our society: lessons learnt and what needs to be done.

Some chapters contain purposeful repetition in order to allow the reader to concentrate on specific chapters in more detail.

The terminology used in the book is mainly ISO terminology, for example, ISO 18001, Risk Management. An annex to Section 4.1 provides a glossary on terminology and identifies several methods that can be used for effective risk management.

Although we have discussed the importance of “one terminology only” and put some effort into adapting the chapters accordingly, we admit that the same terminology is not used in all fields dealing with risks. And even where the same terminology is being used, the general understanding, even the understanding of various experts, is not necessarily identical. Not to mention the difficulties when translating into different languages.

And thus, as the separate chapters have been written by experts from different fields: (public) health and medicine/technical safety and engineering/sociology/legal provisions (lawyers), the terminology may vary slightly.

Information on the Authors

HANS-JÜRGEN BISCHOFF

Lawyer, long-time experience as managing director of a German accident insurance and prevention institution (Berufsgenossenschaft Nahrungsmittel und Gaststätten – BGN), where his main tasks are prevention, rehabilitation, disability management, and compensation in the field of occupational accidents and diseases.

He also is, as general secretary of ISSA Machine and System Safety Section since 1991, responsible for the co-ordination of the Section's projects, in particular risk management, machinery safety, market observation, target group SMEs. Participation in "all-Sections'-projects" of the ISSA Special Commission on Prevention, for example, planning and organizing World Congresses on Occupational Safety and Health, marketing strategies, legal aspects, target group SMEs.

DOMENICO GERACI

Engineer, Research Manager in ISPESL (National Institute of Occupational Safety and Prevention), Department of Safety Technology, Rome. In this Department he is Coordinator of the Functional Unit for Machinery Safety. Main tasks cover safety system management, quality and design for quality, design tools and methodologies. Participates in national and international commissions and working groups (UNI, CEN, ISO), in the field of quality management systems and conformity assessment in particular.

He is expert in nuclear and conventional pressure equipments (design, materials) and in the standardization for PED directive.

Coordinator of many research projects within ISPESL and in collaboration with Universities and the Ministry of Health (Integrating systems in sanitary structures).

Expert Evaluator for NMP-NI-3 with reference to 6th EU Framework Programme for research and technological development (FP6) in the area of

nanotechnologies and nanosciences, in the sub-domain Hazard reduction in industrial plant and storage sites-integrated projects.

SUVI LEHTINEN

Studied economics and business administration and got her MSc from Tampere University. She works in the Finnish Institute of Occupational Health since 1975. Has edited and co-edited numerous proceedings in occupational health and safety (OH&S), published research and popularized articles in professional journals and newsletters in OH&S. At the national level, she has participated in the work of several Governmental Working Groups and Committees. She has also participated in several WHO, ILO, FINNIDA and EU Expert Meetings as member or rapporteur during the past 20 years. In addition, she has been involved in the work of the Network of the WHO Collaborating Centres in Occupational Health from its start in 1990, and worked as Programme Manager in the WHO Regional Office for Europe in 2005. She has established three regional newsletters on OH&S: in Africa, Asia and Northern Europe, and works as Editor-in-Chief in them. She is Board Member of the International Commission on Occupational Health and Chair of the ICOH Scientific Committee on Occupational Health and Development.

SIEGFRIED RADANDT

Electrical and mechanical engineer.

Long-time head of prevention department concerning occupational risks in a German Berufsgenossenschaft (Berufsgenossenschaft Nahrungsmittel und Gaststätten); Managing director of FSA (Forschungsgesellschaft für angewandte Systemsicherheit und Arbeitsmedizin = Research Society for Applied System Safety and Industrial Medicine), an association with international members mainly from the occupational risk area.

Chairman of different Technical Commissions for European and international standards in the field of safety at work.

Technical adviser of the ISSA-Section on Machine and System Safety for over 30 years.

JORMA RANTANEN

MD, PhD is professor and specialist in occupational health. Until 2003, he served for 30 years as the Director General of the Finnish Institute of Occupational Health. He has experience in practical occupational health

services, in clinical occupational medicine, in toxicology research and in the development of regulations for OSH in Finland and internationally. He has published about 500 research and professional articles on several topics of occupational health, including assessment of radiation, toxic and occupational safety and health risks and risks of military personnel. He has worked as an expert for WHO, ILO and EU in drafting strategies, programmes and regulations, including the ILO instruments on Occupational Health Services, the WHO Global Strategy on Occupational Health for All, and recently the WHO/ILO/ICOH Guideline for Basic Occupational Health Services. He has over 30 years' experience in programmes for occupational health in developing and transitory countries in Africa, Asia, Central and South America, China and Eastern Europe, including the Russian Federation, the Baltic and Balkan areas. He has served as the Board Member of ICOH and was elected President of ICOH for the tenure 2003–2006 and 2006–2009.

ORTWIN RENN

Serves as full professor and chair of environmental sociology at Stuttgart University. He directs the Interdisciplinary Research Unit for Risk Governance and Sustainable Technology Development (ZIRN) at the University of Stuttgart and the non-profit company DIALOGIK, a research institute for the investigation of communication and participation processes in environmental policy making.

Ortwin Renn has a doctoral degree in sociology and social psychology from the University of Cologne. His professional career began with an appointment at the National Research Center, Jülich; he served as professor at Clark University (Worcester, USA) and at the Swiss Institute of Technology (Zurich) and directed the Center of Technology Assessment in Stuttgart for 10 years. He is a member of the panel on “Public Participation in Environmental Assessment and Decision Making” of the US National Academy of Sciences in Washington, DC, an ordinary member of the Berlin-Brandenburg Academy of Sciences (Berlin), the German Academy for Technology and Engineering, and the European Academy of Science and Arts (Vienna and Salzburg). His honours include the “Distinguished Achievement Award” of the Society for Risk Analysis (SRA) and the Outstanding Publication Award from the Environment and Technology Section of the American Sociological Association. Renn is primarily interested in risk governance, political participation and technology assessment.

He has published more than 30 books and 200 articles.

LEONARD SASSANO

Director, Strategic Alliances & Corporate Development for the Industrial Accident Prevention Association (IAPA). He has executive responsibility for exploring new opportunities for the Association and developing and expanding its provincial, national and international markets.

His career with IAPA spans over three decades: first as a Consultant, then Administrator, Quality Assurance; Manager, Loss Management Services; Director, Consulting Services.

He has served on numerous advisory committees with organizations such as Canadian Standards Association, Major Industrial Accidents Council of Canada, Conestoga College of Applied Arts and Technology and University of Toronto. He was a major contributor to the development of the International Safety Rating System, the Workplace Safety & Insurance Board of Ontario “Workwell” audit protocol and the Workplace Health and Safety Compensation Commission of New Brunswick’s consulting process. He currently is a faculty member of the Interamerican Centre for Social Security Studies in Mexico City.

ALFRED SUTTER

Dipl.-Masch.-Ing ETHZ; Development Engineer (1967–1971); Safety Engineer (1971–1974), Director Health and Safety Europe (1975–1979) Grace Industrial Chemicals, Inc, Lausanne; 1979–today: Schweizerische Unfallversicherungsanstalt (Suva), Lucerne in various positions in the Health and Safety Department. Former member of Federal Commission for Occupational Health and Safety (FCOHS), Participation in various special committees. Present position: Deputy Head of Division Prevention Services, Chairman ISO TC 199/CEN TC 114; Convenor ISO WG14 Risk Assessment; Member of CEN SMS Advisory Nucleus.

PETER WÜTHRICH

PhD in Sociology and Economics (University of Berne/Switzerland), Master of Public Health (Johns Hopkins University/Baltimore, MD, USA). Member of the Executive Board of the Swiss Accident Insurance Fund Suva (1988–2002). Long experience in OSH as Suva’s Head of the Department of Safety and Health and as an expert in national and international organizations.

As an expert reader he supervised the coherence of the Risk Book.