Enhancing Safety:
The Challenge of Foresight

ESReDA Project Group *Foresight in Safety*

Introduction to the report

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Introduction

ESReDA Project Group on Foresight in Safety[4]

This introduction gives an overview of topics in foresight contained in thirteen chapters written by members of ESReDA's project group on Foresight in Safety. The group did not attempt a comprehensive treatment of foresight. Instead, experts in safety have shared ideas about the role and challenges of foresight in their field—mainly industrial safety, and focussed on accident investigation and prevention. But the chapters span a broader scope; and address foresight in process safety, nuclear safety, transportation safety, occupational safety, consumer safety, and medical safety.

If you are a reader that is interested in foresight in socio-technical systems and safety, this is a book for you. In the main, the authors have concentrated on a pragmatic approach with a relatively short-term time horizon. Their aim is to enhance the level of safety in important, societal fields. However, there are also some observations that would apply equally well to 'futures research' and related fields. The reader is directed to the conclusions chapter in particular.

As you read, you will find links to the individual chapters. It is suggested that you read all the way through this introduction before reading the chapters. Please note that a related volume of seminar proceedings is also available for download.

The first part of this introduction presents signposts to ways of conceptualising foresight. These include how foresight is seen within different paradigms such as resilience engineering, social science, and accident investigation.

The second part of this introduction considers foresight alongside various aspects of socio-technical systems. There are three main headings: foresight as a property of organisations; foresight in the prediction and control of operations, and lastly; foresight as a subject for regulatory action.

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[4] *The introduction has been prepared by John Kingston, Ana Lisa Vetere Arellano and Yves Dien on behalf of the project group.*

Conceptual views of "Foresight in Safety"

Foresight is based on knowledge of what has happened before and what has yet to happen. Chapter 5, Use of Scenarios, refers to this as retrospection and prospection, respectively.

Chapter 1, Foresight in safety. Theories, traditions, and challenges – a new approach, shows how the issue of foresight has been considered in the field of safety. It describes how some methodologies for foresight are already implemented in some sectors. The time concept in foresight and foresight traditions and futures research is described and analysed. The chapter also considers the relationships between safety, investigations and the modern system approach. The strategic triangle and resilience are also discussed.

Chapter 1 reviews several theoretical perspectives on foresight. The authors consider apply insights from futures research and resilience engineering to foresight in safety. Resilience engineering is further considered in Chapter 2: Future of safety, resilience. In a similar vein, Chapter 9, Asset Management, Monitoring and KPIs, discusses the role of foresight in asset management and makes comparisons to foresight in safety.

Different theoretical perspectives offer alternative approaches to improving foresight. However, it may not be easy to combine them. As Chapter 2 points out, engineering paradigms and socio-psychological paradigms construe foresight in different ways. Notwithstanding their distinctiveness, different perspectives can be complementary, and arguably this is essential in an inclusive approach to foresight.

Although views differ about what foresight is and how it works, there seems to be general agreement that foresight should be a trigger for learning and risk reduction. The connection between foreseeing and acting is sometimes implicit, such as identifying early warning signs through analysis of scenarios. This is explored in Chapter 5, Use of Scenarios. Scenarios are used as a practical tool for thinking about risk; they are relatively straightforward to create and have many uses. In contrast, the authors of Chapter 7, Utilizing the ESReDA Cube to detect EWS, look at the explicit steps that lead from analysis to action. These steps include identifying which actors are best placed to interpret findings, finding solutions, and

initiating change in the system. Similarly, Chapter 6, Visibility of Early Warning Signs, describes how meaningful signals need to be escalated for review and action. However, there are many situations when an actor—a foreseer as it were—cannot get the right kind of change to happen, or happen with sufficient urgency. Chapter 11, Whistleblowers, explores these situations.

Foresight and levels of system

There are many different perspectives on foresight. It can be seen as a technical question concerned with how people work with technology to better understand and control operational systems. Foresight can also be seen as an aspect of governance of the organisation that owns or has a role in the operation.

The organisation

Foresight as a function of organisations

As explained in Chapter 3, Failures of Foresight in Safety: Fantasy Risk Analysis and Blindness, investigations of major accidents often reveal problems of foresight. As well as questioning the technical adequacy of hazard identification and risk quantification, investigators are increasingly willing to consider structural problems—dysfunctions—in the organisation itself.

Chapter 8, Organizational dysfunctionalities, describes how these conditions are important features for safety which, when degraded, predispose operations to accidents. The chapter also describes how a competent authority assessed the organisational functions of major hazard sites, including those associated with foresight, before accidents. The authors report instances of important functions working badly in organisations, apparently without any awareness by top management. According to the competent authority's inspectors, the factors of special relevance to foresight are often located at a senior level, and include strategy, policy, structure, resources, roles, and responsibilities.

Blindness, deafness and whistle-blowers

The assessment scheme described in Chapter 8 can be seen as a normatively defined contrast between a functional and a dysfunctional organisation. Chapter 3 makes a comparable distinction; using the metaphor of physical ability and pathology, it notes that foresight problems can be considered as blindness and deafness. As noted in Chapter 11, in whistleblowing cases, management appear

insensible to the foresight voiced to them, with only subsequent accidents restoring their sight and hearing. Even if blind to the risks that whistle-blowers express, organisations tend to excessively fixate on the whistle-blower as an enemy in their midst, rather than acting constructively on their message. Chapter 11 gives examples of this and discusses ways that allow whistle-blowers to voice their concerns without the denials, suppression and punishment that invariably follow.

The operational system

Foresight, considered earlier as an organisational duty, can also be considered as a capability. As in most fields, tasks once seen as uniquely human are increasingly assisted by technology. And whilst technology can undoubtedly assist, foresight is largely an exercise in human cognition, professional knowledge, and human relationships within socio-technical systems.

Technology to support foresight

Chapter 12, Role of Technology, points out that people use foresight in a variety of situations, such as development, training, operation, monitoring, diagnoses, prediction, emergency response, and accident management. Technology needs to be designed to accommodate the distinctive requirements of these situations. Chapter 12 reviews the state of these developments. The authors consider the assistance provided by sensors, computing power, communication bandwidth, computer-aided hybrid development, real-time modelling analysis and artificial intelligence. Chapter 10, Big Data Analytics and Early Warning Signs, looks at how foresight by humans can be assisted by patterns detected using big data technology. It describes how big data approaches can help to detect new safety threats, improve the monitoring of safety barriers, facilitate structural health monitoring, and provide inputs to safety investigations. The promise of big data approaches is tempered by a number of issues, not least the inscrutability of the algorithms used and data adequacy.

Knowledge, visualisation and Early Warning Signs (EWS)

Visualisation and early warning signs (EWS) are a recurrent theme in safety foresight. Chapter 6, Visibility of Early Warning Signs, argues that foresight depends on clarity about the meaning of early warning signs. Chapter 5, Use of Scenarios, explains that knowledge of EWS is critical to foresight, and describes how scenarios can be used to identify them. Chapter 3, Failures of Foresight in

Safety: Fantasy Risk Analysis and Blindness, and Chapter 2, Future of Safety, Resilience, note that when EWS are weak signals; they present a special challenge to foresight. Chapter 3 also underlines that, whatever their strengths, EWS seldom trigger actions that are effective in terms of safety.

Knowledge of early warning signs, and their meaning, depend on memory. As Chapter 4, Loss of Memory, explains, memory can be personal, externalised in a database/repository or a combination of these. And in Chapter 5, Use of Scenarios, it is explained that foresight depends on some aspects of memory more than others. However, Chapter 4 points out that because memory is not intrinsic to organisations, risk management depends on deliberate efforts to create this capacity. Organisations suffer memory loss in a variety of ways, and retention of memory is a goal that needs to be managed. Chapter 4 describes the challenges of organisational forgetting and presents approaches that may be helpful in retaining memory. These approaches include using scenarios and the early warning signs associated with them.

Chapter 7, Utilizing the ESReDA Cube to detect EWS, discusses visualisation, not of EWS per se, but of systemic relationships. It presents the ESReDA Cube as a tool to assist stakeholders to make sense of situations, find solutions and improve foresight.

Role of regulators

Chapter 13, The Role of Safety Authorities in Providing Foresight, and Chapter 8, Organizational dysfunctionalities, remind of the unique role that regulators play in the governance of safety. As asserted in Chapter 3, Failures of Foresight in Safety: Fantasy Risk Analysis and Blindness, organisations may be foresight-blind and, as noted in Chapter 8, regulators are well-placed to discover this and challenge the organisation's management and culture.

Chapter 13 describes the unique opportunities that regulators have for foresight in safety, by virtue of their privileged acquisition of data from all levels, and their overview. It describes the role of regulators to generate and disseminate foresight of risks, and how this is discharged by competent authorities.

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