



© Carl Macrae 2014  
Foreword © Jim Reason 2014

All rights reserved. No reproduction, copy or transmission of this publication may be made without written permission.

No portion of this publication may be reproduced, copied or transmitted save with written permission or in accordance with the provisions of the Copyright, Designs and Patents Act 1988, or under the terms of any licence permitting limited copying issued by the Copyright Licensing Agency, Saffron House, 6–10 Kirby Street, London EC1N 8TS.

Any person who does any unauthorized act in relation to this publication may be liable to criminal prosecution and civil claims for damages.

The author has asserted his right to be identified as the author of this work in accordance with the Copyright, Designs and Patents Act 1988.

First published 2014 by  
PALGRAVE MACMILLAN

Palgrave Macmillan in the UK is an imprint of Macmillan Publishers Limited, registered in England, company number 785998, of Houndmills, Basingstoke, Hampshire RG21 6XS.

Palgrave Macmillan in the US is a division of St Martin's Press LLC, 175 Fifth Avenue, New York, NY 10010.

Palgrave Macmillan is the global academic imprint of the above companies and has companies and representatives throughout the world.

Palgrave® and Macmillan® are registered trademarks in the United States, the United Kingdom, Europe and other countries.

ISBN 978–0–230–22084–3

This book is printed on paper suitable for recycling and made from fully managed and sustained forest sources. Logging, pulping and manufacturing processes are expected to conform to the environmental regulations of the country of origin.

A catalogue record for this book is available from the British Library.

A catalogue record for this book is available from the Library of Congress.

Typeset by MPS Limited, Chennai, India.

# Contents

<i>Foreword by Jim Reason</i>	vii
<i>Preface</i>	ix
<b>1 Searching for Risk and Resilience</b>	<b>1</b>
Making sense of safety	4
Bracketing the problem	9
Organisations, risk and knowledge	11
A bird's eye view	22
<b>2 Airlines, Incidents and Investigators</b>	<b>25</b>
Vignettes of incidents in the field (and the air)	28
Organising airline flight safety	40
The work of flight safety investigators	50
<b>3 Understanding and Interpreting Safety</b>	<b>57</b>
Safety-critical assumptions	59
Concepts of organisational safety	67
Practical theories of safety and risk	74
<b>4 Analysing and Assessing Risk</b>	<b>89</b>
Qualities of resilient practice	90
Assessing organisational risk resilience	104
<b>5 Overseeing and Monitoring Safety</b>	<b>114</b>
The work of safety oversight	115
The challenges and risks of knowledge	128
<b>6 Identifying and Constructing Risks</b>	<b>138</b>
A vigilant approach to interpretive work	139
Producing and using suspicion and doubt	149
<b>7 Improving and Evaluating Safety</b>	<b>165</b>
The nature of oversight and improvement	166
Creating networks of participation around risks	172
Appraising the value of safety improvement	186
<b>8 Organising Resilience</b>	<b>192</b>
Practical sources of safety	196
Organisational proximity and diagnosis	199
Ignorance and early warnings	201

vi *Contents*

Disruptions and epistemic work	205
Rethinking resilience and high reliability	208
Coda	214
<i>References</i>	216
<i>Index</i>	223

# 1

## Searching for Risk and Resilience

“Close Call”. The term is redolent of the lucky escape, the close brush with disaster, the narrowly avoided catastrophe. Close calls don’t come much closer than on the morning of 21st November 1989, at London’s Heathrow airport. Flying blind in thick cloud and fog, relying on instruments and struggling with bouts of food poisoning and the notoriously tricky old ‘Sperry’-type autopilot, the crew of a Boeing 747 began their final approach. Breaking through heavy cloud just seconds before touch down, they made the gut-wrenching realisation they had drifted way off the runway centre-line, out over the airport’s perimeter fence. Punching the engines to full go-around power to abort the landing, the aircraft lumbered away, clearing the luxury Penta Hotel with little more than twelve feet (3.65 metres) to spare, sending staff and guests screaming into the street. Near-misses don’t come much closer. Nothing but providence and a few feet separated hundreds of people from an horrific catastrophe.

Dramatic events that place hundreds of lives in the balance are rare in commercial aviation. But thanks in part to striking moments such as this, the idea of learning from close calls and near-miss events has become deeply embedded in the culture and practice of airline safety management. It is an idea that has spread far and wide. Analysing and learning from near-miss events and operational incidents is now a central component of risk management practice in industries as diverse as healthcare, nuclear power and banking. At one time, only the most costly and harmful accidents were subjected to intense investigation. Now all manner of procedural mishaps, human errors and operational defects are routinely catalogued and submitted to in-depth analysis and investigation. Well-established incident reporting programmes can collect tens or even hundreds of thousands of

## 2 *Close Calls*

reports each year, each one capturing a fleeting encounter with risk. These provide organisations with countless opportunities for uncovering risks in their operations and for improving safety. But, in practice, investigating, analysing and learning from incidents is rife with complications and difficulties. Transforming incidents into improvements confronts some of the deepest and most fundamental challenges of risk management.

When organisations take safety seriously, risk managers can soon find themselves awash with reports of errors, anomalies, near-misses and failures that are diligently filed by personnel from around the organisation. Some of those incidents may have very serious implications for safety, but many will not. Most operational incidents reported to risk managers involve only minor defects and fleeting disruptions: the occasional mishaps, complications and fluctuations that are inherent to all organised human activity. But in some cases, the underlying risks and the potential consequences can be catastrophic. Analysing incidents is therefore challenging and consequential work: the stakes are high and signals of risk are weak and ambiguous. Failures to identify and address risks at this early stage of risk management are particularly insidious. They allow risks to remain dormant and hidden deep within an organisation. When early warning signs are missed, people simply may not realise that certain risks exist in the first place – until they are dramatically and catastrophically realised. Interpreting and learning from incidents therefore depends on close calls of another kind: fine-grained judgements to determine where safety is satisfactory and where it is troubling, and which weak signals of risk matter most and should be investigated, and which should not. The art of risk analysis is not simply knowing what to look for, it is also the art of knowing what to overlook.

This book is about the practical work of risk management and the practical challenges that are inherent to analysing and learning from incidents, errors, failures and close calls. Specifically, this book is about the practices of airline flight safety investigators. Flight safety investigators are responsible for overseeing the safety of airline operations and ensuring that risks to flight safety are properly identified, understood and addressed. They are a special breed of risk manager and belong to a distinct technical and professional community with roots stretching back over a hundred years to the earliest days of formal air accident investigation. Nowadays, most flight safety investigators work in commercial airlines and much of their work focuses on assessing and investigating relatively minor flight safety

events, reports of which are submitted in their thousands by airline personnel.

This role places flight safety investigators at the sharp end of risk management. They work in a context in which the deep interpretive challenges of risk management are particularly pronounced. In large airlines, front-line operational personnel can report tens of thousands of safety incidents each year. Each of those incident reports is extremely brief – often little more than a one-line description with some additional geographical and technical data. Typical incident reports merely highlight, for instance, that “flights A2490, A2940 and A2840 all operate from the same station at the same or similar departure times, which causes call-sign confusion”. Or that, “during pre-flight checks, the wrong departure route was entered into the flight computer and the error was only noticed and corrected after take-off”. By definition, these are reports of transient and fleeting events that have typically resulted in limited – and usually no – adverse outcome. A defect was discovered or an error was made, and then corrected. Investigators must trawl through these incidents to work out what they mean and what their implications might be for flight safety, all the while looking for new risks and remaining attentive to the early and weak signs of emerging threats. This work requires extensive and deep technical expertise. It also requires creative thinking, a deep index of suspicion and a healthy – or perhaps unhealthy – dose of curiosity.

Close calls involving jumbo jets and luxury hotels provide clear signals of risk, and naturally provoke intensive investigation and improvement efforts. But such events are extremely rare. The routine stuff of close calls is no longer a dramatic brush with catastrophe. Instead, the majority of events reported to investigators appear, at first blush, to be rather humdrum and mundane moments of organisational life. ‘Distant misses’ or ‘far calls’ might be more appropriate descriptors. The consequence of near-miss events becoming more distant and risk management becoming more precautionary is that warnings get weaker and more equivocal. The early signs of emerging risks are rarely self-evident, and the most serious and challenging risks typically lie at – or just beyond – the limits of current knowledge. Signs of new and emerging risks must be actively interrogated, pieced together and made sense of by investigators. To complicate matters further, safety investigators, like most other risk managers, have no executive control or direct authority to address risks. They provide independent oversight and impartial guidance, and so are separated from operational and executive functions. As a result, investigators’ practical strategies for managing and addressing

risks are almost as subtle and nuanced as their strategies for identifying and assessing them.

This book, then, is about the practical work that is done to analyse, learn from – and make – close calls in safety improvement. It explores how operational incidents, failures and errors are interpreted and analysed in practice and how some come to be defined as risky whilst others are deemed acceptably safe. It examines how the earliest and most tentative signs of risk are identified and extracted from a mirky sea of anomalies and defects. And it analyses how knowledge is produced and practices are improved by transforming small moments of organisational life into signals of risk, around which wide-ranging activities of investigation and improvement are then organised. Flight safety investigators engage in a continual search for risk and resilience: this is the story of that search.

### **Making sense of safety**

Risk has become an organising feature of modern industrial life. Ideas and ideals of risk management are embedded in a proliferation of risk management standards, safety improvement models and error analysis methods. Whilst risk is a staple of both professional and academic discourse, the practical nature of the work actually involved in interpreting and managing risk is more often assumed than explored. The practical work of analysing and addressing risk can remain largely invisible to the regulators and executives who are responsible for assuring the safety of their organisations. It often remains invisible in much of the research literature, too. Yet if organisations are to improve their ability to manage risk and safety, it is first necessary to understand the practices and the practical work that underpin these tasks. This requires up-close, prolonged and in-depth study of the situated practices, practical theories and analytical tactics that are employed by risk managers to make sense of and address organisational risks. We need to make sense of the practical work that risk managers do when they themselves make sense of risk and safety – and that was my purpose when I began this research.

Over the course of four years I observed, interviewed and worked with a group of airline flight safety investigators to understand the work they did and the shared knowledge and conceptual tools that they found useful. My focus was on understanding how flight safety investigators monitor, identify, analyse and manage risks to airline flight safety. My principle aim was to understand the interpretive work that is involved in identifying and understanding risks and organising safety

improvement. I wanted to understand how flight safety investigators interpret the masses of safety incidents that are reported to them, how they use those incidents to identify and uncover potential risks to safety, how they analyse those risks and monitor safety and how they work to coordinate investigations and oversee improvements. As such, my attention focused on the cultural practices, the cognitive work, the conceptual frameworks and the shared social representations, ideas and models that underpin and shape how investigators analyse risk and improve safety. That is, my focus was on making sense of safety.

How experts interpret and make sense of safety is central to how risks get managed – and whether certain risks are even noticed and understood in the first place. When the interpretation and analysis of risks goes awry in organisations, risks can be inadvertently neglected or ignored. Effective risk management is the art of continually identifying and addressing the most pressing set of problems threatening safety. It is also the art of knowing what to overlook. Or, to put it another way, the most fundamental challenge of risk management practice is knowing “which aspects of the current set of problems facing an organisation are prudent to ignore and which should be attended to, and how an acceptable level of safety can be established as a criterion in carrying out this exercise” (Turner, 1976a, p. 379).

Investigators, like all risk managers, are confronted with masses of safety-relevant information and are faced with the imperative to act early and often, before risks are revealed by major organisational failures. But data on risk do not interpret themselves. In modern, complexly hazardous organisations like airlines, risks are rarely self-evident. One of the core challenges facing safety investigators is therefore interpreting and making sense of incidents and identifying the underlying risks that these may point to – challenges that are amplified and particularly pronounced in the setting of airline flight safety oversight. In the course of their daily work, “managers literally must wade into the ocean of events that surround the organisation and actively try to make sense of them” (Daft and Weick, 1984, p. 286). Risk managers face this challenge in the extreme, and this book is about how flight safety investigators work to meet this challenge.

To understand how investigators analyse, improve and make sense of safety, I focused on understanding their situated practices of risk management as they actually conducted their day-to-day work. Studying practical work in its organisational setting is notoriously challenging. It requires detailed analysis of the organisational context, social structures and conceptual and material resources used in practice. It also requires attentiveness to the cultural, cognitive and interpretive processes that

underpin routine activities (Hutchins, 1996). Moving away from front-line personnel such as – in aviation – pilots and engineers, practical work takes on a less visible form, being more about analysing and interpreting than operating and acting. Studying how investigators analyse, make sense of and act on risks is particularly challenging due to the subtle nature of interpretive work. Interpretation and sensemaking involve active, effortful processing and social interaction. Sensemaking – literally the processes of making sense of situations, data and events – involves building a coherent account by combining the information, evidence, theories and knowledge at hand (Weick, 1995; Maitlis, 2005). Active processing and interpretation are typically occasioned by things that are out of the ordinary: “sensemaking begins with the basic question, is it still possible to take things for granted? And if the answer is no, if it has become impossible to continue with automatic information processing, then the question becomes, why is this so? And, what next?” (Weick, 1995, p. 14).

The work of risk management is focused on understanding failures and uncertainties: two common triggers of sensemaking. Efforts to make sense are commonly provoked by problems, gaps, puzzles, novelty, ambiguity and surprises – when things can no longer be taken for granted and when people’s sense of the familiar and routine has been shaken. At core, sensemaking is a process of identifying, bracketing and labelling certain things as relevant and worth attending to and then relating those things to existing concepts, knowledge and broader frames of reference to work out what they mean. Those broader frames of reference may be past experiences, memories, stories, professional standards, formal models or company procedures. Interrelating moments of experience with frameworks of knowledge is at the heart of how people interpret events and make data meaningful. These processes are inevitably social – if only because the frames of reference that people draw on are the products of previous collective activities, social communities, organisations and prior interactions (Wenger, 1999). The nature of expert practice, then, needs to be understood as more than merely doing, behaving or acting. Rather, practice “is doing in a historical and social context that gives structure and meaning to what we do” (Wenger, 1999, p. 47). To understand how professionals work, it is important to understand what knowledge they draw on and how they put that knowledge in practice. Put another way, “if you want to understand the essentials of what accomplished engineers know, you need to look at what they do as well as what they possess” (Cook and Brown, 1999, p. 387).

In this book, my focus is on what flight safety investigators do, what they know and how they put that knowledge into practice to manage

risk and improve safety. This study took me deep into the practical world of flight safety investigators and allowed me to lift the lid on their work. To explore this world I used a range of methods over several phases of fieldwork. These ranged from short interviews, critical incident reviews, structured group discussions, in-depth interviews and working with investigators day-in, day-out for months at a time. During this time I spent some 400 hours systematically observing their practice, observed and discussed the analysis of 464 flight safety incidents, sat in on five different forms of safety meeting, including board meetings, team meetings and operational reviews, and conducted 39 lengthy and iterative in-depth interviews (Macrae, 2007; 2009). I studied the work of 26 flight safety investigators, at various levels of seniority, working across seven different organisations. My work was iterative. Each stage contributed to an emerging and evolving picture of practice, which set the focus for future stages of work. These methods allowed me to conduct research “in close rather than from the armchair” (Weick, 1995, p. 173). I listened to investigators’ conversations, observed their work, questioned their assumptions and worked with them to refine and elaborate my emerging explanations of their practice. I came to learn about the challenges they faced, the tactics they employed to deal with those challenges and the fundamental assumptions, conceptual tools and practical theories that shaped their work, their thinking and their management of risk. My analysis rigorously followed the tenets of the constant comparative grounded theory method, which seeks to produce useful, relevant and coherent theories of organisational life that are well-grounded in empirical evidence (Glaser and Strauss, 1967), and my methodology was ethnographic (Emerson, Fretz and Shaw, 1995; Crotty, 1998) in which, quite simply, I sought “to conduct informal interviews in industry, to participate in industrial life, and to ‘be around’ as industrial life unfolds” (Turner, 1971, p. 136).

My work was conducted in five airlines and two state air safety agencies, though I primarily focused on the work of flight safety investigators in large international airlines. All of these organisations employed specialist flight safety investigators whose primary responsibilities were analysing and responding to flight safety incidents. Five of these organisations were based in the UK and two of them in its linguistic and cultural cousin, Australia. These organisations were chosen to allow me to challenge, test and elaborate my emerging theoretical account of investigators’ practice. They were selected both for their similarities and differences in terms of the safety management principles and tools being used, their operational activities and the linguistic and

regulatory frameworks they operated within. My focus was on producing well-grounded theory that was recognisable and useful to the practitioners involved, so I regularly engaged with flight safety investigators to invite challenge and comment on my emerging explanation of their practice. Nonetheless, as with all ethnographic explanation, this account is necessarily my working theory of their working theory.

Well-grounded theory interrelates the particular and the general, the practical and the theoretical. Throughout this book I liberally show the practical thinking and the work of flight safety investigators in order to richly illustrate both their working theory – and mine – and to deeply ground my analysis in the practical world of flight safety management. When the direct words of investigators are presented they are either indented and set apart from the main text, or are marked in “double quotation marks”, and referenced with an anonymous safety investigator (Si) code. These codes provide a degree of transparency regarding the relative sources of the fieldwork data being presented, while ensuring anonymity: each code refers to a participant involved in a specific phase of my research, and not to a specific individual investigator. Throughout my analysis in the chapters that follow, quotes in ‘single quotation marks’ are indirect quotations, being either common terms used by investigators or comments that were not recorded verbatim in my fieldnote or interview transcripts (e.g. Emerson, Fretz and Shaw, 1995). To provide further anonymity to the investigators and the organisations involved in this research, a range of technical details and names have been altered or disguised in all of the examples, vignettes and incidents presented.

A reasonable question at this juncture might be – why airline flight safety investigators? There are a number of reasons. Airlines represent one of the most technologically advanced and one of the least forgiving operational environments that exist. But they are also extraordinarily safe. This is in large part due to a well-developed infrastructure of safety oversight that spans regulation, design, manufacture and operation. It is also because so much effort is put into analysing and learning from failures. Accident investigation has been formally conducted for over a century and incident analysis has been deeply established in aviation for decades. Flight safety investigators have been at the forefront of these movements. Investigators represent a long tradition of safety management and a well-established professional community. Yet there is also surprisingly little wider understanding of the practices and the practical work of flight safety investigators. This is despite airlines having become something of a touchstone in the world of safety and reliability. Aviation is commonly held up as an exemplary case, and models and

metaphors from airline flight safety are being increasingly and widely applied in other industries. Many of those models and metaphors are unfortunately rather fragile: they are not always built on a deep or rigorous understanding of the practical work and the cognitive, social and organisational processes that contribute to the extraordinary levels of safety that the passenger air transport system routinely achieves. A better grounded understanding of flight safety management therefore seems important, both to explain this challenging arena of risk management and as a route to producing better theories and exemplars for other areas of industrial life.

Ultimately, this book is about a small number of airlines and the role of one particular type of risk manager that works within them. But the reach and implications are much broader. This book is about the practical work of managing risk in complex, challenging and dynamic organisations, where the opportunities for failure are manifold, the consequences of accidents are extremely costly but the actual incidence of adverse outcomes is surprisingly low. The work of risk management is always unique and specific to the context it operates in. But many of the underlying principles, approaches and practices of interpreting risk and improving safety described here are relevant to many other risk management domains, from hospitals to oil rigs to trading floors. So while this book is about airlines and airline flight safety investigators, the implications and aspirations reach beyond the specifics of the airline industry: this analysis aims to help make sense of the practical work that is involved in managing risk and improving safety in all complex, dynamic and unforgiving organisational settings.

## **Bracketing the problem**

The work of flight safety investigators represents the sharp end of risk management. Investigators are responsible for monitoring, analysing and interpreting reports of flight safety incidents to identify any emerging risks, as well as overseeing and organising any required investigation and improvement activities to address those risks. This work brings many of the most pressing challenges of risk management into sharp relief. In particular, this work raises three important sets of questions that have implications and relevance to both the theory and practice of risk management.

First is perhaps the most fundamental issue of all. What is risk management trying to achieve? What does safety look like in organisational settings where errors occur frequently, risks are potentially catastrophic,

systems are complex, but adverse outcomes are relatively rare? The meaning of safety is both deeply problematic and deeply consequential in practice. How safety is understood determines how risks are analysed and managed. Practical theories of safety provide idealised benchmarks against which safety is judged and risks are assessed. How investigators understand safety, and how those understandings influence their assessments of risk, are deeply consequential and complicated questions.

Second, how are weak signals of threat and the early signs of emerging risks first identified? How do investigators interpret and bracket indications of potential problems? Managing risks and improving safety depends on first recognising that a risk might exist. What do the formative and earliest moments of risk identification look like, and what analytical strategies and interpretive tactics are used to identify those early signs of potential risks? Identifying new and emerging risks is a critical element of risk management, and is a key purpose of incident reporting programmes more broadly. In a complex, messy and noisy world, distinguishing signal from noise and uncovering the early signs of risk are some of the most pressing challenges in risk management.

Third, how is new knowledge produced and change effected in response to operational incidents and disruptions? How is safety improved? Investigators are responsible not just for assessment and analysis, but for coordinating improvement and overseeing changes to practise throughout an organisation. Yet, as is the case for most safety oversight functions, they are independent and removed from operational activities. They work at a distance. How, then, do they influence and drive change with no executive capacity? How do they determine what changes are needed and where to focus resources? And how do they ensure resources are organised to deliver improvements? These are persistent challenges in all of risk management and issues that need to be negotiated by all risk managers.

Investigators confront these questions afresh each day. How they answer them in practice is centrally important both to our understanding of risk management and safety improvement, and to our efforts to support and improve risk management itself. As such, this book engages with these three core issues. How is organisational safety understood and analysed in practice? How are early signals of risk identified and interpreted? And how are errors and incidents used to drive improvement, shape culture and improve practice? At core is the question of how close calls and safety incidents are used by risk managers to understand safety, produce knowledge and improve practice in complex sociotechnical systems – and what the particular practices of flight

safety investigators can reveal for current theories and models of risk management.

## **Organisations, risk and knowledge**

This book is about the practical work of managing risk: what it looks like, why it takes certain forms and how it can be improved. It is also a book about the practical work involved in overseeing and improving safety in complex systems. And it is a book about how experts think about safety, analyse error and interpret and respond to weak signals of risk. The focus is on describing and explaining the practical work of flight safety investigators, to understand the cultural practices of this professional group and the key characteristics of their approach to risk analysis and safety management. The point is not only to describe these practices, important though that is. The purpose is also to contribute to our theoretical understanding of risk management and the practical theories that underpin it: to produce new conceptual insights and in so doing elaborate, challenge and extend existing theories of safety and risk. And theories there are aplenty.

At first blush the range of ideas and theories that have been advanced to explain risk management, safety improvement and resilience in organisations is quite startling. The field of risk management has undergone something of an explosion (Hutter, 2001; Power, 2007). Issues that were once the preserve of niche academic sub-disciplines are now mainstream issues in both academic and popular discourse. Risk, complexity, resilience, failure, ignorance: popular as well as professional attention has seen a dramatic turn to these issues in recent years (e.g. Sheffi, 2005; Harford, 2011; Zolli and Healy, 2012; Hutter and Power, 2005), on top of the work of an already packed landscape of regulators, standard setters, government agencies, professional bodies and advisors all seeking to define and impose a variety of risk and safety management models.

Despite this cacophony of voices, two strong undercurrents run through the dominant ideas and discourses of risk management. One is a deep assumption embedded in many of these ideas. The other is a broad theme that characterises and frames many debates in this field. The deep – and often hidden – assumption is that social and technological systems always exist in a degraded and imperfect state, and that much of the work of risk management is therefore a continual process of uncovering and dealing with the errors, imperfections and surprises inherent to the sociotechnical systems that we create. Safety is an ongoing process: “a dynamic non-event” (Weick, 1987, p. 118) that requires

ongoing effort, invention and adaptation to produce a seemingly stable non-outcome – where bad things constantly don't happen. Entropy and ignorance are continual sources of organisational risk, and safety must be actively managed and “continuously reaccomplished” (Wildavsky, 1988, p. 209) in the face of changing and unknown risks and the gradual degradation of systems. Or, to put it more bluntly, “Risk management, like life, is ‘one damn thing after another’” (Reason, 1997, p. 36). This assumption underpins and informs a broad theme that runs through much of this field: that the most fundamental challenges of risk management arise from the complex and problematic relationship between knowledge and practice in complex sociotechnical systems. How do organisations remain cognisant of the risks they are responsible for both manufacturing and managing? How do we generate effective knowledge of risks? And how can practice be informed and improved by that knowledge?

Both this deep assumption and this broader theme run throughout many of the dominant theories of organisational accidents and socio-technical failure. They also animate and frame many explorations of the social and organisational sources of safety. These issues can be seen in the original work on accidents and disasters that has shaped this field, and they resonate in current debates on the nature of safety, resilience and improvement. They also define and delineate the core concerns of this book.

### **Organisational risk**

Much of our knowledge of risk and safety is derived from the analysis of past accidents and failures. A variety of theories have been developed to explain the causes of accidents and the organisational sources of risk. Each provides a different image of organisational failure and focuses on different aspects of organisational life: activity and error, knowledge and ignorance, and values and deviance. Or, perhaps more pithily, the unintended, the unexpected and the unaccepted. Taken individually, each of these provides a partial theory of organising and its inherent risks. Taken together, they offer a rich conceptualisation of how risks and accidents are generated in complex sociotechnical systems – and specify the malign forces arraigned against those tasked with managing risk and improving safety.

Perhaps the most popular and widespread theory of organisational accidents – amongst practitioners working in the field, at least – focuses on the activity of humans in their organisational context and how both those activities and that context can go awry. Led by Reason's (1990,

1995, 1997) influential work, in this view organisational risks have two primary sources. The first is human error, or 'active failures': human actions gone wrong. The notion of error "is intimately bound up with the notion of intention" (Reason, 1990, p. 17). Errors are deviations or departures from intended actions and are viewed as an inevitable feature of human action. They must be managed by efforts to address error-provoking local conditions, such as poorly designed equipment. And they must be protected against by creating organisational mechanisms that can catch and contain errors when they do occur. These mechanisms are the second defining feature of Reason's model: the safety defence or barrier that represents any aspect of an organisation that is intended to deal with errors or other threats to operational safety.

Organisations can be conceived as being designed with numerous layers of diverse defences – 'defences in depth' – that protect against individual errors and failures. The defences take the form of, for instance, procedures, supervision, training or simply physical protections. Of course, it is fallible humans who design, maintain, operate and manage these defences, and therefore defences are always partial and incomplete. Holes in safety defences, or 'latent conditions', are "an inevitable part of organisational life" (Reason, 1997, p. 11), and can lie dormant and undiscovered in an organisation until they interact with some set of unsafe acts, at which point the defence is breached. Slices of Swiss cheese, full of holes, provide the common image for this model – and if enough holes line up, a sequence of errors can breach all the defences and cause a catastrophic accident. But defences are a double-edged sword. Introducing new defences – such as a new protocol or a checklist – adds complexity and opacity to a system. It becomes harder to understand the interactions that can occur between errors and defences, introduces new opportunities for error and makes it harder to identify where errors are occurring, as they may be being compensated for by multiple defences. Organisational risks are therefore produced through an "insidious build-up of latent conditions" (Reason, 1997, p. 8), and these hidden defensive weaknesses threaten to combine with active failures to bring about catastrophic accidents.

Swiss cheese is a common item on the menu when safety professionals meet, and the principles and tools developed by Reason and his colleagues have proved popular and productive in practice (e.g. Maurino et al., 1997; Australian Transport Safety Bureau, 2004; Vincent et al., 2000). The problematic relationship between risk, practice and knowledge is at the heart of this theory of organisational accidents, though how or why latent conditions become – or remain – latent is relatively

unexplored. We must look to other theories for those explanations. Themes of organisational complexity and hidden interactions are also central to Perrow's (1984, 1999) thesis of normal accidents. While Reason argues that active failures and latent conditions are inevitable in organisations, Perrow argues that accidents themselves are inevitable, or normal, in certain types of organisation, namely those in which operational activities are both highly complex – and therefore hard to comprehend – and tightly coupled, where failures in one area can quickly propagate to others. Perrow's analytical focus is on the structure of sociotechnical systems rather than the social processes that produce them, but the underlying implications are clear. Accidents can be incomprehensible, unpredictable and appear 'impossible', particularly to the managers and operators working on the organisational front-line (Sagan, 1995; Wagenaar and Groeneweg, 1987). And the designers and regulators of complex systems face deep and persistent epistemic challenges in their efforts to monitor, understand and assure safety (Downer, 2009). In some form or other, accidents are therefore impossible to eradicate.

A broader body of work attempts to explain the social, cultural and organisational processes through which signs of threats and risks are misunderstood or entirely missed by people and through which pockets of organisational ignorance can emerge and persist. The work of Barry Turner (1976a, 1978) was both seminal (Weick, 1998a) and eloquent. It has been developed and drawn on by a range of organisational scholars (e.g. Weick and Sutcliffe, 2001; Hopkins, 1999, 2000, 2005; Vaughan, 1996, 2005; Pidgeon, 1991, 1997; Turner and Pidgeon, 1997; Smithson, 1990). Turner adopted an explicitly cultural approach, and viewed organisations as systems of shared beliefs and collective assumptions that influence what information is attended to and how it is interpreted and communicated – and importantly, what is overlooked and ignored. Organisational cultures are not monolithic, and organisations are populated by numerous sub- or "micro-cultures" (Turner, 1971, p. 2) based on locally distinct patterns of knowledge (Turner and Pidgeon, 1997). Communication between these different organisational groups or "silos" (Hopkins, 2005, p. 41) can be problematic, resulting in different interpretations of the same situation emerging: the "variable disjunction of information" (Turner and Pidgeon, 1997, p. 40).

Organisational risks can both arise from and be perpetuated by unevenly distributed knowledge, partial communication and assumptions that blinker and limit perception. Turner describes how, over time, events and circumstances that are discrepant with peoples' currently held knowledge and beliefs can accumulate in organisations. This insidious process

of incubation sees the gradual build-up of organisational conditions and practices that are at odds with current knowledge: a sprawling “incubation network” (Turner and Pidgeon, 1997, p. 74) of discrepant and misunderstood or hidden problems that are at odds with the current collectively held picture of the world. Simply put, this represents “the management system losing touch with its operational realities” (Turner, 1994, p. 216). If uninterrupted, this incubation network gradually develops into disaster, when an initiating or “precipitating incident produces a transformation, revealing the latent structure of the events of the incubation period” (Turner and Pidgeon, 1997, p. 75). Disasters arrive with considerable surprise along with a “cultural collapse” (Turner and Pidgeon, 1997, p. 72), as the limits of the previously held norms, assumptions and beliefs are laid bare. As such, accidents are defined culturally – as a catastrophic breakdown in the collectively held knowledge of risk.

How does such a situation develop? Through “false assumptions, poor communications, cultural lag, and misplaced optimism” (Turner, 1976a, p. 395) that produce a “collective ignorance” (Turner and Pidgeon, 1997, p. 116) or “collective neglect” (Turner, 1976a, p. 385) of risks. These processes have been reframed as cultural mechanisms of risk-blindness and risk-denial, that prevent risks being noticed or fully appreciated (Hopkins, 2005, p. 61). They underpin the emergence of a mismatch between how organisational practices are understood and the way they actually are. ‘Practical drift’ can see local work activities evolve away from established ways of working, leaving gaps in the way people do and understand things in different areas of an organisation (Snook, 2000; Snook and Connor, 2005). Organisational practices can ‘migrate’ away from the originally specified and designed ways of doing things, and move towards – and sometimes beyond – the limits of safe performance (Rasmussen, 1997; Amalberti et al., 2006). Dianne Vaughan (1996) explains the social processes through which accepted norms and boundaries of safety can gradually shift over time: events that were once considered deviant gradually and incrementally come to be seen as normal. This normalisation of deviance progresses simply and subtly, by groups “redefining evidence that deviated from an acceptable standard so that it became the standard” itself (Vaughan, 1996, p. 65) – typically because people don’t appreciate or understand the full implications of that evidence.

At the heart of these cultural theories is the idea of ignorance and the deep problems associated with generating effective knowledge about organisational technologies, practices and associated risks (e.g. Smithson, 1989, 1990; Weick, Sutcliffe and Obstfeld, 1999;

Weick, 1998b; Pidgeon, 1998; Downer, 2011). Ignorance is primarily a social creation (Smithson, 1990, p. 208), and efforts to understanding the sources of organisational risk are in many ways efforts to understand the organisational sources of ignorance. The catch, of course, is that ignorance is inherent to social organisation. Organisations are based on presumptions of selective ignorance and limited attention (Turner, 1971; Weick, 1998a): with the division of labour comes specialisation, expertise and the variable distribution of knowledge – and ignorance. The challenge in risk management practice is to differentiate between those things that can be safely ignored and those that must be attended to, and to develop practices that can identify, uncover and smoke out ignorance.

### **Sources of safety**

Safety is a troublesome notion. Traditionally it has been associated with the avoidance of harm. A solid granite sign stands outside the headquarters of the UK's Civil Aviation Authority Safety Regulation Group at Gatwick airport. It reads, 'Safety is no accident'. This is true, in both senses. But it is only part of the picture. The absence of harm, or the avoidance of accidents, is a necessary but not sufficient signifier of safety (Braithwaite, 2001). Few would claim that the occupants of that jumbo jet were safe purely because it didn't hit a hotel and they came to no harm. Adverse or harmful outcomes point to the absence of safety, but the avoidance of harm does not equate directly with a state of safety. There is a deep asymmetry of meaning here that underlies many of the analytical and interpretive challenges in this area: "while high accident rates may reasonably be taken as indicative of a bad safety state, low asymptotic rates do not necessarily signal a good one" (Reason, 2000, p. 6). Our knowledge of what contributes to safety, what a safe organisation looks like and what characterises effective risk management is therefore coloured with ambiguity. This is because it is hard to determine how effective organisational risk management is when its ultimate achievements are things that do not happen. Nonetheless, we must try – and many have.

A wide range of theory has been developed to explain the organisational sources and characteristics of safety. All of these are open to the legitimate challenge that you cannot prove a negative: that it is not possible to establish that these characteristics and processes will prevent accidents. But the ambitions of many of these theorists are often more nuanced. Much of the theory seeks to describe practices observed in organisations that operate under very trying conditions, facing high-tempo, complex,

uncertain and risky situations and organising themselves accordingly. Other frameworks have been developed that aim to define the strategies and deep principles that appear to underlie effective safety management – based both on organisational practices that appear effective at responding to and addressing risks, and by holding up a mirror to our theories of organisational accidents. Two broad schools of thought frame thinking in this area, and each represents an idealised approach to dealing with the challenges of managing knowledge, practice and risk in organisations. These strategies are resilience and anticipation.

Originally delineated as risk management strategies by Wildavsky (1988), and recently experiencing a surge of interest, these strategies and their implications are being energetically explored in theory and practice (Hood and Jones, 1996; Royal Society, 1992; Weick, Sutcliffe and Obstfeld, 1999; Collingridge, 1996; Comfort, Boin and Demchak, 2010; Hollnagel et al., 2006, 2008, 2011). The strategy of anticipation aims at the prediction and, literally, anticipation of risks, and is based on preventative action taken to stop adverse events from occurring. This is summed up, for instance, in Hollnagel's (2004, p. 185) assertion that "in order to prevent incidents and accidents it is necessary to predict them". Resilience, in contrast, aims for a flexible and adaptive capacity to respond to, cope with and learn from adverse events and to develop an ability to deal with an unknown future. Resilience does not require prediction because, as Hopkins (2001, p. 67) argues, "it is not necessary to predict the precise trajectory of an accident in order to be able to prevent it". So, while normative risk analysis methods and guidelines are based on anticipatory, predictive methods, organisational and cultural theories of safety have latterly focused on ways of achieving resilience.

A huge number of standards, guidelines, frameworks and methods have been produced to prescribe how formal risk and safety management systems should be designed and operated. These are typically described in a profusion of flow charts. At base, risk and safety management systems provide formalised organisational structures and processes for thinking about, predicting, communicating and addressing risks. They have been conceptualised in numerous ways (e.g. Cox and Tait, 1991; Koorneef and Hale, 1997; Hale, Wilpert and Freitag, 1998). Normative frameworks prescribe a series of analytic steps through which risks are predicted and actions chosen. Risk management is treated as decision-making: "acceptable-risk problems are decision problems; that is, they require a choice among alternative courses of action" (Fischhoff et al., 1981, p. 2).

Terminology and detail, again, differ widely across different models (e.g. Royal Society, 1992; Interdepartmental Liaison Group on Risk

Assessment, 1996; Cabinet Office, 2002; British Standards Institute, 1996; Standards Australia, 1999; Health and Safety Executive, 2001; Institute of Risk Management, 2002; National Infrastructure Protection Centre, 2002), but there are three essential steps in all these frameworks. First, the threats faced by an organisation and their possible consequences are identified and catalogued. Second, risk levels are calculated for each threat by assessing the likelihood and the severity of the harmful consequences or outcomes that might result. Third, these risk levels are compared to a predetermined criteria or level of acceptability, and unacceptable risks are selected for action or 'treatment'. The process is then to be repeated as an ongoing cycle.

The key challenges here arise from the assumptions embedded in these normative and anticipatory models in relation to organisational knowledge and practice. Risk management is treated primarily as a 'decision problem'. As such, acquiring knowledge of risks is considered largely unproblematic, as is translating this knowledge into practical organisational improvements; the challenge is measuring risks and deciding which to address. In contrast, in the organisational and cultural theories of safety discussed shortly, knowledge of risk is considered deeply problematic: the emphasis is firmly on how organisations can find out about risks, address gaps in their knowledge and use that knowledge to improve practice. This distinction is perhaps best summed up as between normative models that aim to 'predict and decide' and more cultural and organisational theories that focus on how to 'diagnose and learn' about safety and risk.

Current organisational theories typically focus on the cultural practices that support safety. A growing body of work examines the social processes and cultural characteristics of organisations that tend to achieve high levels of reliability in complex and hazardous operations, such as nuclear aircraft carriers and nuclear power plants (e.g. Roberts, Rousseau and La Porte, 1994; Rochlin, 1989, 1996; La Porte, 1994; Rijpma, 1997, 2003; Roberts, 1990, 1993). One of the defining characteristics of these organisations is how they monitor for disruptions and surprises and then rapidly organise resources to analyse and address them. In this way, high-reliability organisations (HRO) achieve reliable operational outcomes through continual adaptation to and correction of deviations and disruptions as they occur (Weick, 1987). Underpinning this are diverse social practices for communicating about what is going on, checking and cross-checking performance, and monitoring for problems or deviations from normal operations (Rochlin, 1989). When anomalies are identified, informal networks of experts form around them – 'experiential

epistemic networks” (Rochlin, 1989, p. 169) that temporarily transcend formal authority structures and put those with the most experience in charge of resolving a problem, rather than those with the highest rank.

High-reliability depends both on dealing with errors and problems when they are still small, and on developing alternative means to trial-and-error learning. HROs are “coloured by efforts to engage in trials without errors, lest the next error be the last trial” (La Porte and Consolini, 1991, p. 20). These efforts include story telling, fostering diverse perspectives, mental simulation, imagination and learning vicariously from other organisations (Weick, 1987, 1989; Schulman, 1993; Pidgeon and O’Leary, 1994; Pidgeon, 1998). HROs aim to avoid the illusion that no bad events occurring means that there is nothing more to know, and instead aim to foster a “chronic suspicion that small deviations may enlarge” (Weick, 1987, p. 18). These observations share much with the core tenets of resilience, which Wildavsky (1988, p. 93) argues is a process of “interrogating the unknown” through a process of trial and error and which offers “a discovery process that discloses latent errors so we can learn how to deal with them . . . Trial and error samples the world of as yet unknown risks” (Wildavsky, 1988, p. 37). Analysis of errors and surprising events should be collective, “variegated – decentralised, participatory” (Wildavsky, 1988, p. 93), to provide different perspectives on the meaning of errors and to facilitate learning. These decentralised processes of trial and error are, when viewed in practice, considered to be based on the improvisational, inventive – and at times messy and chaotic – activities of groups and networks that respond in the face of failures (Boin and van Eeten, 2013).

To counter gaps in knowledge caused by specialisation, personnel in HROs are expected to be both specialists and generalists. Specialist knowledge is required, due to the complex technologies involved. But this tends to be tempered by generalist knowledge, as so much interdependent action is necessary in complex organisations (Roberts, 1990). The social interrelating that takes place within and between groups of professionals in HROs has been characterised as heedful and attentive: activities through which individuals work to understand, represent and adapt to the activity of others, contributing to the formation of a “collective mind” (Weick and Roberts, 1993, p. 364). Ultimately, many of the social processes in HROs appear designed to reduce opportunities for ignorance and avoid “thoughtless action or mindlessness” (Schulman, 1993, p. 367). These insights have been integrated into a set of principles of “collective mindfulness” (Weick, Sutcliffe and Obstfeld, 1999; Weick and Sutcliffe, 2001) that aim to conceptualise how organisations can

work to notice problems early and then “enlarge what is known about what was noticed” (Weick, Sutcliffe and Obstfeld, 1999, p. 91). The core objective of mindful organising is to find and deal with unexpected problems by focusing on small moments of surprise. That is, to use surprising and unexpected events to identify where currently held expectations are wrong or flawed (Weick and Sutcliffe, 2001).

Five idealised social-cognitive processes are proposed to support safety and define the principles of collective mindfulness that maintain organisational knowledge and continually improve practice. First is a preoccupation with organisational failures, errors and near-misses. Small failures are generalised to the organisation as a whole, and so people “treat any lapse as a symptom that something is wrong with the system” (Weick and Sutcliffe, 2001, p. 10). Second is a reluctance to simplify interpretations regarding how the organisation operates. People aim to create “more complete and nuanced pictures” of the organisation (Weick and Sutcliffe, 2001, p. 11). Schulman (1993, p. 364) calls this “conceptual slack . . . a divergence in analytical perspectives among members of an organisation”. The third principle is sensitivity to operations. People in all areas and levels of the organisation are “attentive to the front line, where the real work gets done” (Weick and Sutcliffe, 2001, p. 13). They are less interested in broad abstractions and more interested in “details and particulars” (Weick, 2001a, p. S74). Fourth is a commitment to resilience. HROs depend on organisational processes that can respond to and bounce back from error, as well as prevent it in the first place: “the signature of an HRO is not that it is error-free, but that errors don’t disable it” (Weick and Sutcliffe, 2001, p. 14). And fifth is an under-specification of organisational structure and deference to expertise. Specialist knowledge and experience takes precedence over hierarchy in problem solving: “authority migrates to the people with the most expertise, regardless of rank” (Weick and Sutcliffe, 2001, p. 16).

The idea of continually reorganising knowledge and practice around unexpected events has a long history. The basis of this approach was present, in all but name, in Turner’s (1976a, 1978) original work on disasters as cultural collapse. He detailed how, following disaster, organisations go through a period of “cultural readjustment” (Turner and Pidgeon, 1997, p. 83) – literally “the restructuring of understanding” (Turner and Pidgeon, 1997, p. 130) – during which time beliefs about risks and ways of acting are revised in light of experience. Turner’s theory was about major disasters, but he proposed that similar mechanisms of cultural readjustment might be possible as a means to avoid catastrophe, by learning from minor disruptions. This could be achieved, he argued, not

by considering incidents in terms of the severity of their consequences “but according to their unexpectedness in the view of prevailing institutionally accepted models of the world” (Turner, 1976b, p. IX 26). That is, learning and cultural change could be provoked by cultural disruption alone – materially adverse outcomes were sufficient, but not necessary.

Similar ideas are found in more contemporary perspectives on safety culture. In Reason’s (1997, 1998) conception, “a safe culture is an informed culture, one that knows continually where the ‘edge’ is without necessarily having to fall over it” (Reason, 2000, p. 3) – the edge in question being between relative safety and unacceptable risk. The emphasis in this definition is on the knowing. Informed cultures are ones in which personnel “have current knowledge” (Reason, 1997, p. 195) about the determinants of organisational safety “and then translate this knowledge into enhanced resistance” (Reason, 1997, p. 116) to threats. In this view, the key is not to try and prevent latent conditions arising – an impossible task – but to identify them and “make them visible” (Reason, 1997, p. 36) so they can be addressed. Developing an informed culture depends on diagnosing organisational weaknesses in order to direct attention and improvement efforts into those areas. Ideally, identifying new risks requires creatively using information and imaginatively thinking through different scenarios that may arise from minor incidents (Pidgeon and O’Leary, 1994; O’Leary and Chappell, 1996) and maintaining “an openness that views every facet of an incident as a potential warning to some as yet unappreciated hazard” (Pidgeon, 1988, p. 362).

These observations and principles paint a rich and compelling picture of the cultural and organisational sources of safety, and attempt to grapple with the deep challenges of producing knowledge about risk and using that knowledge to improve practice. But these theories are not without their problems. These problems largely emerge when considering how these principles can be operationalised in specific practical contexts. Foremost amongst these are defining exactly what a highly reliable or collectively mindful organisation is and establishing that these processes do, in fact, underpin safe performance. Some of the proposed processes of safety even seem close to the processes implicated in analyses of major accidents – what is termed here the ‘reluctance to simplify’, or ‘conceptual slack’, sounds like the disjunction of information (Turner, 1978) and the conditions underlying the collapse of sensemaking (Weick, 1993a; Carroll, 1998).

Further, a degree of confusion persists around the concept of error and its relationship to knowledge production and organisational safety.

Learning from errors is commonly conceived as a primary source of safety and resilience (e.g. Weick and Sutcliffe, 2001), as Wildavsky (1988) holds. For instance, Rochlin (1989, p. 164) notes that “many of the organizational strategies we observed were designed in response to previous serious accidents”. But at the same time, it is commonly argued that, in HROs, risks “must be mastered by means other than trial-and-error learning, since in many cases the first error will also be the last trial” (Weick and Sutcliffe, 2001, p. 21). Similarly, researchers in this area often describe and prescribe that people always fear and imagine the worst from every small error. But in practice, this is intractable, and is a central criticism of anticipatory approaches to risk management. As, while “the human imagination can concoct infinite modes of destruction” (Wildavsky, 1988, p. 92), resources are not available to address them all, and may be expended on imagined risks that never materialise. Wildavsky (1988, p. 6) calls these the risks that result from “unconsequent anticipations”; Turner calls it the “decoy problem” (Turner and Pidgeon, 1997, p. 48).

The problematic relationship between organisational knowledge and organisational practice defines many of the most fundamental issues in managing risk and improving safety – both in the many theories that have been developed to explain risk and safety and in daily organisational practice. While theorists work to explain how organisations can become aware of and remain cognisant of risks, how current and effective knowledge of risks can be generated and how that knowledge can then inform and shape organisational practices, those working at the sharp end of risk management must confront and resolve those challenges every day.

### **A bird's eye view**

At the heart of this book is a theoretical account of the cultural practices, collective assumptions, shared concepts and practical theories that structure and underpin the risk management practices of airline flight safety investigators. The next chapter, Chapter 2, sets the scene. A series of short but detailed vignettes are presented to capture the richness and complexities of investigators' practical work in airline flight safety oversight. The broader processes and challenges of managing risks in airlines are then described, along with a detailed account of the organisational systems and types of work that underpin analysing and learning from incidents. The focus here is heavily on the particularities of airlines and flight safety, but the types of work that investigators engage in are equally representative of safety oversight activities in many other

industries. The next five chapters then develop a theoretical account of investigators' work, presenting an empirically rich description of the cultural practices of this professional community. Each chapter examines a different aspect of risk management practice and presents an explanation and exemplification of one element of flight safety investigators' work. Each of these chapters, and each of these explanations, relates to and builds on the others. Readers can dip into each of these chapters depending on their interest, but those who take in the whole book will find a more cohesive, multifaceted and integrated view of the work of risk management than is offered by the single analytical focus of each individual chapter.

Chapter 3 characterises the key features of investigators' understandings of safety and risk: their interpretive framework or collectively held 'theory in practice' of organisational safety. In this chapter I explore and explain the practical theories and ideas used by flight safety investigators to understand safety and assess risk, along with the deep assumptions and concepts that underpin these. Examining these practical theories reveals how organisational safety is defined by investigators working in inherently hazardous, complex and unpredictable domains. Chapter 4 continues this analysis, and explores the organisational attributes and characteristics that are used by investigators to assess and analyse risk. This chapter focuses on the organisational components of safety that are routinely attended to and assessed by investigators, and reveals the conceptual structures that support the practical work of risk analysis. An idea that is central to investigators' practical theories of safety is resilience, and the analytical work of investigators reveals a complex and nuanced understanding of organisational safety that reframes traditional notions of both risk and resilience.

Chapters 5 and 6 characterise the approach that investigators take to monitoring and overseeing safety, and the interpretive tactics that they employ to identify risks. These two chapters examine how investigators' deep assumptions about their own fallibility and ignorance shape their practices of risk identification. In Chapter 5, I explain the aspirations and ideals of safety oversight that drive investigators' work and the risks that they face in this work. Investigators aim to remain continually vigilant to weak signs of emerging risks, to adopt a bird's eye view of safety and to produce an integrated picture of risk. And, they expect to fail. In Chapter 6 I examine the subtle and creative interpretive processes through which signs of potential risks are pieced together and through which investigators work to identify new and previously unrecognised risks. Investigators attempt to actively construct gaps

in knowledge – that is, they work to actively create ignorance – and use incidents to interrogate, test and challenge current understandings of safety in an effort to uncover latent risks.

Chapter 7 characterises how investigators work to address and manage risks and how they judge where those efforts are best focused. I analyse how investigators aim to coordinate and organise safety improvement and shape organisational culture. Given that safety investigators, like all risk managers, typically have limited authority to mandate or enforce action, this chapter analyses the alternative ways that investigators work to influence, shape and improve safety. These include framing questions, circulating warnings and holding people to account for safety improvements. Given that risks often span several departments – or even several organisations – this chapter also considers how investigators work to bring together widely distributed networks of specialists to reflect on and participate in the analysis and management of risks.

To conclude, Chapter 8 draws together the different strands of investigators' work and considers the key implications for our current theories of safety and risk. This discussion considers how investigators use operational incidents to first identify gaps in their own and their organisation's collective knowledge of risk, then construct and circulate warnings that disrupt currently accepted beliefs about safety, and ultimately use those moments of symbolic disruption as a focal point for organising improvement and coordinating reflection and change. Investigators are involved in the manufacture, as much as the analysis, of close calls and near-misses. They use minor operational incidents to demonstrate how the organisation came close to something it should desperately seek to avoid, and they use those disruptions to organise and enact resilience. This book argues that, when viewed from the sharp-end, organisational practices of risk management can be explained through the enactment of three core processes: resilience, vigilance and participation. Each of these three processes needs to be properly considered in the design and operation of any risk management system – and particularly those dealing with complex, consequential and potentially catastrophic risks such as airlines.

# Index

- Ability 91–93  
 Accidents 12, 13, 14, 15, 26, 41, 59,  
 60, 61, 112, 123–4, 129, 154–5  
 Adaptation 12, 18, 194, 198, 206,  
 211, 213–14  
 Air Traffic Control 44, 46, 47, 68, 70,  
 78, 81, 107, 113, 124, 189, 200  
 Aircraft Maintenance Manual 36,  
 42, 101  
 Anticipation 17, 22, 198, 211  
 Assumptions 7, 14–5, 22–3, 58–9,  
 60, 61, 63, 65–7, 114–15, 128,  
 142, 146–7, 202–4, 206–8  
 Attention, direction of 87, 95, 98,  
 101, 115, 134, 140, 146, 166, 193,  
 199, 206  
 Audit 35, 43, 117, 129, 158, 179, 181  
 Awareness 90, 94–5, 109, 122–3,  
 135, 142–3, 146–47, 173–5  
  
 Barriers 13, 68–9, 79, 80, 198  
 Beliefs 58, 60, 65, 115, 134, 146–7,  
 185, 195, 203  
 Biases 141, 144, 175  
 Big picture 87, 116, 152–3, 156–7  
  
 Catastrophic thinking 61  
 Change, organisational 21, 129, 132,  
 166–7, 183, 185, 205–7, 212–13  
 Checklist 13, 54, 88, 100, 111–13,  
 174  
 Collective mindfulness 19, 20, 222  
 Communication 14–5, 33, 68, 74,  
 90, 96–7, 102, 147, 175,  
 Complexity 14, 25–6, 40, 73,  
 129–30  
 Conceptual slack 20, 21  
 Connections, drawing of 51, 76, 117,  
 124, 149–50, 155, 157, 202, 205  
 Context 5, 108, 119–20, 127–8, 150  
 Cultural collapse 15, 20, 21  
 Cultural readjustment 20, 185, 194,  
 206  
  
 Defences 13, 58–9, 68–70, 71, 72–3,  
 77, 80, 196–8  
 Disaster 12, 15, 20, 83–4, 203, 212  
 Disjunction 14, 21, 134, 150, 161–2  
 Doubt 97, 138–9, 148, 149–50, 156,  
 163, 202–4  
 Drift 15, 198  
  
 Emerging risks 114, 118, 138, 149,  
 163  
 Enactment 24, 177  
 Epistemic, networks 19  
     Challenges and risks 128, 138, 202  
     Work 193–94, 205–8  
 ETOPS 66–7  
 Evaluation 186–87  
  
 Flight Data Monitoring 30, 44, 46  
  
 GPWS 71–3, 78, 84  
  
 High reliability 18–19, 181, 203,  
 208, 210–11  
 Humility 138, 140, 143–44  
  
 Ignorance, organisational 12, 14–16,  
 130, 137, 139–40, 144–6, 201–5  
     Use of 24, 145–6, 149–50, 162,  
     164, 174, 176, 188, 194–6,  
     201–5  
 Imagination 19, 22, 65  
 Incubation 15  
 Integration 45, 53, 71–2, 116–17,  
 178, 205, 209–10, 213  
 Integrative performance 72, 198  
 Interpretive slippage 128, 133,  
 135–6, 140  
 Interpretive vigilance 115, 128,  
 138–40, 149, 194–5  
 Intolerable 133–4, 187, 207  
  
 Knowledge production 21, 130, 200,  
 204

224 *Index*

- Latent risks 19, 21, 24, 84, 115,  
128–30, 149–50, 161, 202–3
- Learning, organisational 21, 22, 133,  
183, 184–5, 187–8, 193–5, 206–8,  
211, 213
- Margin 53, 91, 102–4, 200, 204
- Minimum Equipment List 62
- Mismatch 15, 101–2, 139, 161–3,  
198
- Narratives 123–4, 126, 128, 205–6,  
208, 210
- Neglect 5, 15
- Normal accidents 14, 15
- Normal error 62–3, 148, 209
- Normalisation of deviance 12, 15
- Norms 15, 96, 197
- Novelty 6, 157–9, 161, 202
- Outcomes 9, 16, 18, 21, 50, 57–9,  
60–2, 66, 79–80, 84–6, 187,  
199–201, 204–5, 206
- Participative networks 166, 184,  
195, 215
- Pattern making 139, 150, 153, 157,  
202–3
- Pattern matching 150, 153
- Potential catastrophe 58–60, 64–7,  
74–6, 83–5, 111, 113, 212
- Practical theory 8, 50, 57–9, 68,  
74–7, 84, 88–9, 139, 196, 214
- Pragmatism 167–8
- Prediction 17, 57, 65–7, 83–6, 187
- Probability 49, 66, 204
- Professional community 2, 8, 23,  
60
- Professional pessimism 65, 144,  
177
- Questions, use of 52, 54, 121, 124,  
145–6, 148, 163, 166, 172–4,  
176–7, 180–181, 184, 208
- Reality, operational 76, 128, 134,  
136, 210
- Risk communication 15, 178, 207
- Risk resilience 76–7, 84, 104–13,  
187–8, 194–6, 198, 207–8, 210–14
- Safety value 166, 186–9, 195, 208
- Shared representation 5, 140
- Scepticism 138, 140–1, 143–4, 202
- Specification 91, 99–102, 198, 201
- Stories 6, 116, 123–6, 126, 128, 205
- Surprise 6, 11, 15, 18, 20, 70, 115,  
125, 133–5, 137, 146, 210–203
- Suspicious 3, 19, 139–40, 145–7,  
149–53, 162–4, 170, 174–6, 203
- Swiss cheese 13, 198
- Taipei 83, 154
- TCAS 71, 78, 94, 152
- Tenerife xiv, 82, 123, 154
- Trial and error 19, 22, 211
- Uncertainty 193, 201–2, 204
- Unease 140, 144, 149, 157, 202–3
- Verification 91, 98–9
- Vicarious experience 19, 123
- Vigilance 115, 128, 138–40, 149,  
194–5
- Wariness 140–1, 143–4, 149
- Warning signs 2–3, 96, 100, 139,  
161, 172, 201–3
- Weak signals 2–3, 10–11, 127, 162,  
202–3
- Worst cases 22, 28, 83, 199