

Supporting
European
Aviation



Setting the Scene: Theory and Direction

BALPA Flight Safety Conference

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Systems Thinking

WHAT IS SYSTEMS THINKING?

Systems Thinking: 10 Axioms

1. A 'system' is a social construct (same for *boundaries, purposes, causes*)
2. Systems have boundaries, which are not fixed and often permeable
3. Systems have multiple purposes
4. A system does something that none of its (interconnected) parts can do
5. Influence and causation spreads through the system
6. Complex systems have a history
7. There will be different assumptions or imaginations about the 'system'
8. Understanding requires synthesis (not just analysis)
9. Understanding can only ever be partial
10. There are multiple perspectives on a system

Complicated/ Mechanical

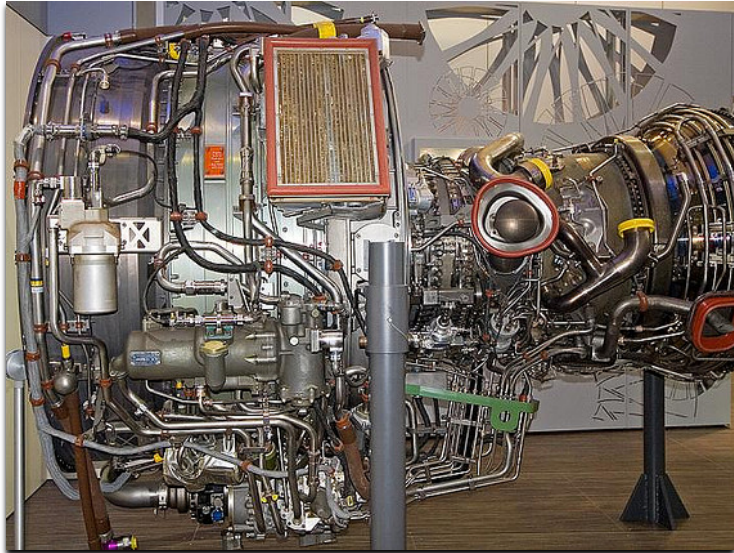


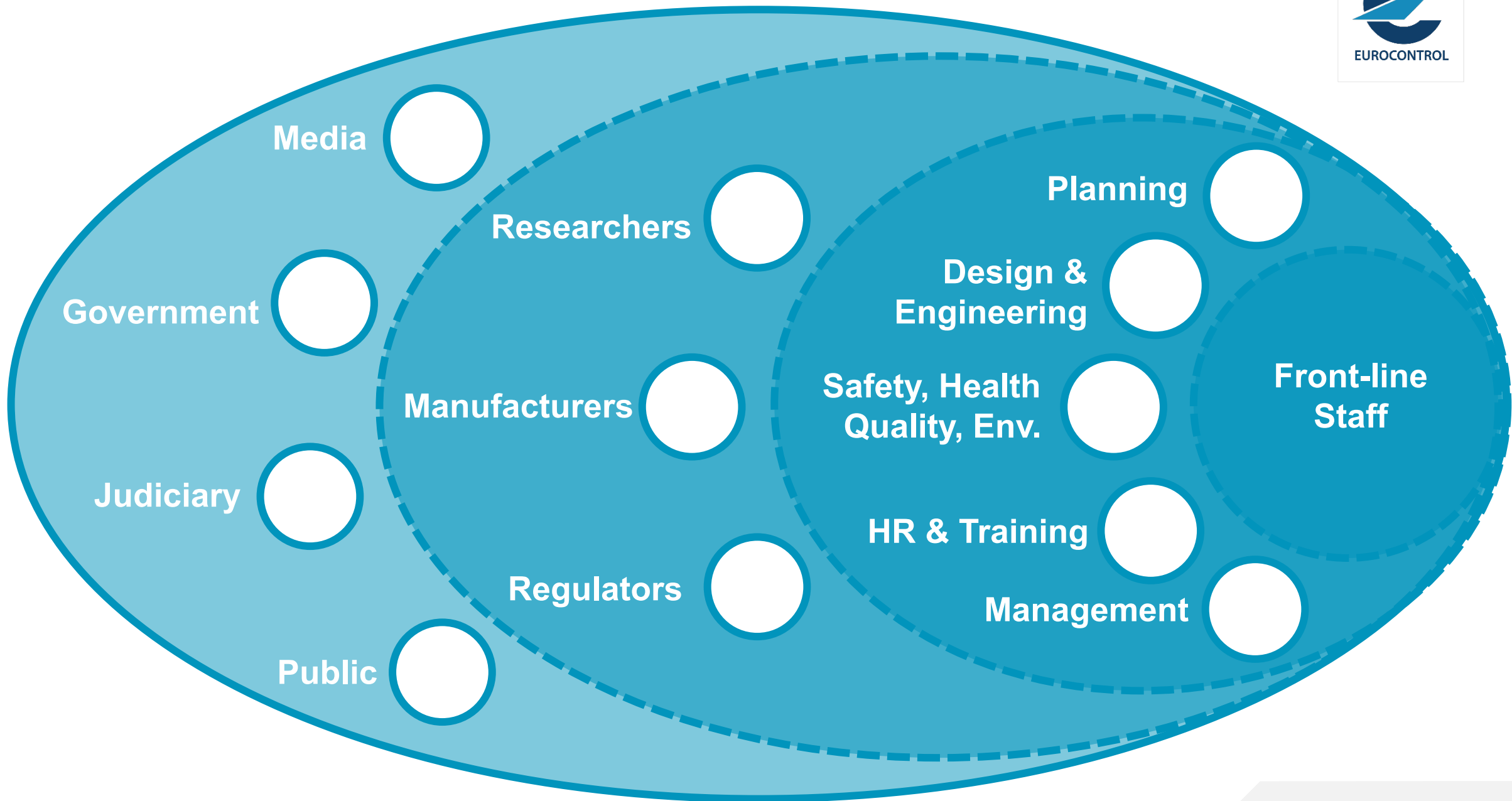
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Nature of goals?
Understandability?
Deconstructability?
Clarity of boundary?
Quantifiability?
Cause-effect relationships?
Stability over time?
Predictability?
Tractability?

Complex/ Socio-technical

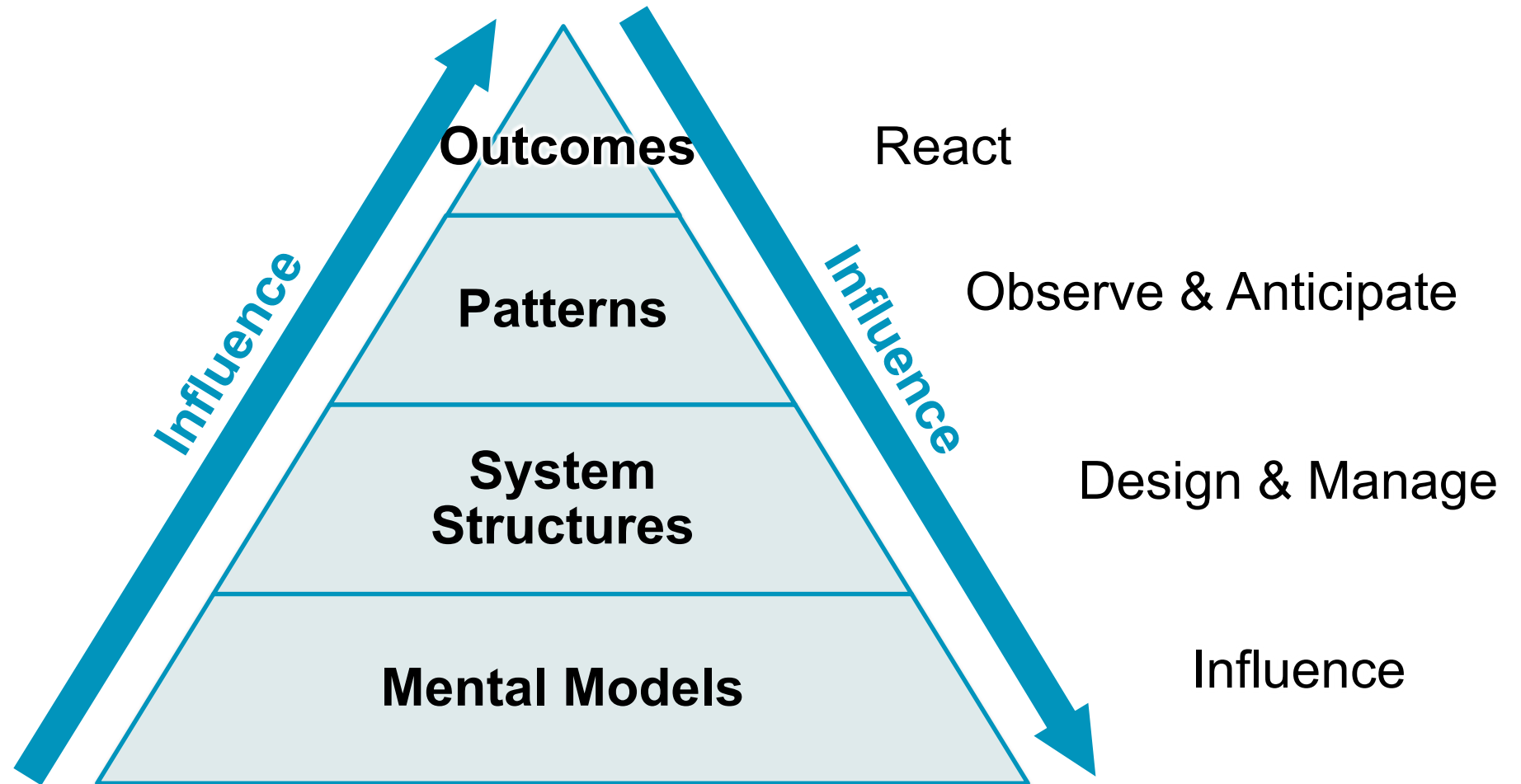


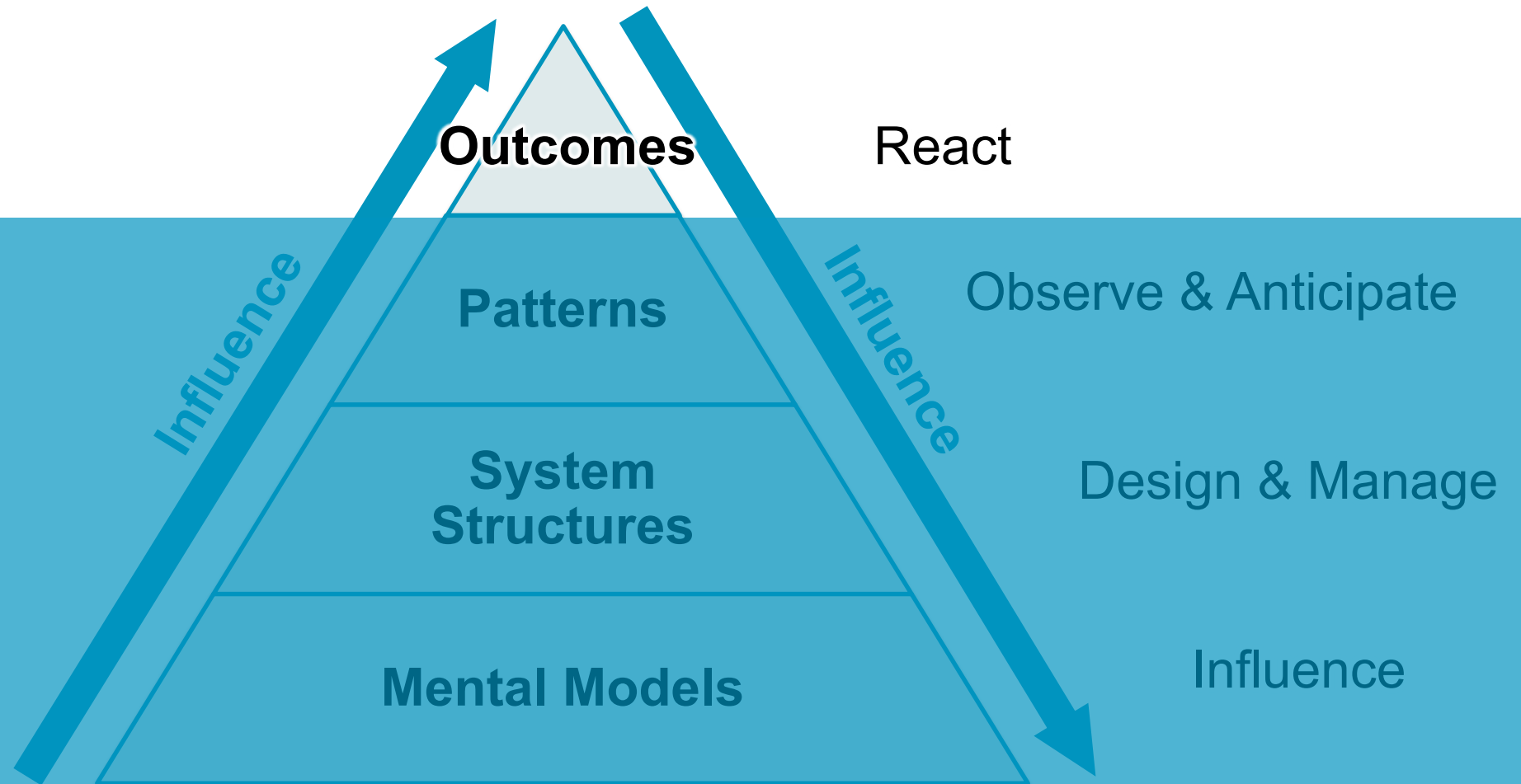
Implications for *understanding* and *intervention*?



Systems Thinking

HOW DO THINGS HAPPEN?





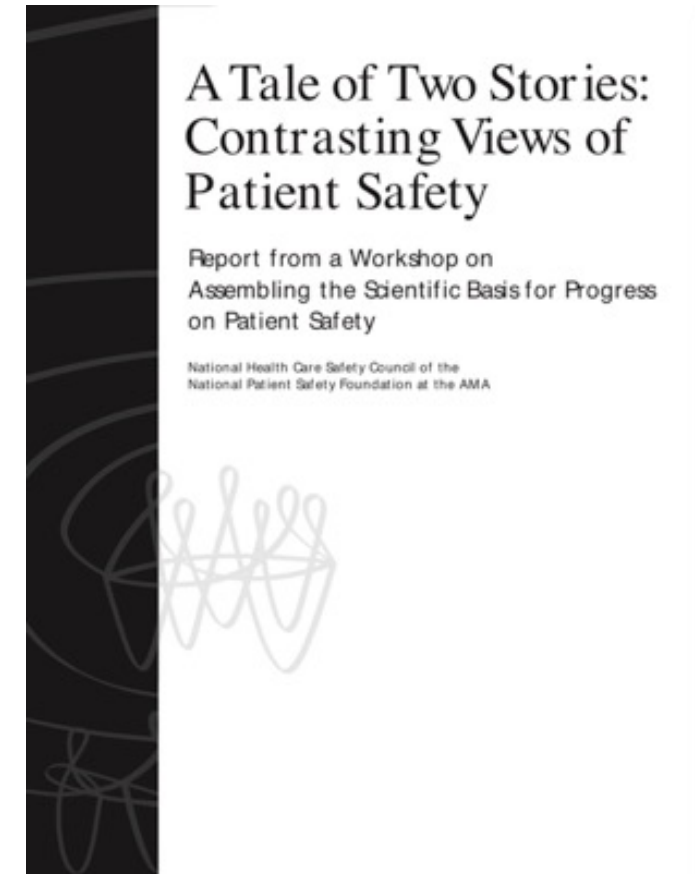
Systems Thinking

HOW DO WE EXPLAIN HOW THINGS HAPPEN?

The First Story

‘Human Error and Component Failure’

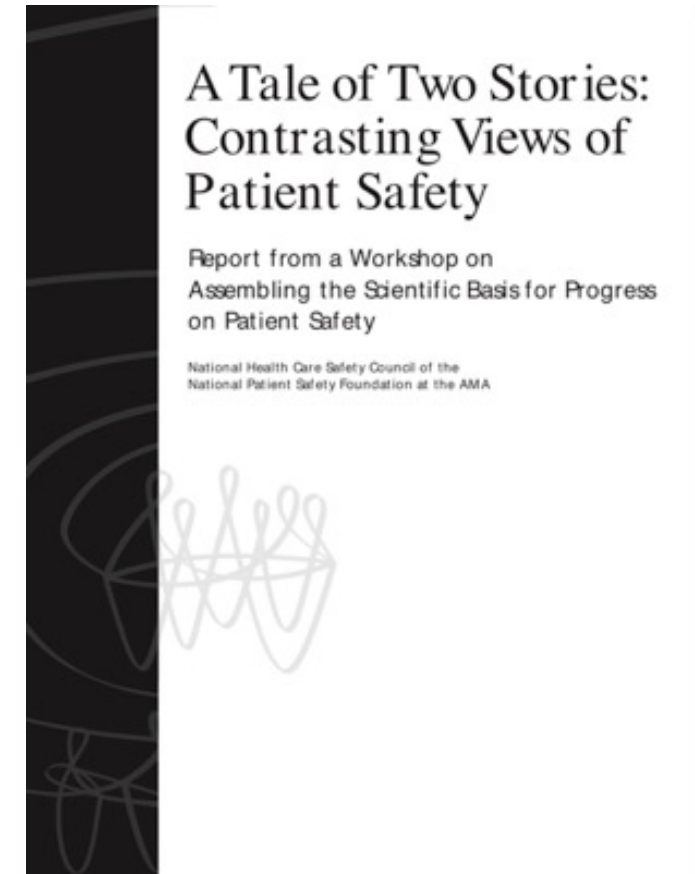
- Appears quickly after event
- Focuses on short time period
- High personalisation
- Focus on components
- Low context and complexity
- High newsworthiness



The Second Story

System Vulnerabilities

- Emerges slowly after long delay
- Focuses on longer time period
- Lower personalisation
- Focus on interactions
- Higher context and complexity
- Lower newsworthiness

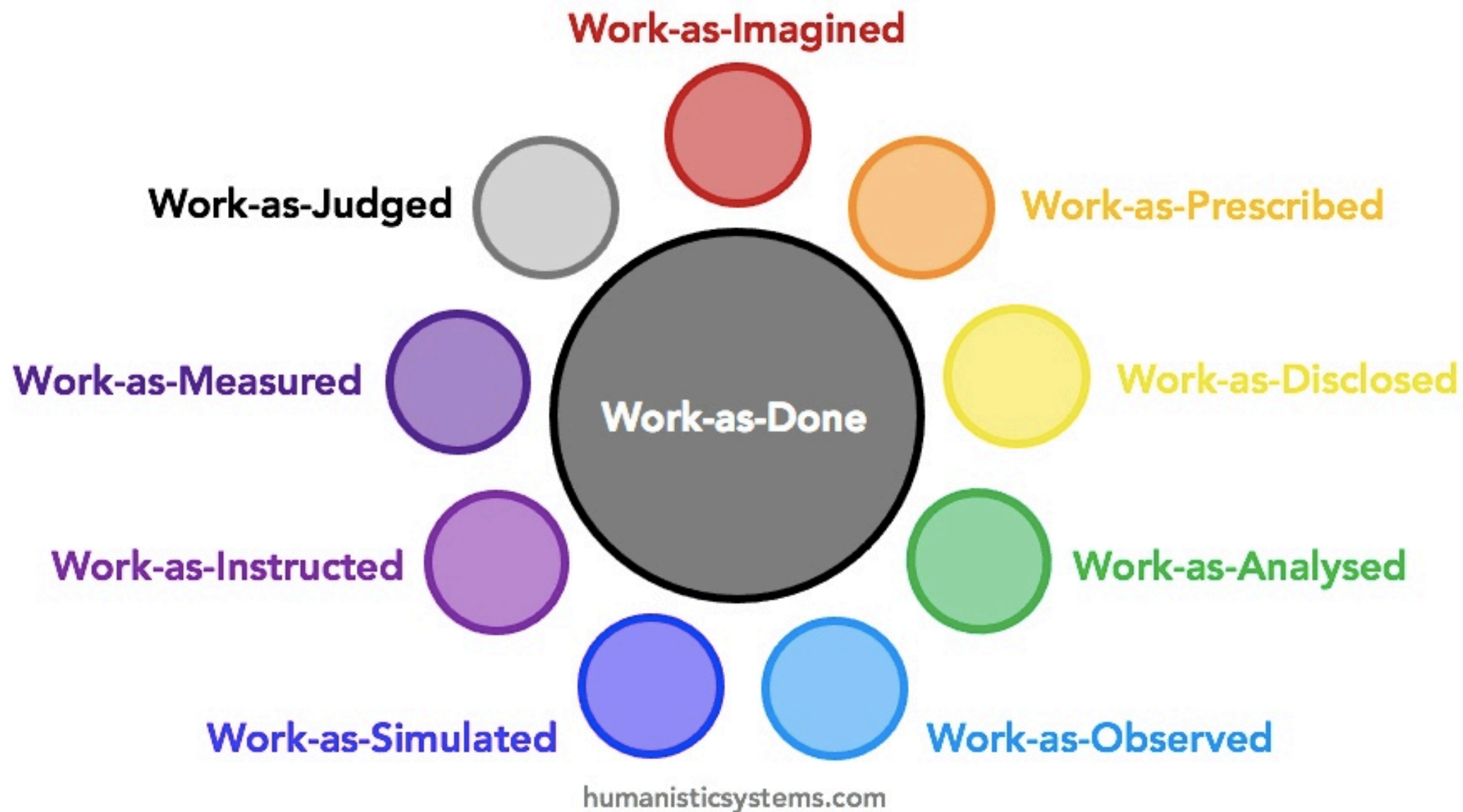


Did design and management make it:

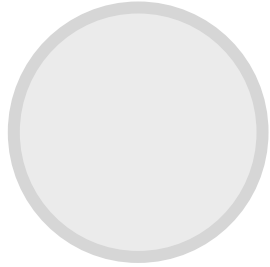
- easy to do the right thing?
- hard to do the wrong thing?
- very hard to do a disastrous thing?

Systems Thinking

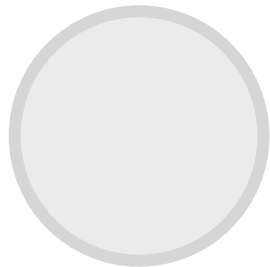
HOW DO WE UNDERSTAND HUMAN WORK?



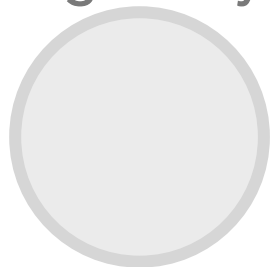
societal



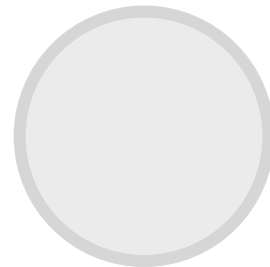
political



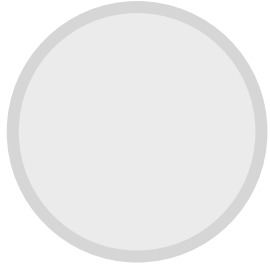
legal &
regulatory



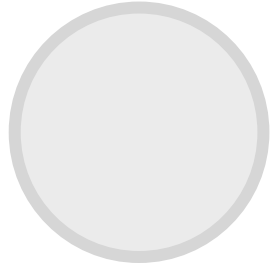
economic



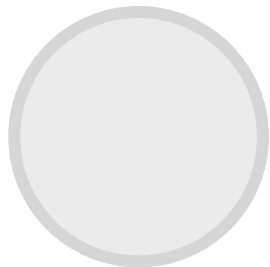
social &
cultural



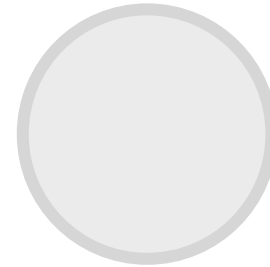
organisational
& institutional



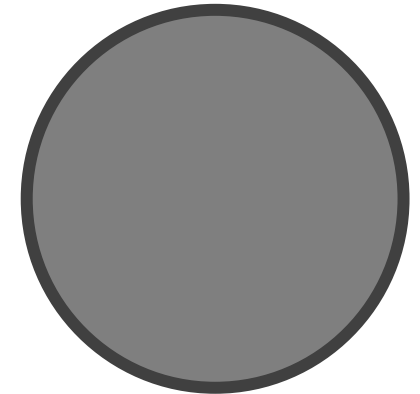
physical &
environmental



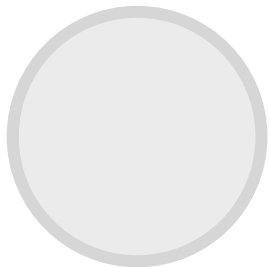
technological



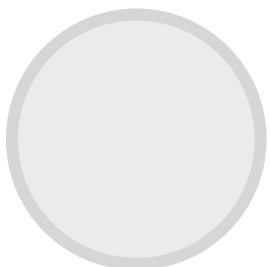
work-as-done



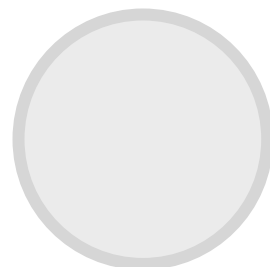
personal



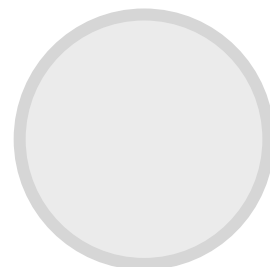
procedural



temporal

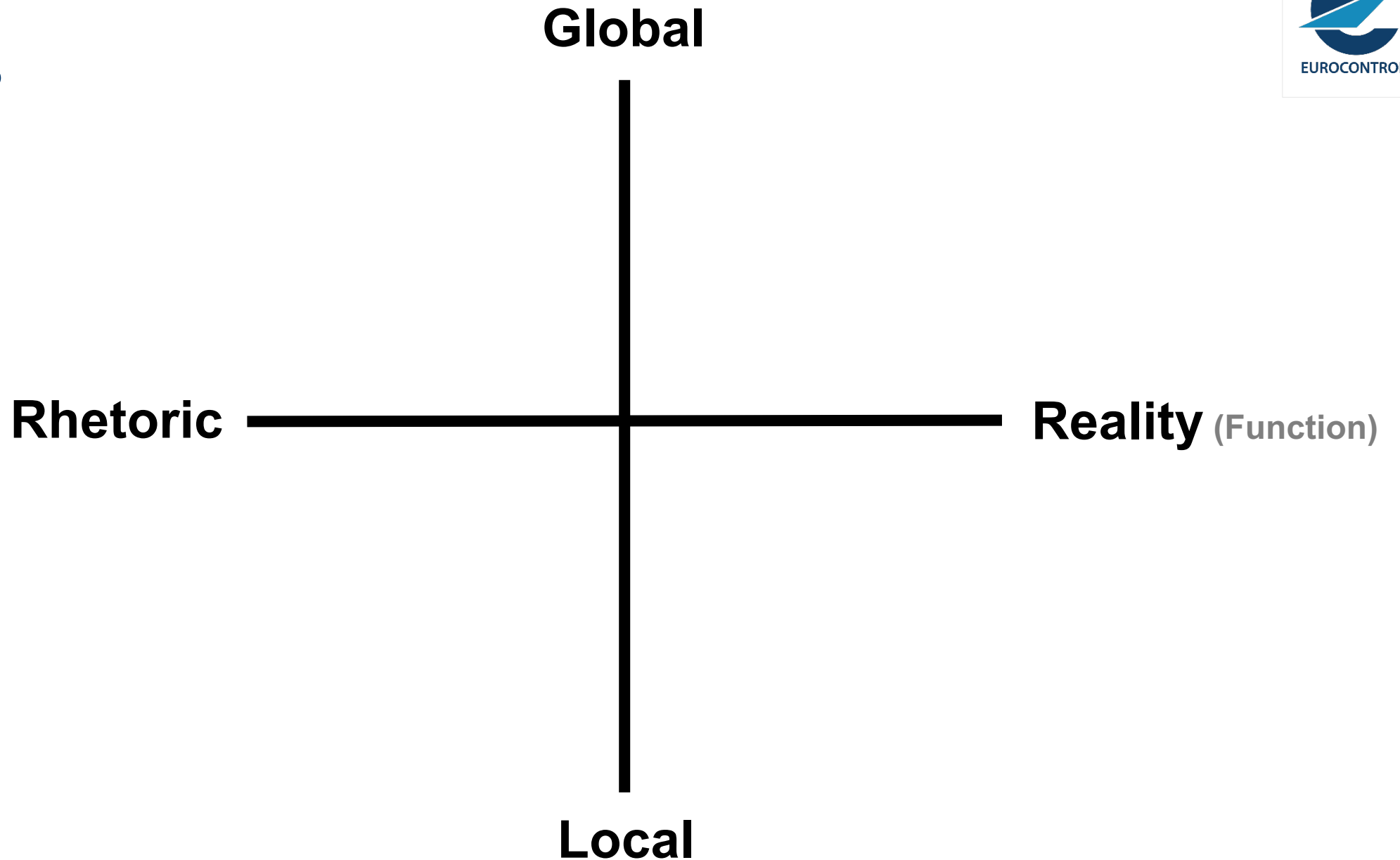


informational



CONTEXTS FOR WORK-AS-DONE

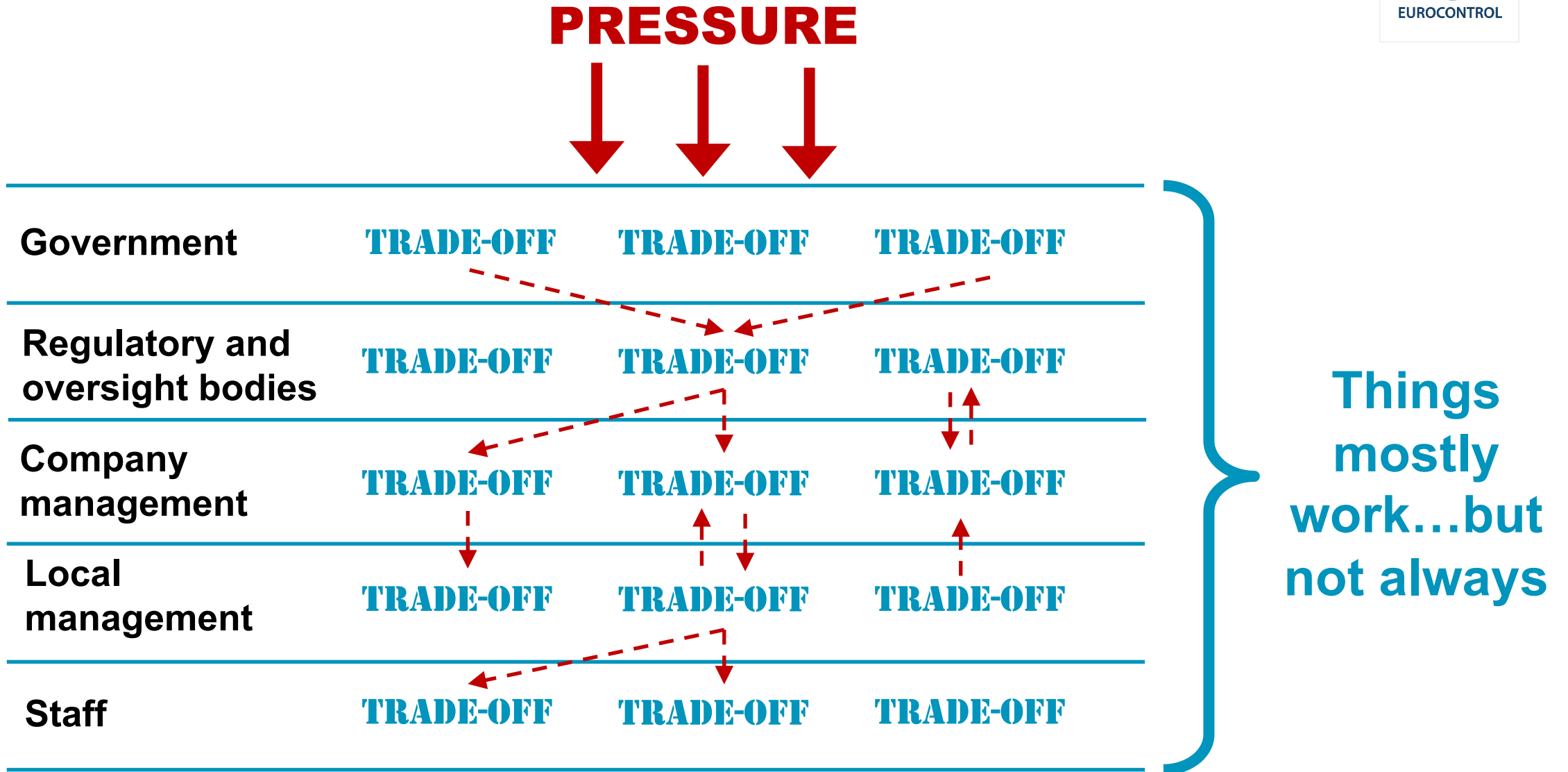
Goals



Five Truths about Trade-offs

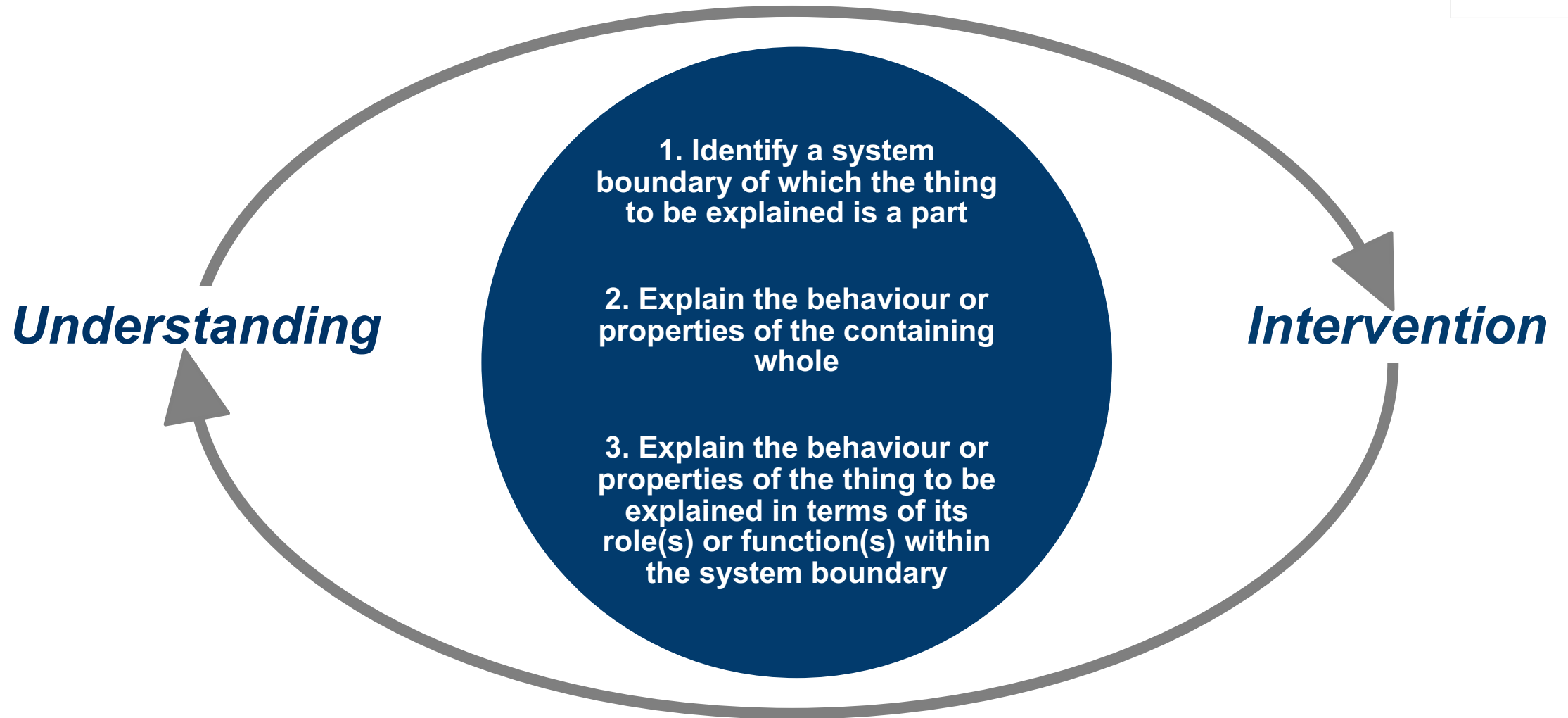
1. Trade-offs occur at all levels of systems
2. Trade-offs trickle down
3. Trade-offs combine in unexpected ways
4. Trade-offs are necessary for systems to work.
5. Trade-offs require expertise





Systems Thinking

**WHAT CAN WE DO TO
UNDERSTAND & INTERVENE
(WELL)?**



- navigation
- Home page
 - Operational issues
 - Human performance
 - Enhancing safety
 - Safety regulations
 - Accidents and Incidents
 - Aircraft Types
 - Airport Direct
 - Toolkits
 - Bookshelf
 - Publications
 - OGHFA
 - ICAO FSIX

- Information
- About SKYbrary
 - Contact us
 - Help
 - Who is who
 - Glossary
 - Promotion

- toolbox
- What links here
 - Related changes
 - Upload file
 - Special pages
 - Printable version
 - Permanent link

Operational Issues


Human Performance

Enhancing Safety

Safety Regulations


Highlighted Article

Systems Thinking for Safety



The **Systems Thinking for Safety Toolkit** provides useful principles, practical advice, narratives and methods to encourage a systems thinking approach to systems, work and safety.

[Read more >>](#)



System Focus

- Equivalence
- Field Expert Involvement
- Local Rationality
- Just Culture
- Demand & Pressure
- Resources & Constraints
- Interactions & Flows
- Trade-offs
- Performance Variability
- Emergence

2014 Safety Forum Airborne Conflict

One Safety Issue - One Coordinated Outcome

posted 29 July 2014 in Portal:Airborne Conflict

The findings and conclusions of the recent Airborne Conflict Safety Forum are now available on SKYbrary along with all the presentations.

[Read more >>](#)

Toolkits

- [Systems Thinking for Safety **New**](#)
- [AllClear?](#)
- [Airspace Infringement Prevention](#)
- [Stabilised Approach Awareness Toolkit for ATC](#)
- [Flight Deck Procedures - A Guide for Controllers](#)
- [Level Bust Toolkit](#)
- [TCAS Awareness](#)
- [Just Culture Toolkit](#)

navigation

- Home page
- Operational issues
- Human performance
- Enhancing safety
- Safety regulations
- Accidents and incidents
- Aircraft Types
- Airport Directory
- Toolkits
- Bookshelf
- Publications
- OGHFA
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- What links here
- Related changes
- Upload file
- Special pages
- Printable version
- Permanent link

Toolkit:Systems Thinking for Safety: Ten Principles

Executive Summary



"To understand and improve the way that organisations work, we must think in systems." Image:  NATS Press Office  CC BY-NC-ND 2.0

To understand and improve the way that organisations work, we must think in systems. This means considering the interactions between the parts of the system (human, social, technical, information, political, economic and organisational) in light of system goals. There are concepts, theories and methods to help do this, but they are often not used in practice. We therefore continue to rely on outdated ways of thinking in our attempts to understand and influence how sociotechnical systems work. This White Paper distills some useful concepts as principles to encourage a 'systems thinking' approach to help make sense of – and improve – system performance. It is hoped that these will give new ways of thinking about systems, work and safety, and help to translate theory into practice.

Principles 1, 2 and 3 relate to the view of people within systems – our view from the outside and their view from the inside. To understand and design systems, we need to understand work-as-done. This requires the involvement of those who do the work in question – the field experts. (Principle 1. Involvement of Field Experts). It follows that our understanding of work-as-done – past, present and future – must assimilate the multiple perspectives of those who do the work. This includes their goals, knowledge, understanding of the situation and focus of attention situated at the time of performance (Principle 2. Local Rationality). We must also assume that people set out to do their best – they act with good intent. Organisations and individuals must therefore adopt a mindset of openness, trust and fairness (Principle 3. Just Culture).

Principles 4 and 5 relate to the system conditions and context that affect work. Understanding demand is critical to understanding system performance. Changes in demands and pressure relating to efficiency and capacity, from inside or outside the organisation, have a fundamental effect on performance. (Principle 4. Demand and Pressure). This has implications for the utilisation of resources (e.g. staffing, competency, equipment) and constraints (e.g. rules and regulations) (Principle 5. Resources and Constraints), which can increase or restrict the ability to meet demand.

Principles 6, 7 and 8 concern the nature of system behaviour. When we look back at work, we tend to see discrete activities or events, and we consider these independently. But work-as-done progresses in a flow of interrelated and interacting activities (Principle 6. Interactions and Flows). Interactions (e.g. between people, equipment, procedures) and the flow of work through the system are key to the design and management of systems. The context of work requires that people make trade-offs to resolve goal conflicts and cope with complexity and uncertainty (Principle 7. Trade-offs). Finally, continual adjustments are necessary to cope with variability in system conditions. Performance of the same task or activity will and must vary. Understanding the nature and sources of variability is vital to understanding system performance (Principle 8. Performance Variability).

Principles 9 and 10 also relate to system behaviour, in the context of system outcomes. In complex systems, outcomes are often emergent and not simply a result of the performance of individual system components (Principle 9. Emergence). Hence, system behaviour is hard to understand and often not as expected. Finally, success and failure are equivalent in the sense that they come from the same source – everyday work, and performance variability in particular (Principle 10. Equivalence). We must therefore focus our attention on work-as-done and the system-as-found.

[\[edit\]](#)

Toolkit Navigation

- **Summary**
- The Foundation. System Focus
- Principle 1. Field Expert Involvement
- Principle 2. Local Rationality
- Principle 3. Just Culture
- Principle 4. Demand and Pressure
- Principle 5. Resources and Constraints
- Principle 6. Interactions and Flows
- Principle 7. Trade-offs
- Principle 8. Performance Variability
- Principle 9. Emergence
- Principle 10. Equivalence
- Principles in Action
- Systems Thinking Methods
- Narratives: Systems Thinking in the Wild
- References and Further Reading
- Authors and Acknowledgements





Network Manager
nominated by
the European Commission



Systems Thinking Learning Cards

Moving towards Safety-II



Systems Thinking for Safety

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Feedback

If you have any comments on the cards, please contact steven.shorrock@eurocontrol.int and esp@eurocontrol.int.

Find out more

To find out more about systems thinking for safety, go to: <http://bit.ly/ST4SAFETY>

Edition 1.1 November 2014

Photo: NATS Press Office <https://fic.kr/p/cwfQQL> CC BY-NC-ND 2.0



Foundation: System Focus

Safety must be considered in the context of the overall system, not isolated individuals, parts, events or outcomes

Most problems and most possibilities for improvement belong to the system. Seek to understand the system holistically, and consider interactions between elements of the system.

Systems Thinking Principles



Practical advice

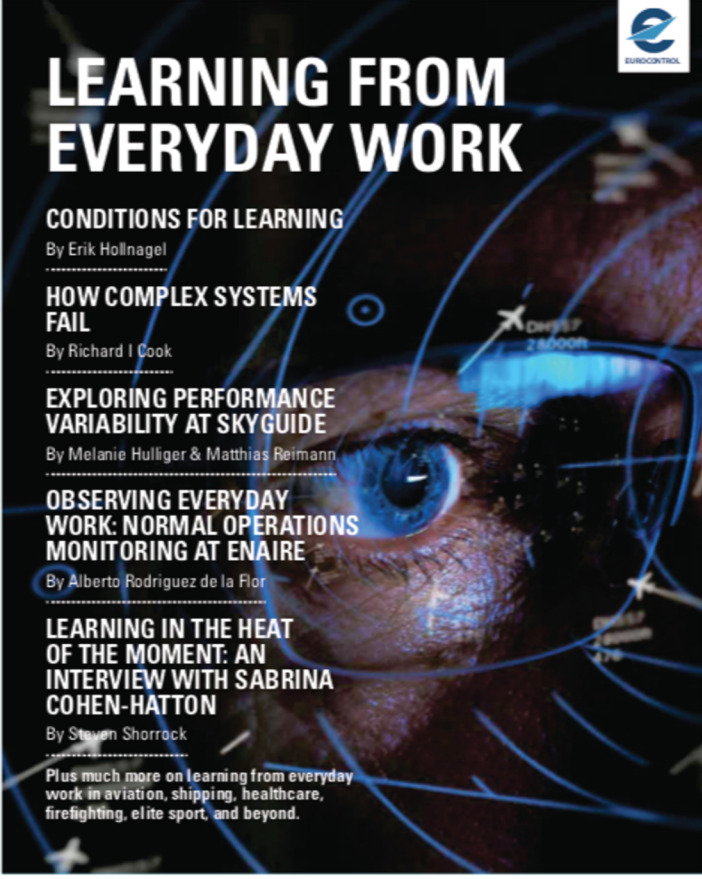
- **Identify the stakeholders.** Identify who contributes or delivers resources to the system and who benefits, i.e. system actors (including staff and service users), experts/designers, decision makers, influencers.
- **Consider system purposes.** Reflect on the common or superordinate purpose(s) that defines the system as a whole, considering customer needs. Study how parts of the system contribute to this purpose, including any conflicts or tension between parts of the system, or with the superordinate system purpose(s).
- **Explore the system and its boundary.** Model the system, its interactions and an agreed boundary, for the purpose, question or problem in mind (concerning investigation, assessment, design, etc.). Continually adapt this as you get data, exploring the differences between the system-as-imagined and the system-as-found.
- **Study system behaviour and system conditions.** Consider how changes to one part of the system affect other parts. Bear in mind that decisions meant to improve one aspect can make system performance worse.

Read more
<http://bit.ly/0-SF>

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Human and organisational factors in operations



LEARNING FROM EVERYDAY WORK

CONDITIONS FOR LEARNING
By Erik Hollnagel

HOW COMPLEX SYSTEMS FAIL
By Richard I Cook

EXPLORING PERFORMANCE VARIABILITY AT SKYGUIDE
By Melanie Hulliger & Matthias Reimann

OBSERVING EVERYDAY WORK: NORMAL OPERATIONS MONITORING AT ENAIRE
By Alberto Rodriguez de la Flor

LEARNING IN THE HEAT OF THE MOMENT: AN INTERVIEW WITH SABRINA COHEN-HATTON
By Steven Shorrock

Plus much more on learning from everyday work in aviation, shipping, healthcare, firefighting, elite sport, and beyond.

Winter 2020-2021

HindSight30

The ability to anticipate, understand and judge the state or operation of a system

WELLBEING

QF32 AND POST-TRAUMATIC STRESS
Steven Shorrock interviews Captain Richard Champion de Crespigny

MORAL REASONS FOR PROMOTING WELLBEING IN ORGANISATIONS
Suzanne Shale

SYSTEM WELLBEING
Anders Ellerstrand

THE ENERGY PROJECT @MUAC
Marinella Leone

BURNOUT IN EMERGENCY MEDICINE: HOW DO WE GET BETTER?
Shannon McNamara

Plus much more on Wellbeing in aviation and beyond



HindSight29

The ability to anticipate, understand and judge the state or operation of a system

GOAL CONFLICTS AND TRADE-OFFS

TRADE-OFFS AND TABOOS
Jean Paris

GOOD JOB, EVERYBODY
Emmanuelle Gravelon

INVISIBLE TRADE-OFFS AND VISIBLE CONSEQUENCES
Erik Hollnagel

CONFLICTS WITHIN AND WITHOUT: LEARNING FROM COSTA CONCORDIA
Nippin Anand

QF32
An interview with Captain Richard Champion de Crespigny

Plus much more on goal conflicts and trade-offs in aviation and beyond



HindSight28

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CHANGE

CHANGING TO ADAPT AND ADAPTING TO CHANGE

MODE SWITCHING IN AIR TRAFFIC CONTROL
Zohir Bekou and Nagel Hossain

CLOSE ENCOUNTERS OF THE LEGAL KIND: A NEED FOR AIRSPACE CHANGE?
Marc Baumgartner

THE JUST CULTURE JOURNEY IN EUROPE: LOOKING BACK AND LOOKING FORWARD
Roderick van Dam, Maria Kozlova and Tony Lico

FOUR MODES OF CHANGE: TO, FOR, WITH, BY
Cornac Russell

LEARNING FROM PSYCHOLOGY AND PSYCHOTHERAPY
conversations with David Murphy

Plus much more on changing to adapt and adapting to change in aviation and beyond



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COMPETENCY AND EXPERTISE

THE DARK SIDE
by Rhonda Ikin

COMPETENCE LAGGING OR LEADING?
by Erik Hollnagel

THE GOOD, THE BAD AND THE UGLY
by Ashley Lauritsen

LEARNING FROM SPORT PSYCHOLOGY: A CONVERSATION WITH LEE CROMBLEHOLME
Plus much more on competency and expertise for the safety of air traffic management and aviation



HindSight26

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SAFETY AT THE INTERFACES: COLLABORATION AT WORK

THE VOICE OF AN ANGEL
by Sidney Dekker

FROM EXPERIENCE REPORTS TO EXPERIENCE SHARING
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COLLABORATIVE ADAPTATION IN A CONSTRAINED SYSTEM
by Don Dyles and Chris Bearman

Plus much more on collaboration within and between organisations



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WORK-AS-IMAGINED & WORK-AS-DONE

MALICIOUS COMPLIANCE
by Sidney Dekker

CAN WE EVER IMAGINE HOW WORK IS DONE?
by Erik Hollnagel

SAFETY IS IN THE EYE OF THE BEHOLDER
by Florence-Marie Jegoux, Ludovic Miesusset and Sébastien Follet

I WOULDN'T HAVE DONE WHAT THEY DID
by Martin Bromiley



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