# System Lifecycle Operational Governance

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PEOPLE
PROCESS
PERFORMANCE

# Overview

- The problem and the gap
- Transformative power of information technology
- The challenge of new ‘automation’
- Design for operations
  - How to understand the operation
  - Change the mindset – system knowledge
- Build a Knowledge Exchange to feed:
  - Governance
  - Competence
  - Regulation & standards
  - New system design

# Problem

- Because of the transformative power of information technology, operational systems are changing
  - Greater connectivity brings more integration
  - AI and machine learning increases the power of what the technical system can do
  - Meaningful content changes the relationship with people
- The stakes are getting higher
  - Commercial aviation is ‘ultrasafe’ – intolerance of any accidents – have to reconcile safety, cost and environmental impact
  - Healthcare – demand & cost escalating, but unsafe care can represent 10-15% of hospital expenditure
  - Financial services – crisis due in part to failure to understand operational risk?
- Does the technology offer the possibility for better governance?

# The Gap

| Design | Remote from operations |
| --- | --- |
| Human & Social Sciences | Lack capability to systemically analyse functionality of operations |
| Quality and Safety professionals | Overwhelmed with data, unable to detect significant patterns |
| Safety regulation | Performance-driven, proactive, systemic and change oriented-aspirations? |
| Certification | How to take account of the realities of complex operations? |

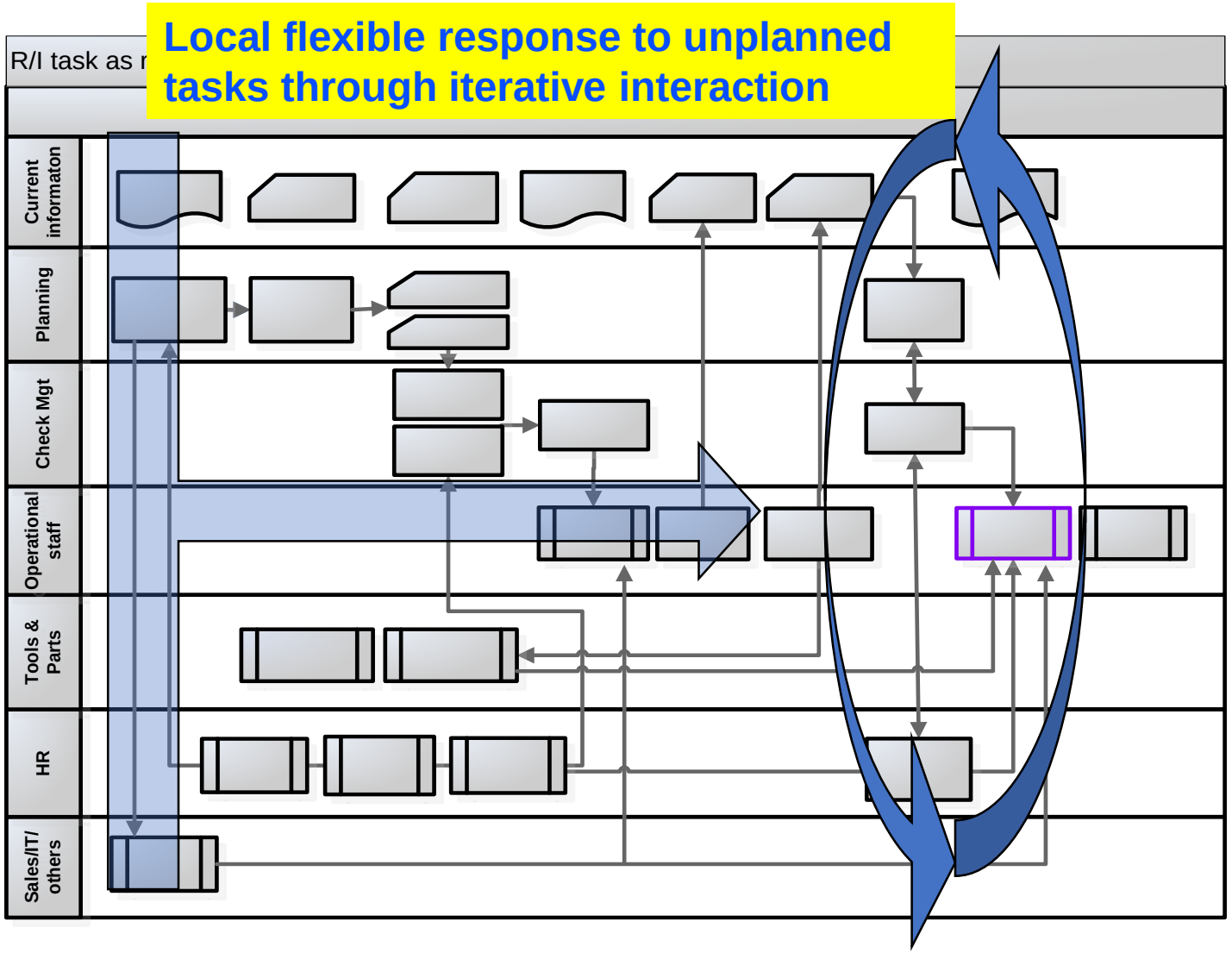
# Transformative power of information technology

Condition-based maintenance (TATEM project)

# Main axes of co-ordination – ‘current world’

Uncertainty about maintenance demand

- 40-60% unplanned
- Chronic resource shortage
- Constant local reactive ‘firefighting’

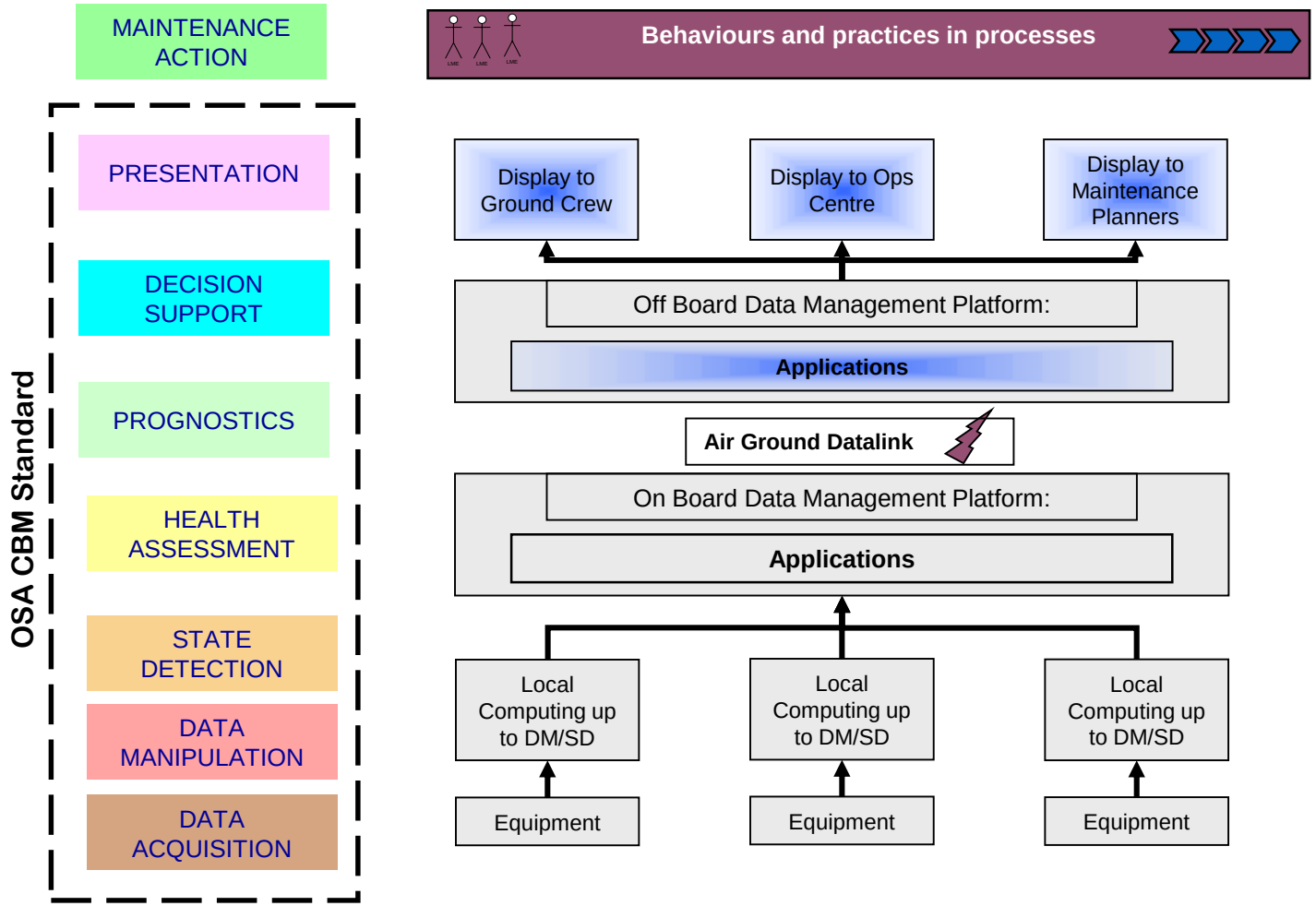



WIPIDO - Well Intentioned People in Dysfunctional Organisations

- It is the role of people to make the system work and manage the uncertainty
- Accept the blame

# Condition-based Maintenance

## TATEM project - 2007



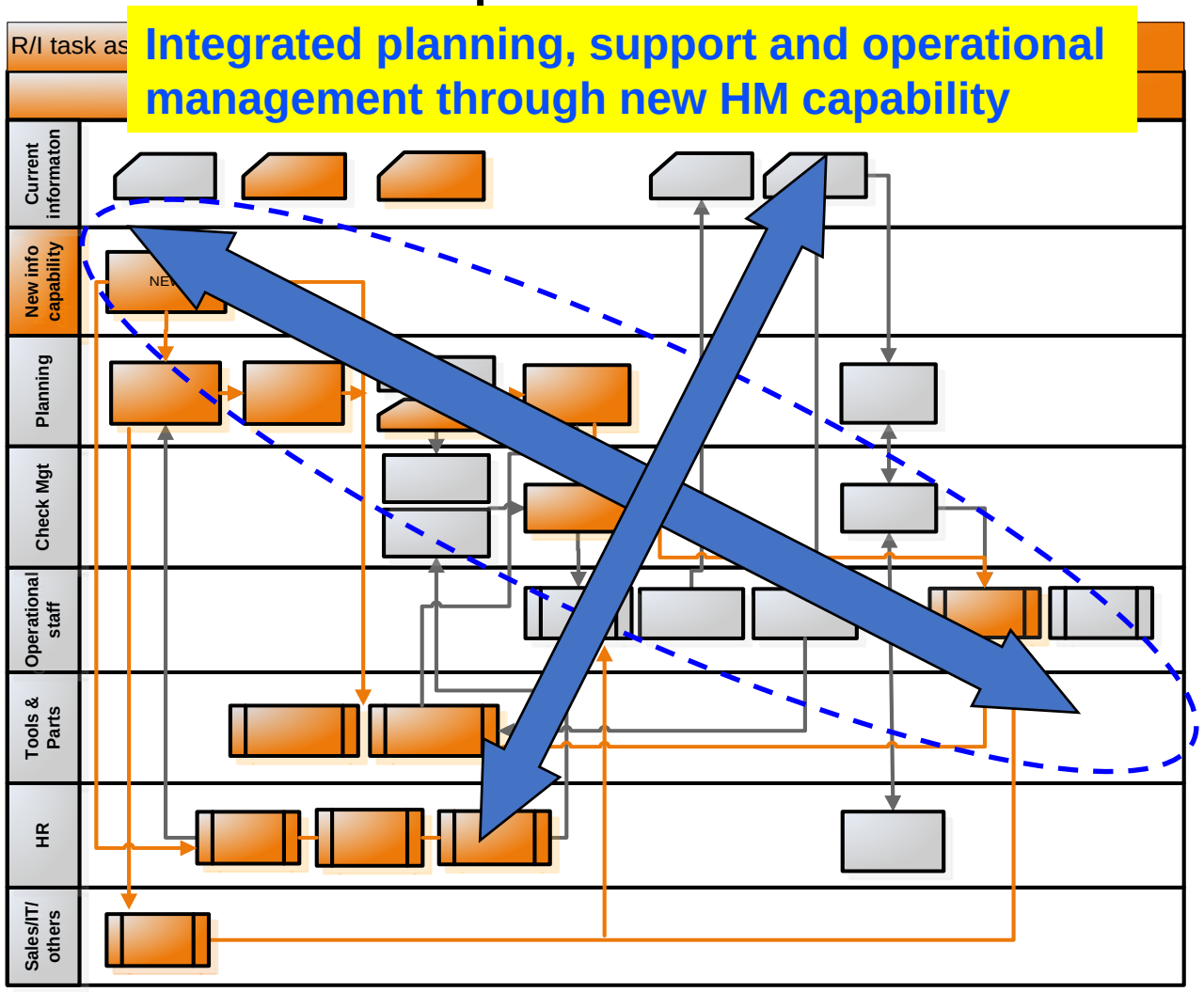

Open Systems Architecture for Condition-Based Maintenance

- Concludes with presentation layer
- **Operational impact is beyond terms of reference**
- Propose new “Maintenance Action” layer?
- **Who is responsible for understanding the system as a whole?**

# New co-ordination space – future world

New functions enabled by reduced uncertainty:

- Information capability
- Planning
- Check management
- Tools and parts
- Operations
- Human resources
- IT




New business models now possible

- ‘Equalised maintenance’
- Fleet management
- Integrated supply chain
- Fully maintained aircraft

# The challenge of new automation

The new generation of automation forces us to rethink our theories and methods.

Not just the human interface with technology, but also what task performance means and how the system as a whole works.

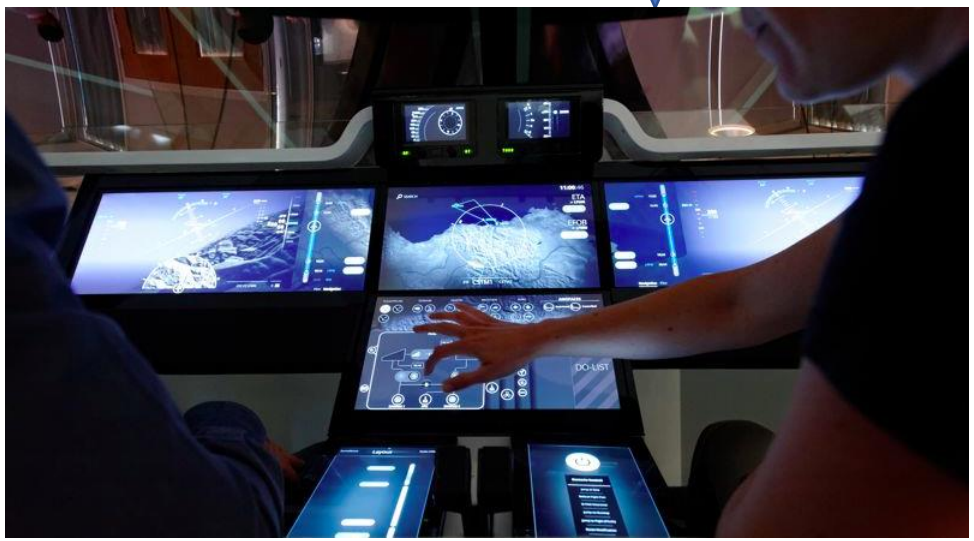
International Society for Automation:

> The dictionary defines *automation* as “the technique of making an apparatus, a process, or a system operate automatically.”
>
> We define automation as "the creation and application of technology to monitor and control the production and delivery of products and services.”

Is this definition still adequate?

Concorde

A320



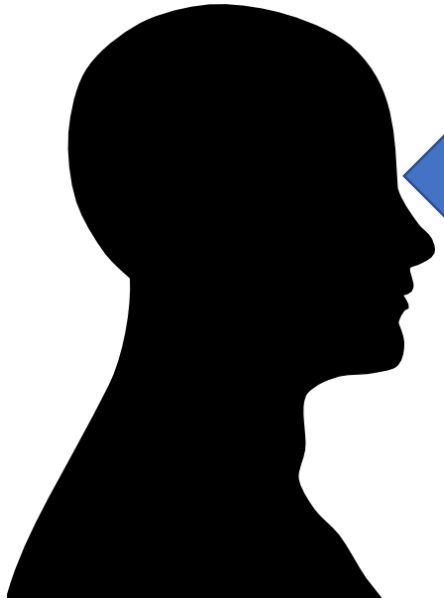
Thales touchscreen cockpit

# Ruptures in Evolution of Technology

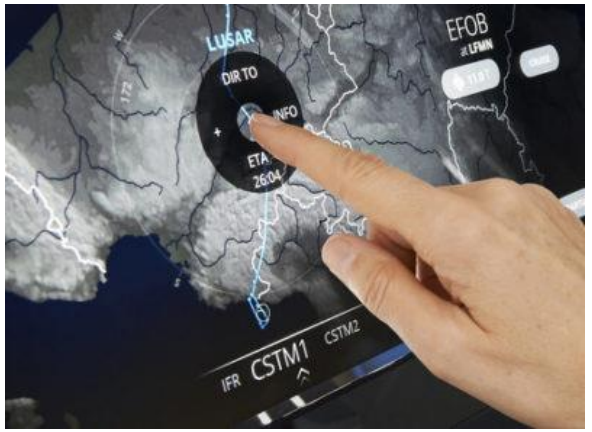
(After Hourlier, S. 2014)

# Rethinking HMI - Strategies for Sparing Cognitive Resources

Hourlier, S. (2014)



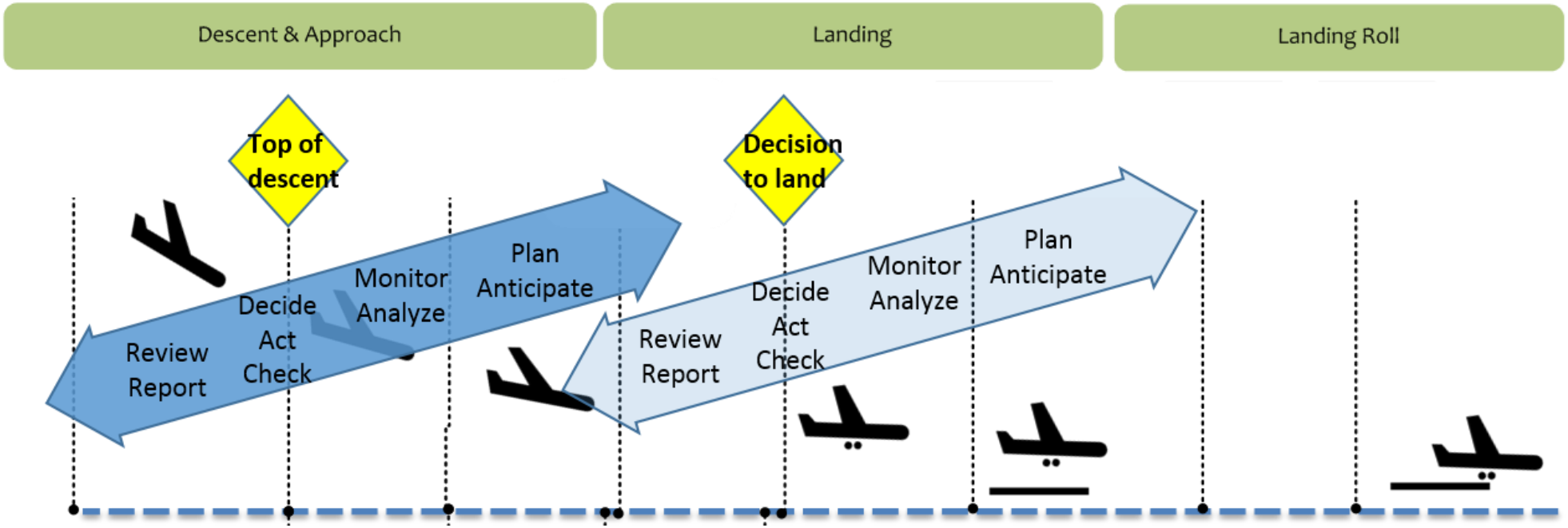
- Anticipate
  - Timeline enables representation of future
- Schematise
  - Represent complex schematic info from user p.o.v.
- Routinise
  - Intuitively easy with little learning required
- Delegate
  - To automation or to others in the system



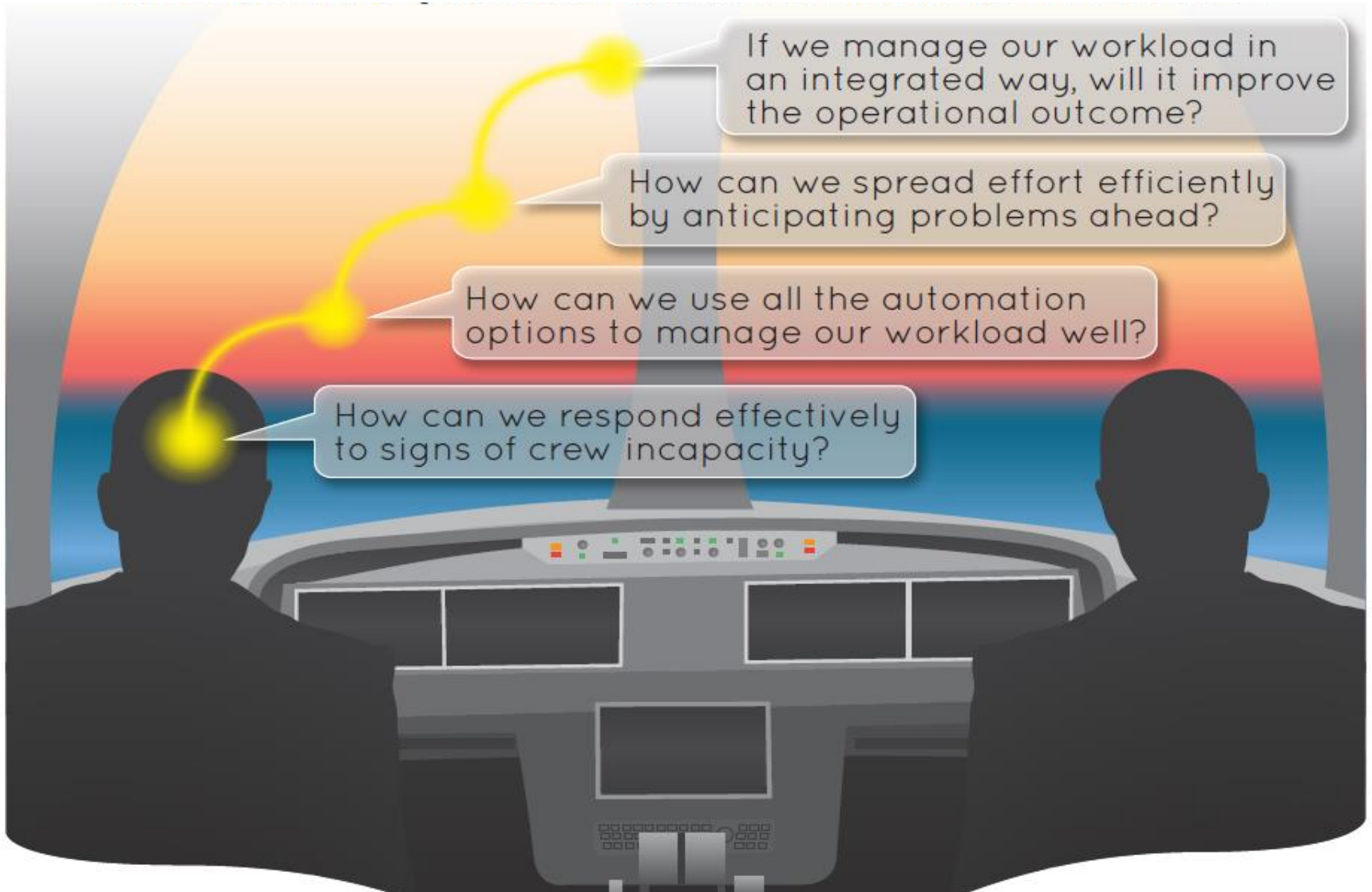

Thales

# For the first time we have to consider the full cognitive cycle

- Two timelines
  - Process flow is sequential
  - Cognitive functions look back and ahead
- Crew manage the whole operation
  - Not only during the flight, but most particularly during the turnaround



# How can crew use technology to manage the whole operation? Workload / incapacity on the flight deck (ACROSS project)



# Human Issues in transitions between configurations

**Ground Crew**

**A/c Crew incapacitated**

**2 Crew**

**1 Crew remains**

**Proactive Workload Management**

Advanced information enables anticipation, planning, preparation & adjustment of mission

**Immediate Workload Management**

Manage demand by linking info & action, auto check, decision support, and actuate automation

Reinforce 2 crew roles

Consolidate functions for 1 crew. Stronger role for ATC / ground control

**Reactive Workload Management (incapacity)**

Monitor crew capacity

Transfer control to emergency support system

Human strategic role for ground control / ATC. Human decision on transfer? Ability to take control?


The issue becomes not what goes on in the cockpit but what happens in the wider system
UB
ENA
HAM
WAW
KBP
RG
STR
NCE
MAD
PMI

# Who is responsible for the overall system?

- Flight deck automation reduces crew and increases dependence on the ground
- ATC automation reduces controllers and transfers functions to the cockpit
  - Control of trajectory, separation
- Has SESAR automation delivered a viable operational solution?
  - New Head of Eurocontrol calls for intervention of ‘disruptive technology’

# What is the Role of Automation?

**Replacing people?**

- Increasingly complex automatic control of functions
  - Artificial intelligence
- Functions that can be made routine and predictable can be automated
  - What happens to the residual variance?
  - Externalisation

**Re-engineering social systems?**

- Massive sources of data
- Meaningful content
- Unlimited connectivity
- Increasing scale, complexity and integration
  - Limits to externalisation of risk?
- How does the social act as a system, incorporating the technology?

# Last Generation Automation Philosophy Capt. E. Tarnowski, 2003

- Automation can give the best of all worlds, if automation is complement to man (sic). Automation must thus be applied wherever it can do better than man:
  - Man is best as a decision maker, for strategic purposes
  - Automation is better for tactical tasks such as:
    - Consistent and accurate aircraft operation
    - Fast computation System and Situational Awareness Enhancement
- But automation is not there to challenge the pilot’s role and responsibility.

# New Approach to Automation needed

- Policy Gap
  - Classic automation engineering
    - Automate what you can, let the human do the rest
  - Humans as source of error and unreliability
- Capability Gap
  - Understanding socio-technical systems
- Consequence
  - Overall human impact as externality

- Inability to change invites business models based on disruptive integrating technology
  - Social information as private good
  - Lack of accountability
  - With large system integration, what limits to externalisation of risk?
- Potential regulatory impotence
- Ramifying social impact

# New capability to ‘Design for Operations’ depends upon understanding the operation as it normally functions.

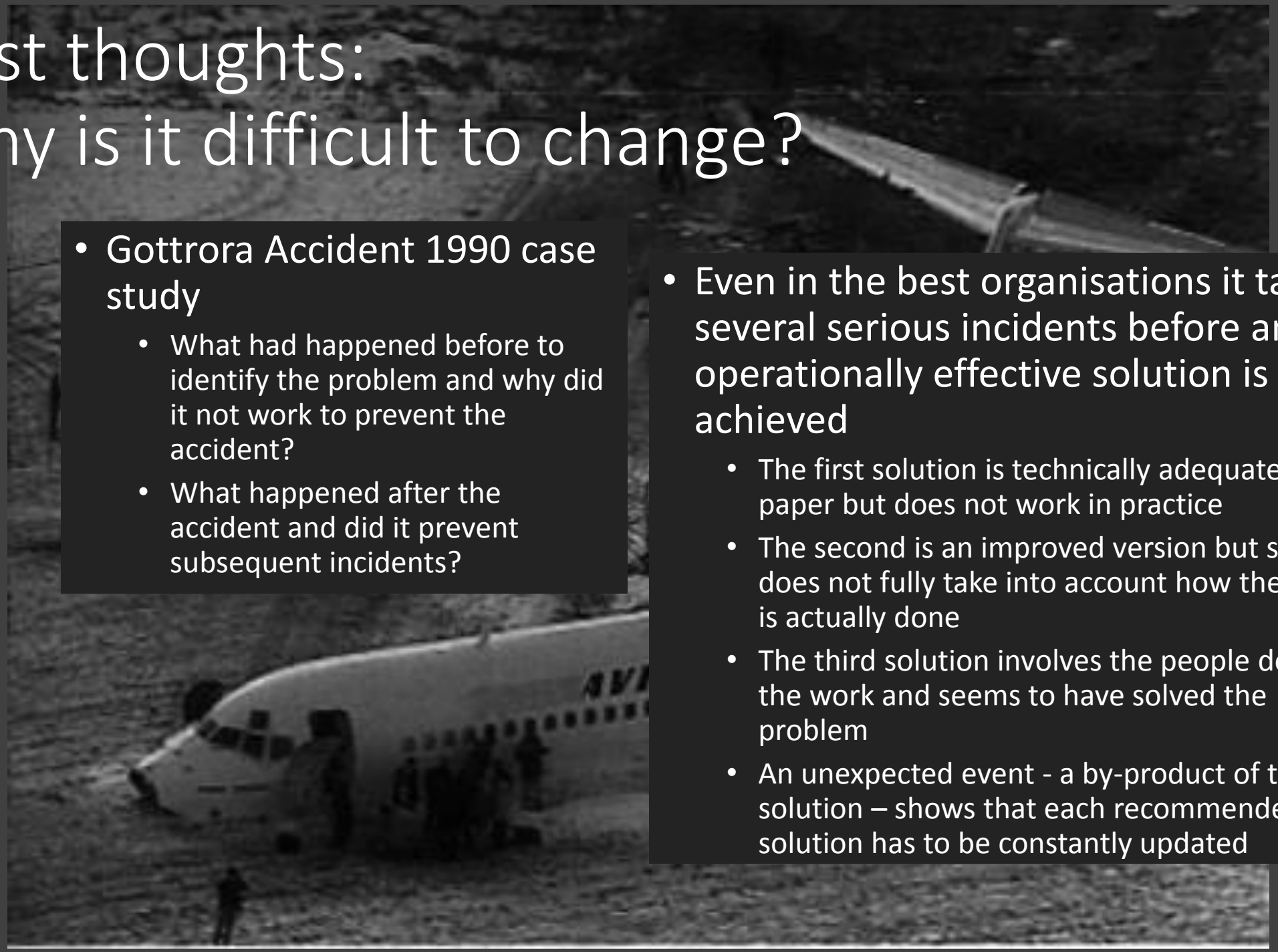
New understanding of operational risk based on massively enhanced supply of data from diverse sources

- Build risk profile linking supply to process to outcome

Quantity is important, but quality of information is critical

- Sometimes 2 is enough, but ‘it often takes 3 or 4 serious incidents to achieve an effective solution’

# First thoughts:
# Why is it difficult to change?



- Gottrora Accident 1990 case study
  - What had happened before to identify the problem and why did it not work to prevent the accident?
  - What happened after the accident and did it prevent subsequent incidents?

- Even in the best organisations it takes several serious incidents before an operationally effective solution is achieved
  - The first solution is technically adequate on paper but does not work in practice
  - The second is an improved version but still does not fully take into account how the work is actually done
  - The third solution involves the people doing the work and seems to have solved the problem
  - An unexpected event - a by-product of that solution – shows that each recommended solution has to be constantly updated

# Second thoughts:
# Serious Incidents in Healthcare – 2019
# PhD thesis – Cora McCaughan

- Development of incident investigation policy
- Development and delivery of investigation training
- Investigation evaluation protocol – developed and implemented
- Analysis of 100+ serious healthcare incidents
- Emergent features from multiple investigations
  - Detection of deteriorating patient (for example)
  - Misdiagnosis with multiple morbidity (for example)

- Critical importance of systemic investigation
- Need to embed integrated meta-analysis into normal practice
- Sets scene for change implementation and verification of outcome

# Build a Knowledge Exchange…..

Synthesise emergent system properties that create strong agenda for change

- Sustain change until verification of outcome

Evidence-based Governance of Operational Risk

- Systemic risks within the operation
- How implementation works – ‘risk in change’

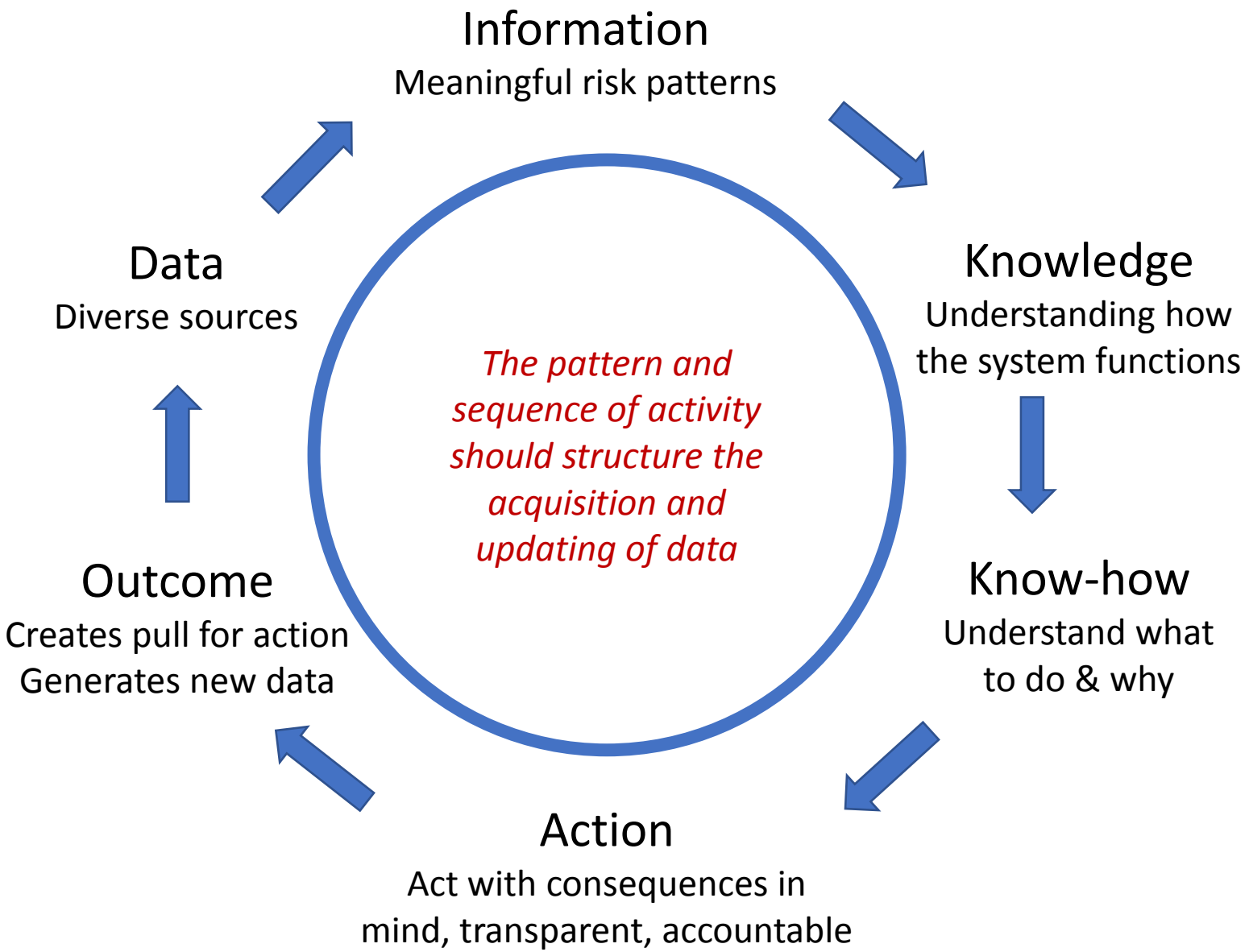
Operational organisations – Strategic governance of operational risk


National & international authorities - certification, approval, licensing

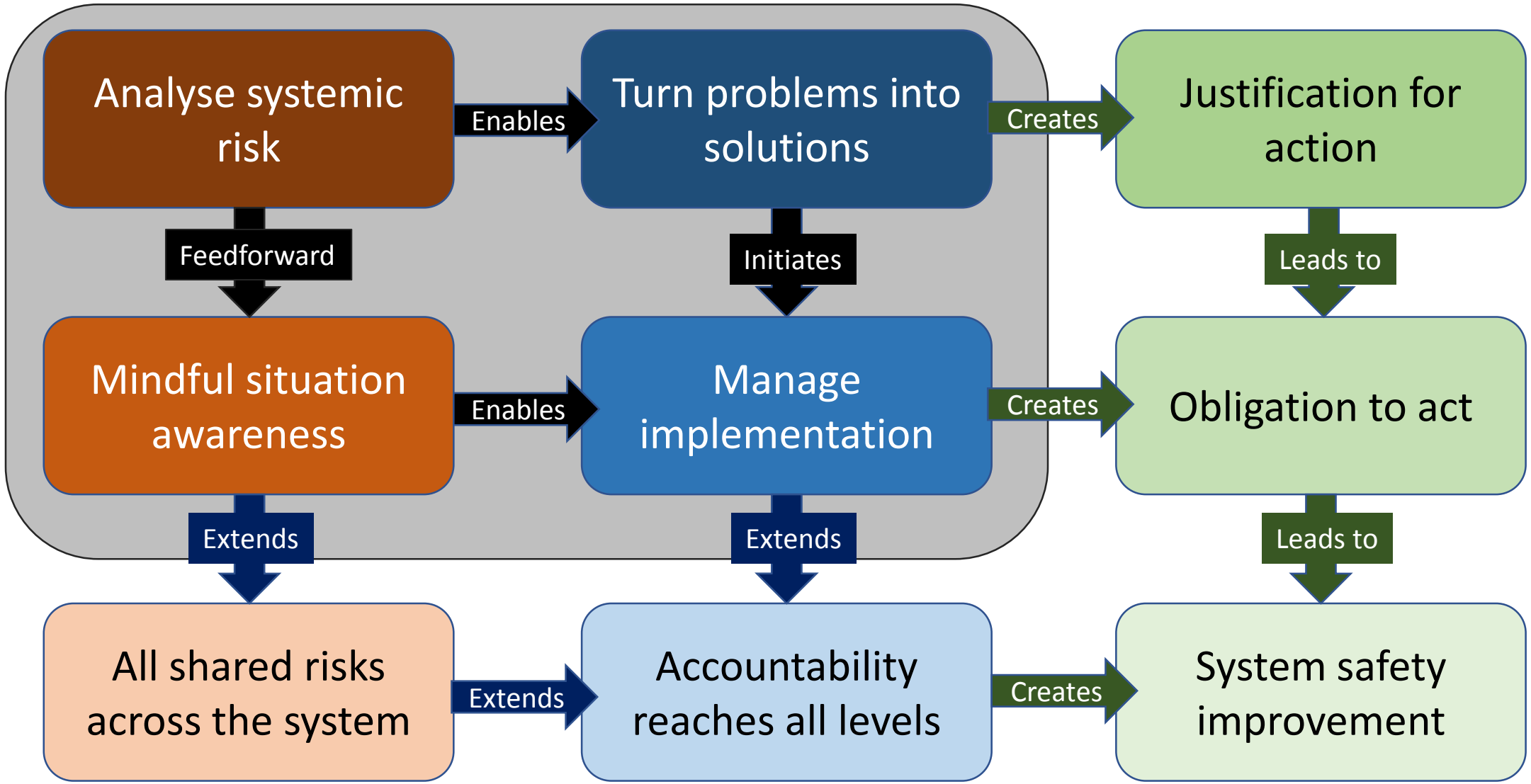
Capability to manage and mitigate operational risk across the system lifecycle

OEMs
Software services – design for operations

RICE Risk Intelligence Community Exchange


Information
Meaningful risk patterns
Knowledge
Understanding how
the system functions
Know-how
Understand what
to do & why
Action
Act with consequences in
mind, transparent, accountable
Outcome
Creates pull for action
Generates new data
Data
Diverse sources
The pattern and sequence of activity should structure the acquisition and updating of data

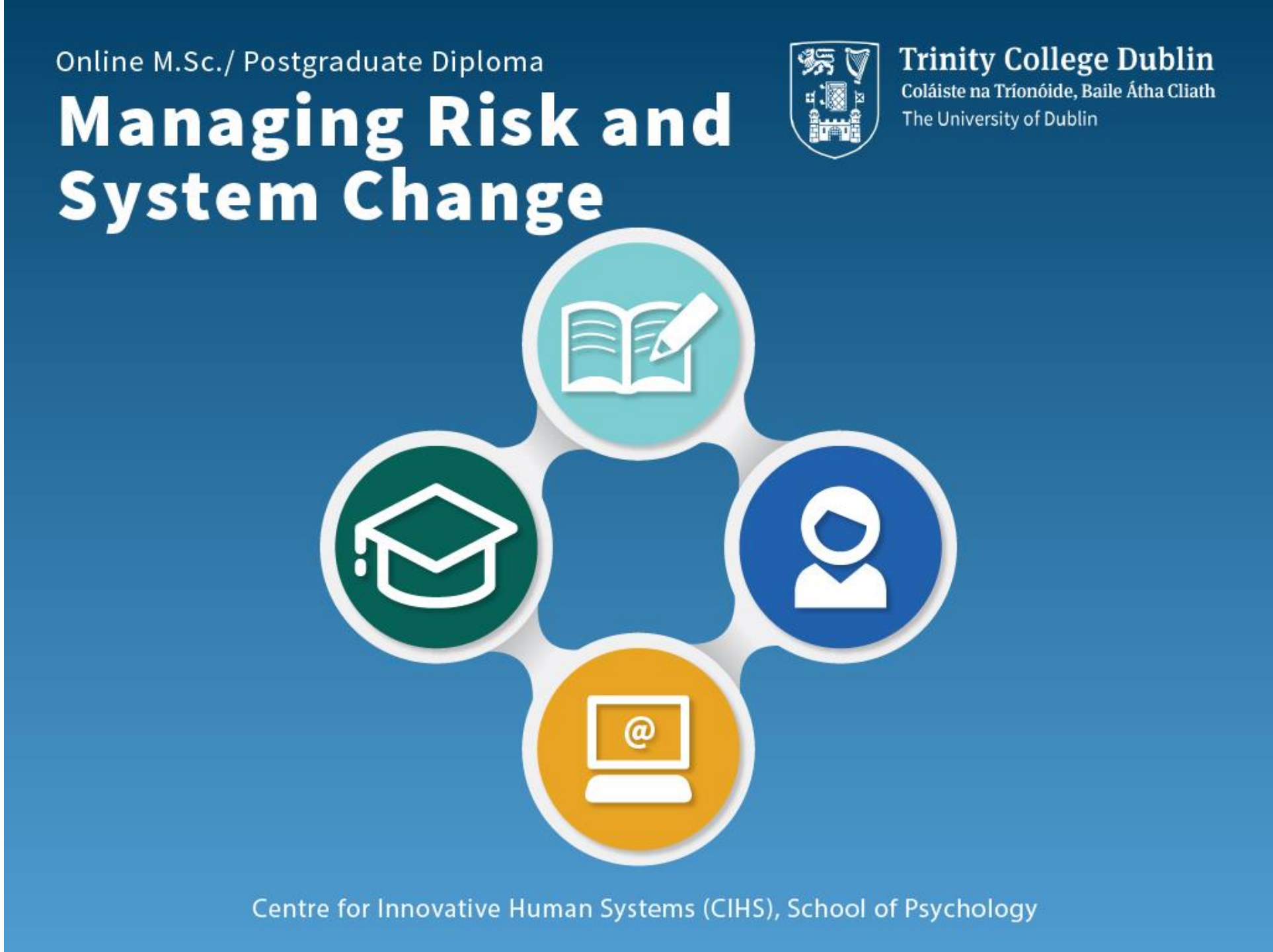
# Governance Model for Advanced Integrated Systems



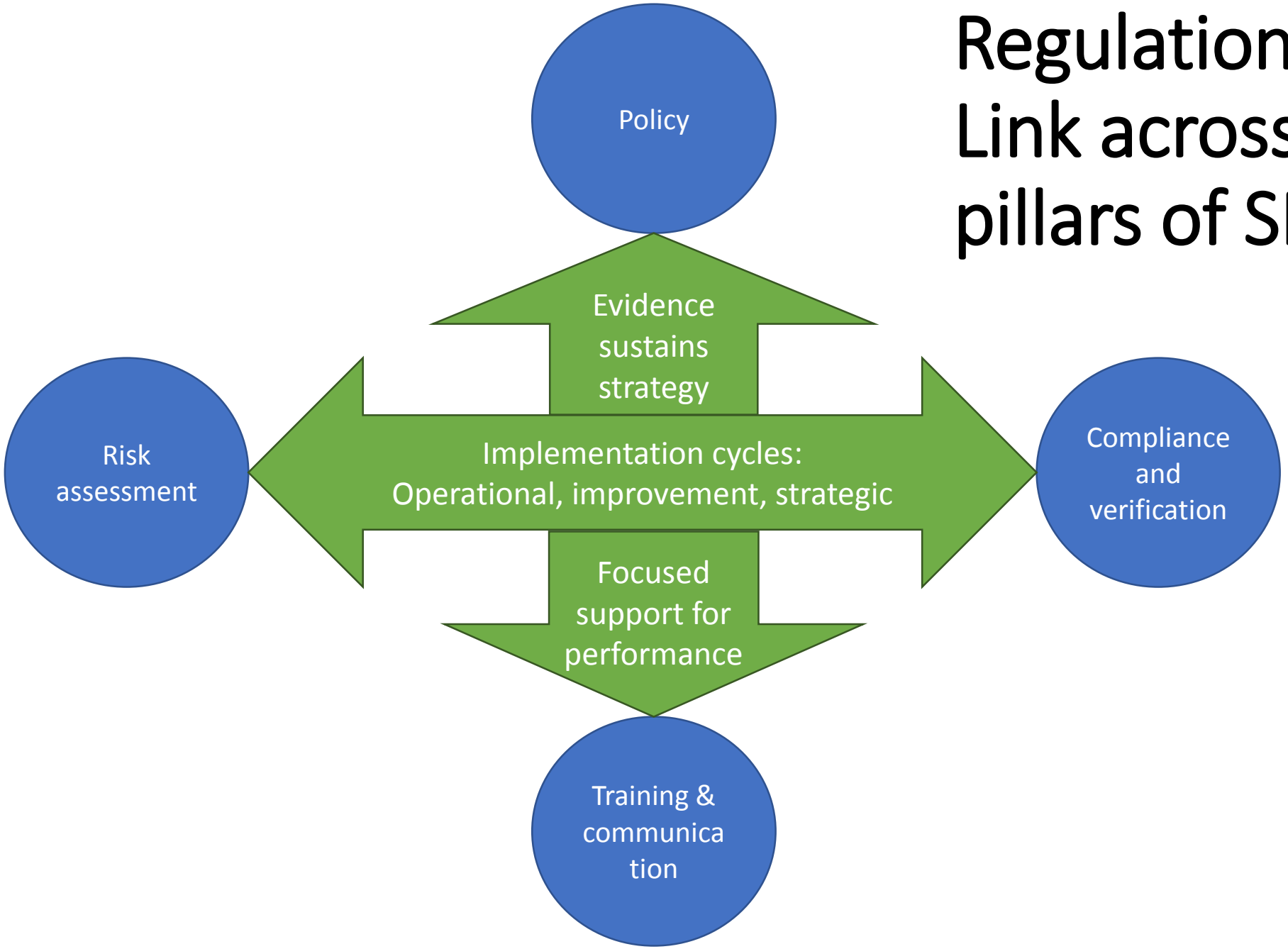
# Competence

Training for implementation of advanced SMS

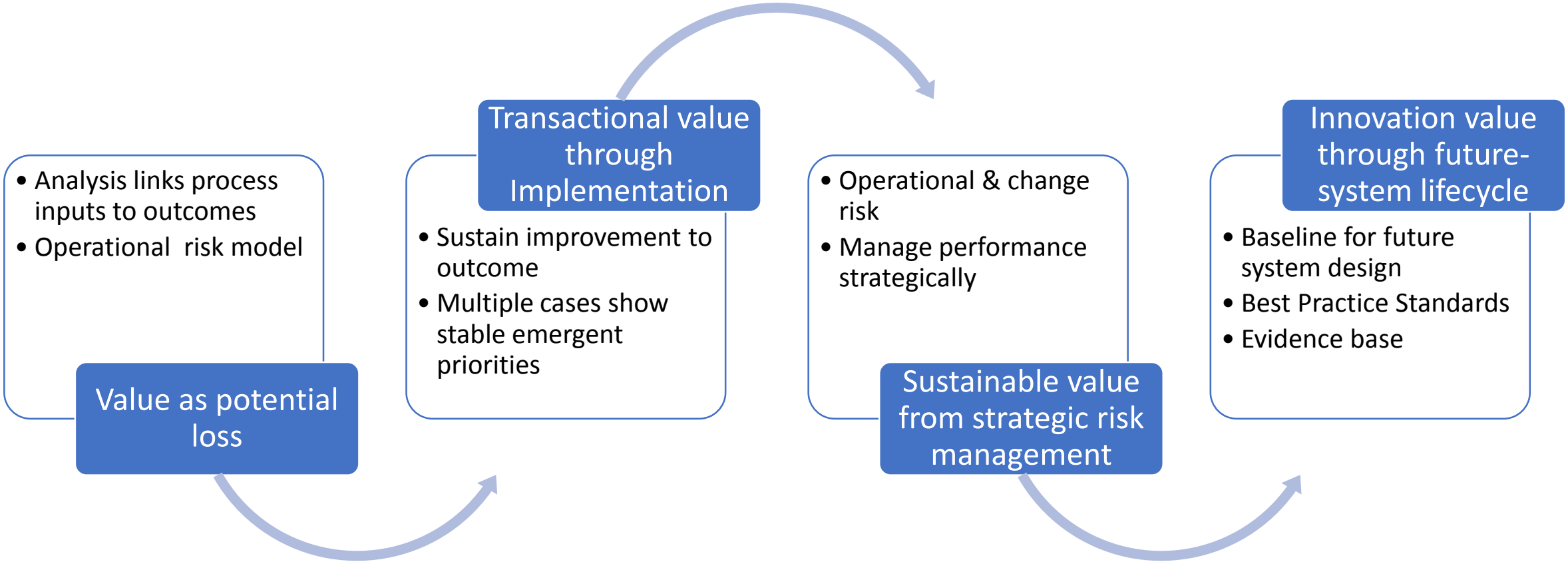
ORION project



# Regulation: Link across the pillars of SMS



# New System Design
# Knowledge Transformation delivers escalating value



# Obligation to Act

Implementation of sustainable improvement

- Importance of the problem
  - Potential loss
- Efficacy of solution
  - Projected gain
- Viable pathway
  - Reliability of gain

# Acknowledgements


| **EU Framework projects** | **HILAS, TATEM, MASCA, PROSPERO, ACROSS, FutureSkySafety** |
|---|---|
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