KTH ROYAL INSTITUTE
OF TECHNOLOGY

Risk information production
-and what you can do with it

Aviation research experiences form a human factors and safety perspective

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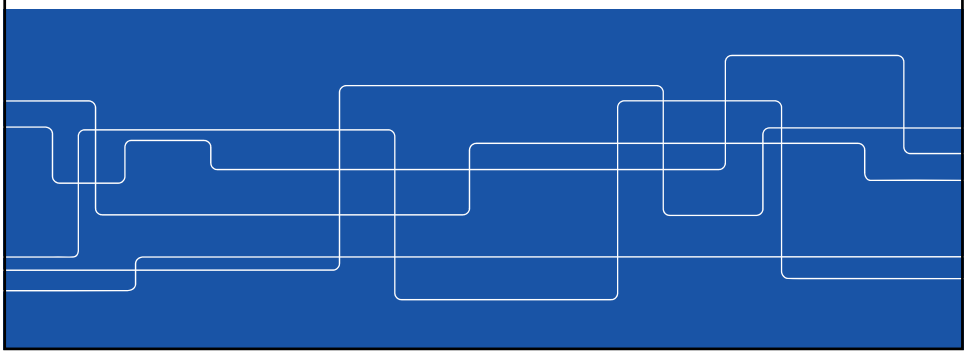

Research in EU-projects

All co-ordinated by Trinity College Dublin

Centre for innovative human systems (McDonald N.)

HILAS (EU-FP6) 2005-2009
- Human Integration into the Lifecycle of Aviation Systems

MASCA (EU-FP7) 2010-2013
- MAnaging System Change in Aviation

PROSPERO (EU-FP7) 2012-2014
- Proactive safety performance in operations

- Application in for PRAXIS, like a PROSPERO II
  – but ”Just do it!”

Concepts, domains – same but different?

- **System**
- **System view**
- Technical system
- Human-machine system
- **Work system**
- **Socio-technical system**
- **Large technical system**
- **System of systems**
- Technology reliability
- Human performance
- **System performance**
- Design of products and machine elements
- Technology development
- **Industrial management**
- **Organisational design and management**
- **Operational process**
- **Management process**
- **Risk management**
- **Safety management**
- Safety culture

What operations? Many production areas within an airline, each with their own safety rules and risk

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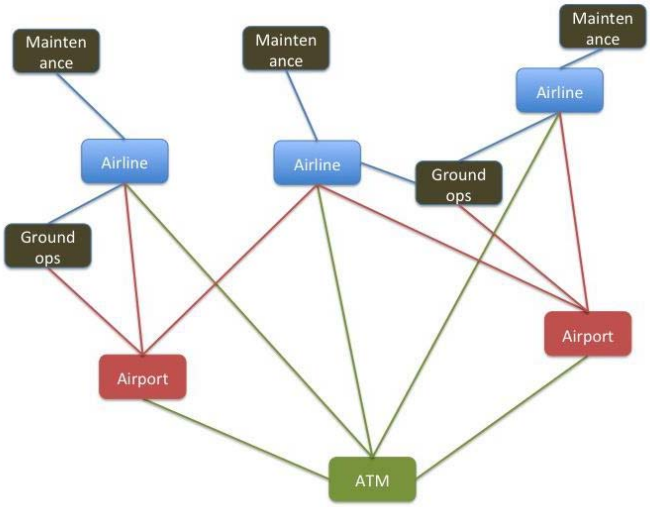
What actor in the air transportation system?

Risk transfer and propagation across actors and various operations deliver overall safety.



Desing and engineering & Human factors engineering (Ergonomics)

Technical system design
Human-machine system design
Organisational design and management

All domains have direct influence on system performance.
They set the basis for all human activity and conditions under which people work in operations.

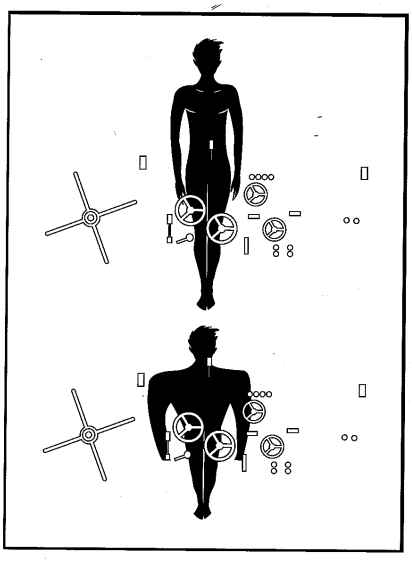
It is peoples' work that creates value, efficiency and safety!

Overall system functionality need to be understood.

Human Factors

We cannot change the human condition, but we can change the conditions under which people work!

- Reason, 1997



Figur 7.16. *Nedre bilden visar ett idealiskt utseende hos en operatör för att han ska kunna nå alla manöverdon på en svarv (Galer, 1987).*

Technology that make us SMART
Technology that make us DUMB

Enhance human abilities
Reduce human limitations

Donald Norman: Things that make us SMART, 1993

Design gap (Norman, 1986)

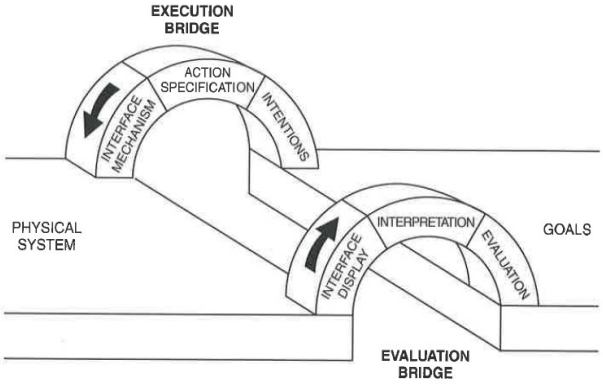


FIGURE 15.2
Bridging the gulf of execution and gulf of evaluation. (*Source:* Norman, D., 1986. Cognitive engineering. In D. A. Norman & S. W. Draper [eds.], *User-Centered System Design.* Hillsdale, NJ: Lawrence Erlbaum. Copyright ©1986. Reprinted by permission of Lawrence Erlbaum Associates.)

Figure 15.2 i Wickens et al., 2004

Four seconds after the explosion

LM1839 CSM ECS-CRYO TAB 0613
CTE 055:54:56 (55.915) GET 055:54:58 (55.916) SITE GDS09

	LIFE SUPPORT				PRIMARY COOLANT		
GF3571	LM CABIN P	PSIA		CF0019	ACCUM QTY	PCT	34.4
CF0001	CABIN P	PSIA	5.1	CF0016	PUMP P	PSID	46.7
CF0012	SUIT P	PSIA	4.1	SF0260	RAD IN T	°F	73.8
CF0003	SUIT ΔP	IN H2O	-1.64				
CF0015	COMP ΔP	P PSID	0.30	CF0020	RAD OUT T	°F	35
CF0006	SURGE P	P PSIA	891	CF1081	EVAP IN T	°F	45.9
	SURGE QTY	LB	3.67	CF0017	STEAM T	°F	64.4
O2	TK 1 CAP ΔP	PSID	-109	CF0034	STEAM P	PSIA	.161
O2	TK 2 CAP ΔP	PSID	-872	CF0018	EVAP OUT T	°F	44.2
CF0036	O2 MAN P	PSIA	105	SF0266	RAD VLV 1/2		ONE
CF0035	O2 FLOW	LB/HR	0.181	CF0175	GLY FLO	LB/HR	214.6
CF0008	SUIT T	°F	50.8				
CF0002	CABIN T	°F	65		SECONDARY COOLANT		
CF0005	CO2 PP	MMHG	1.5	CF0072	ACCUM QTY	PCT	36.8
	H2O			CF0070	PUMP P	PSID	9.1
CF0009	WASTE	PCT	24.8	SF0262	RAD IN T	°F	76.5
	WASTE	LB	13.9	SF0263	RAD OUT T	°F	46.2
CF0010	POTABLE	PCT	104.1	CF0073	STEAM P	PSIA	.2460
	POTABLE	LB	37.5	CF0071	EVAP OUT T	°F	66.3
CF0460	URINE NOZ T	°F	72	CF0120	H2O-RES	PSIA	25.8
CF0461	H2O NOZ T	°F	72	TOTAL	FC CUR	AMPS	81.45

CRYO SUPPLY			O2-1	O2-2	H2-1	H2-2
SC0037-38-39-40	P	PSIA	782	19	224.2	233.6
SC0032-33-30-31	QTY	PCT	78.04	47.04	73.64	74.03
SC0041-42-43-44	T	°F	-190	84	-417	-416
	QTY	LBS	252.4	260.0	20.72	20.83

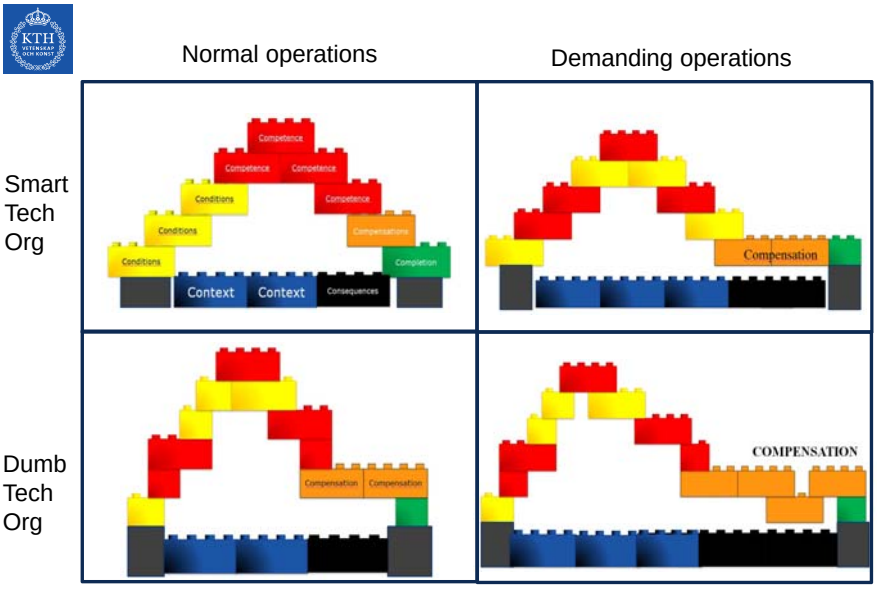
Industrial management

Management that make operations ”SMART”
Management that make operations ”DUMB”

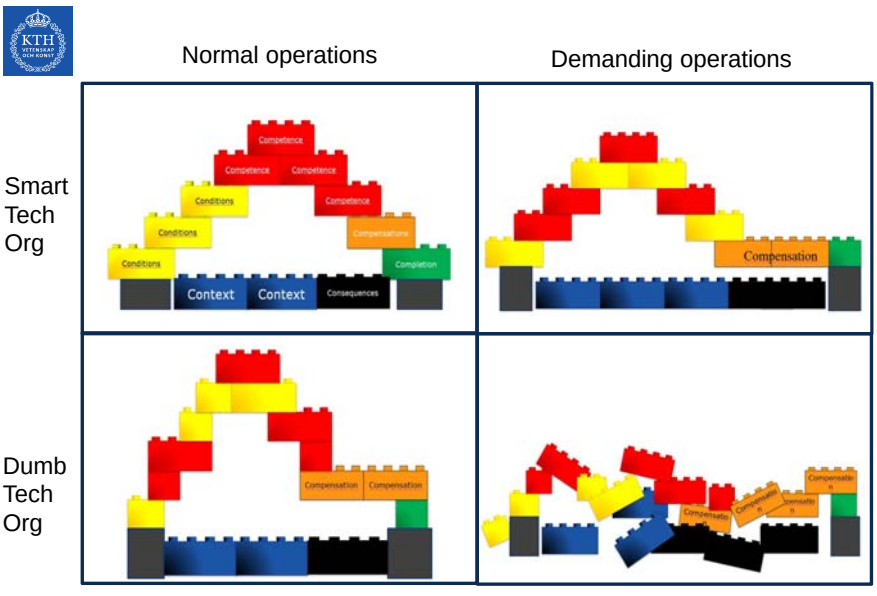
Strengthen organizational capabilities
Reduce influlence from organizational weaknesses

Building material

- **Conditions** ➢ Organisational support, giving the conditions under which you work.
- **Competence** ➢ Human operators make things work, professional skills, individual capabilities and competence.
- **Context** ➢ Standard , Critical and High risk operations, the operational context in which work is performed.
- **Contributing factors** ➢ Gaps in the conditions, and or, competence may contribute negatively to context.
- **Compensation** ➢ Perceived or real lack of support at hand in the given situation may result in compensational behaviour to get the job done!
- **Completion** ➢ Get the job done in a safe and efficient manner!



The Bridge concept (Ulfvengren, 2011)



The Bridge concept (Ulfvengren, 2011)

100% human factors?

Stupid users?
Stupid managers?
Stupid designers?

Anyhow BAD design? Why?

Incomplete risk information and access for relevant stakeholders?

- ✓ For safety operations
- ✓ For safety design
- ✓ For safety management

It is peoples' work that creates value, efficiency and safety!

The need for bottom-up, distributed authority and accountable self-regulation is essential for safety!

Safety Management System

•SMS (ICAO, 2009)

Integrated management system for safety

1. Safety policy
   Safety model, management commitment, appointments, documentation etc.
2. Safety risk management
   Hazard identification, Risk assessment and mitigation
3. Safety assurance
   Safety performance monitoring and measurement, management of change, continuous improvement of the SMS
4. Safety promotion and training
   Training, eduction, safety communication

Safety performance

”Effectiveness of the SMS, how well it performs and manage to improve the system”.

- Safety performance is **change capability**!
- Responsiveness to identified needs for change!
- Not just identify what needs to change but implementing actual and safe changes!

Managing risk = Managing change?

Risk information contribution!

We cannot change the human condition, but we can change the conditions under which people work

…by providing improved risk information!

Could this be applied also to other domains than aviation?
Could this be applied also to engineering and tech firms?

THE PROSPERO CONCEPT

PROSPERO

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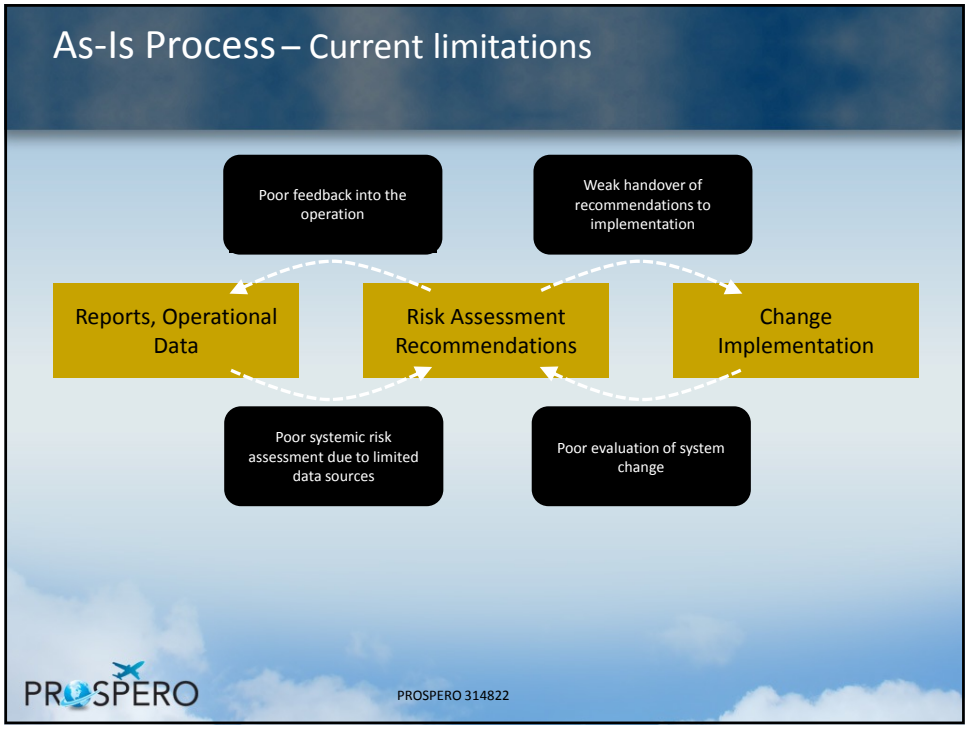
As-Is Process – Current limitations
Poor feedback into the operation
Weak handover of recommendations to implementation
Reports, Operational Data
Risk Assessment Recommendations
Change Implementation
Poor systemic risk assessment due to limited data sources
Poor evaluation of system change
PROSPERO
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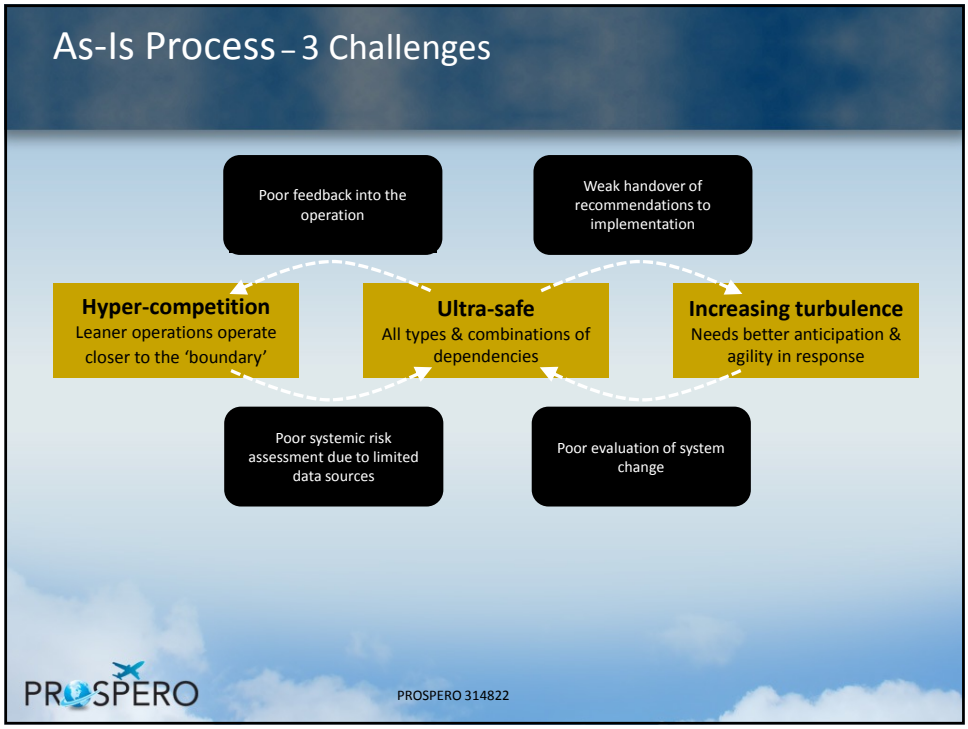
As-Is Process – 3 Challenges
Poor feedback into the operation
Weak handover of recommendations to implementation
Hyper-competition
Leaner operations operate closer to the 'boundary'
Ultra-safe
All types & combinations of dependencies
Increasing turbulence
Needs better anticipation & agility in response
Poor systemic risk assessment due to limited data sources
Poor evaluation of system change
PROSPERO
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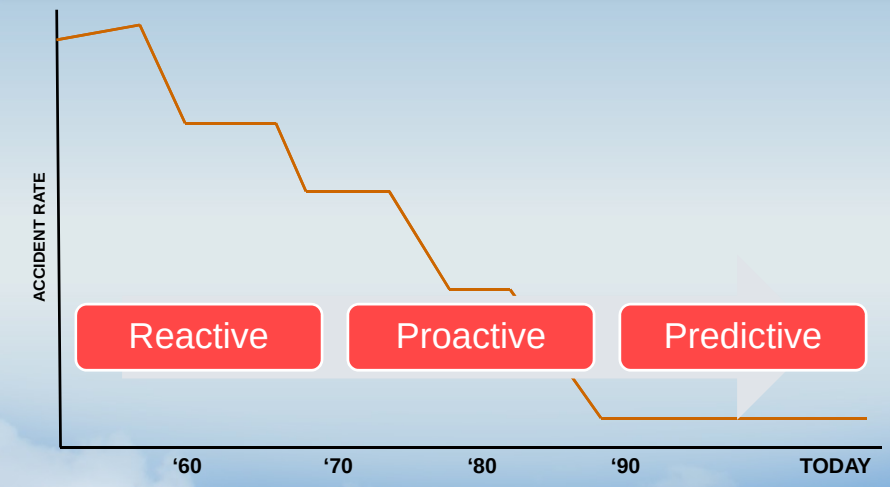
Evolution of Safety Management from Reactive to Predictive



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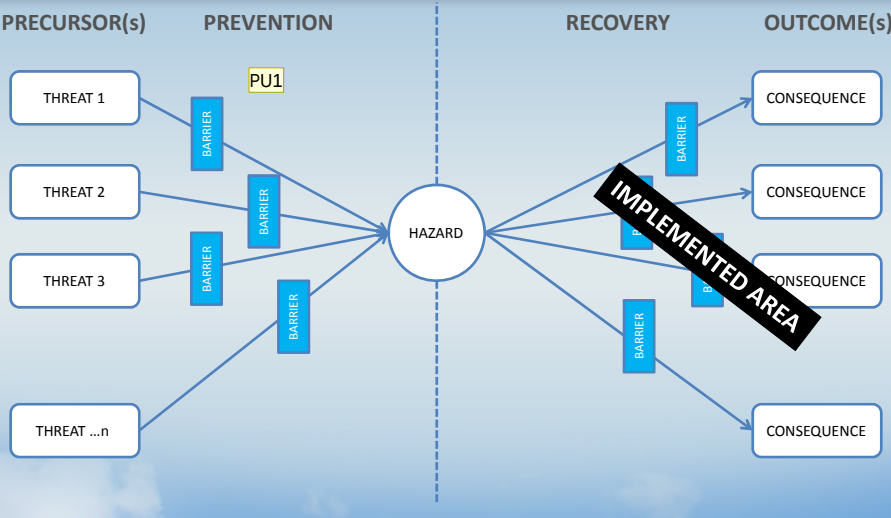
Current primary focus of operational safety effort



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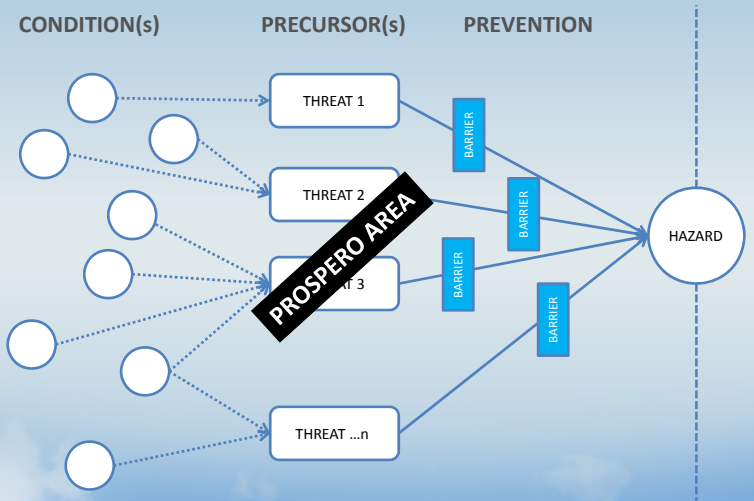
PROSPERO seeks to shift the focus to antecedent conditions and precursors



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PROSPERO – Needs and Objectives

Predict combined effects of seemingly harmless variables

Regulate safety against operational performance criteria

Reduce high failure rate of change initiatives

PROSPERO

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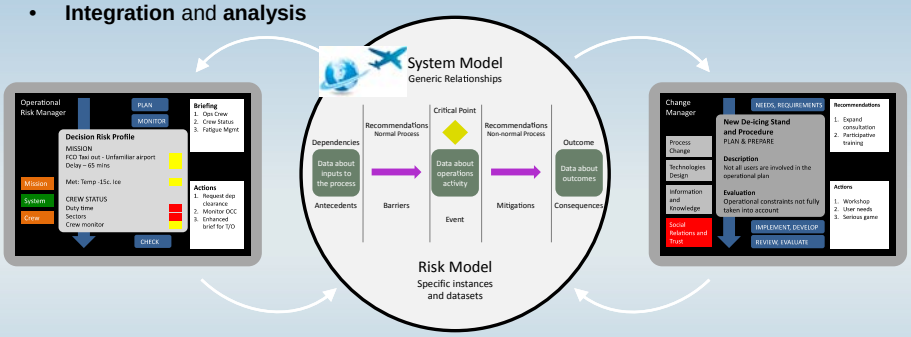
PROSPERO To-Be Process

Normal operational data feeds the **system risk model**

- **Integration** and **analysis**



Two activation and feedback loops

- **Pattern matching** and feed forward to operational crew
- **Managing change** to reduce system risk and **mitigate risk in change**

Combining data from different ATS partners enables an ATS system risk pattern

PROSPERO

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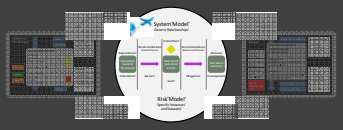
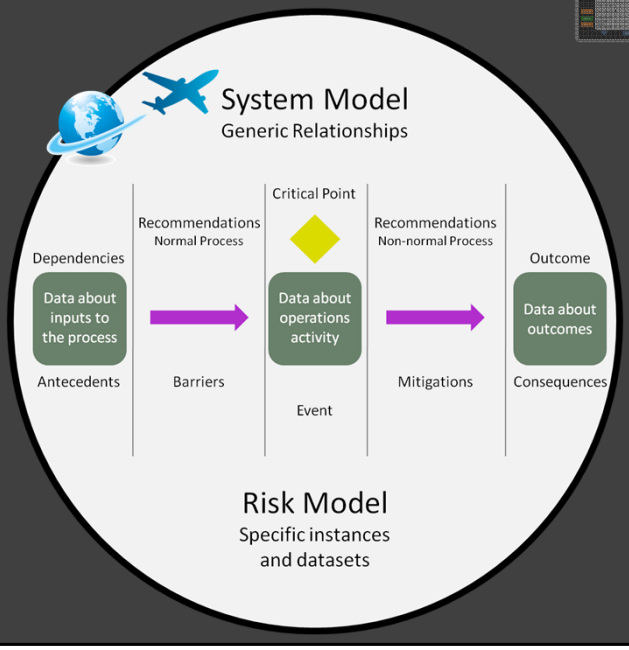
PROSPERO System Risk Model





Dependencies / Antecedents

All available data about:
Crew Factors
Aircraft status
Route
Weather
NOTAMS

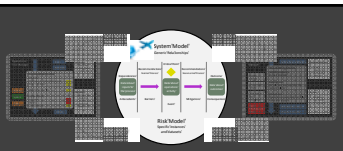
Bow-tie

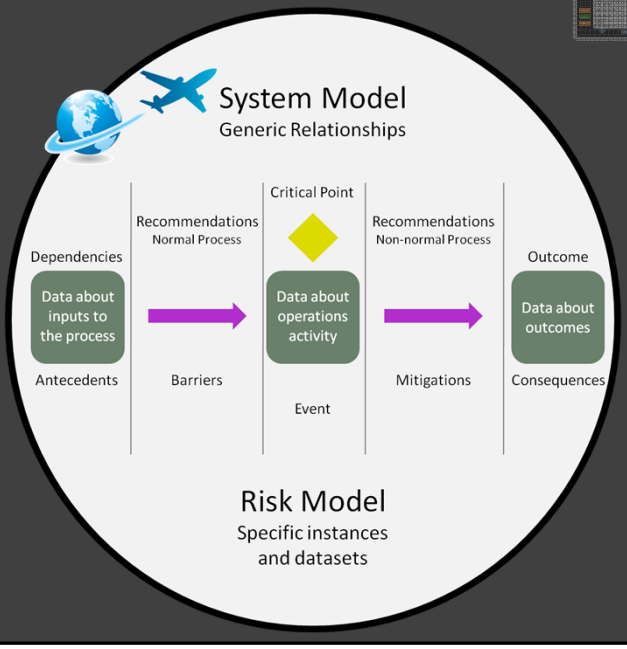
Links analysis of activity / event to general system model

Critical points

Recommendations propose barriers & mitigations in propagation of uncertainty

PROSPERO System Risk Model





Systemic – Complex System Interactions

Common models of operation

Consistent valid risk assessment

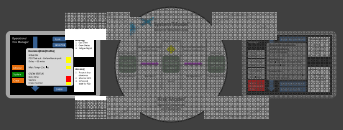
Model future system and project future system risk

Scalable

Accountable and transparent management of operational risk can be scaled up from local to global system level

Within organisations & between (system of systems)

PROSPERO Operational Loop



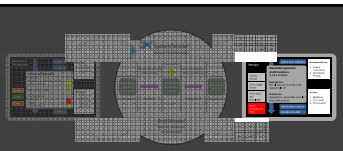
Distributed Authority

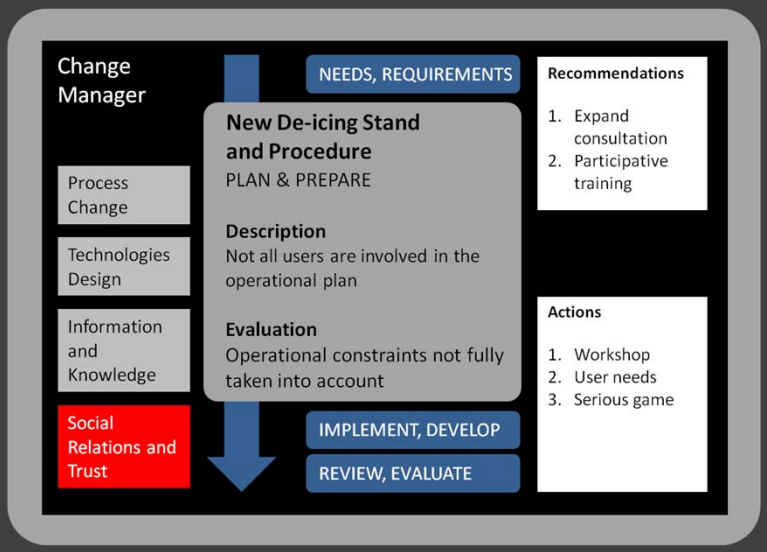
A tailored risk profile for each operation supports crew/staff at all levels in managing their operation

Accountable Self-Regulation

Feedback enables transparent management of risk between core and periphery

PROSPERO Change Loop





Distributed Authority
A tailored risk profile for each initiative supports crew/staff at all levels in managing change

Accountable Self-Regulation
Feedback enables transparent management of risk between core and periphery

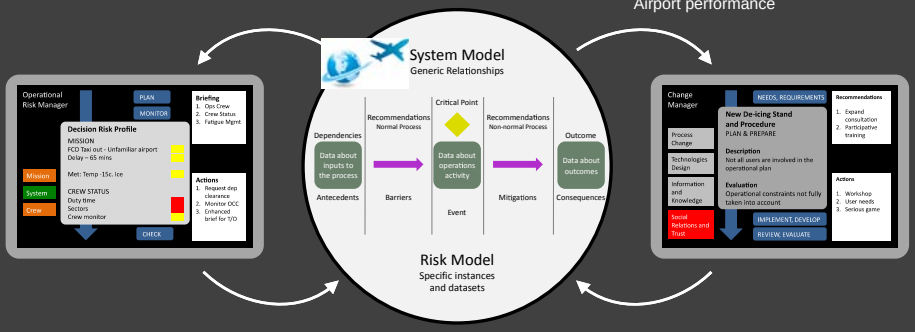
PROSPERO – Progress and Benefits

Progress

Common risk approach
Airline and airport
ATM performance simulation

Data integration
Initial demonstration
Ongoing analyses

Change case studies
ACDM
New De-icing stand
Airport performance



Performance focus
Data driven
Verifiable improvement
Proactive – actively managing all known risks

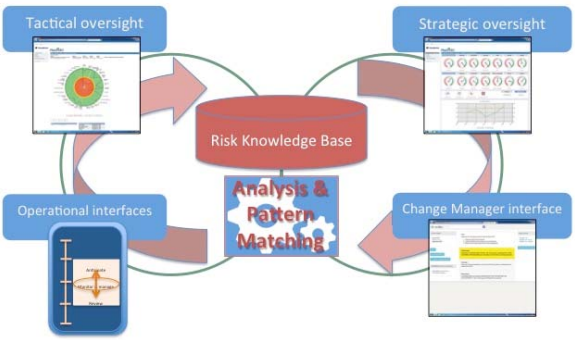
Integrated Management System
Safety partners with other risk stakeholders

Lean SMS – less bureaucracy, more embedded

Resilient & preventive
Support for leading and managing change
Manage the risk in change
Verifiable risk reduction through change

Benefits / Value

PRAXIS, coming soon????



Thank you!

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