Network Manager
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Systems Thinking
Learning Cards

Moving towards Safety-II

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

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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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Principle 1. Field Expert Involvement

The people who do the work are the specialists in their work and are critical for system improvement

To understand work-as-done and improve how things really work, involve those who do the work.

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Practical advice

- **Enable access and interaction.** Managers, safety specialists, designers, engineers, etc., often have inadequate access and exposure to operational field experts and operational environments. To understand and improve work, ensure mutual access and interaction.
- **Consider the information flow.** Field experts of all kinds (including system actors, designers, influencers and decision makers), need effective ways to raise issues of concern, including problems and opportunities for improvement, and need feedback on these issues.
- **Field experts as co-investigators and co-researchers.** Field experts should be active participants – co-investigators and co-researchers – in investigation and measurement, e.g. via interviews, observation and discussions, data analysis, and synthesis, reconstruction and sense-making.
- **Field experts as co-designers and co-decision-makers.** Field experts need to be empowered as co-designers and co-decision-makers to help the organisation improve.
- **Field experts as co-learners.** All relevant field experts need to be involved in learning about the system.

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http://bit.ly/1-FE

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Principle 2. Local Rationality

People do things that make sense to them given their goals, understanding of the situation and focus of attention at that time

Work needs to be understood from the local perspectives of those doing the work.

Systems Thinking Principles

Practical advice

- **Listen to people's stories.** Consider how field experts can best tell their stories from the point of view of how they experienced events at the time. Try to understand the person's situation and world from their point of view, both in terms of the context and their moment-to-moment experience.
- **Understand goals, plans and expectations in context.** Discuss individual goals, plans and expectations, in the context of the flow of work and the system as a whole.
- **Understand knowledge, activities and focus of attention.** Focus on 'knowledge at the time', not your knowledge now. Understand the various activities and focus of attention, at a particular moment and in the general time-frame. Consider how things made sense to those involved, and the system implications.
- **Seek multiple perspectives.** Don't settle for the first explanation; seek alternative perspectives. Discuss different perceptions of events, situations, problems and opportunities, from different field experts and perspectives. Consider the implications of these differential views for the system.

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http://bit.ly/2-LR

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Principle 3. Just Culture

People usually set out to do their best and achieve a good outcome

Adopt a mindset of openness, trust and fairness. Understand actions in context, and adopt systems language that is non-judgmental and non-blaming.

Systems Thinking Principles

Practical advice

- **Reflect on your mindset and assumptions.** Reflect on how you think about people and systems, especially when an unwanted event occurs and work-as-done is not as you imagined. A mindset of openness, trust and fairness will help to understand how the system behaved.
- **Mind your language.** Ensure that interviews, discussions and reports avoid judgemental or blaming language (e.g. "You should/could have…", "Why didn't you…?", "Do you think that was a good idea? "The controller failed to…", "The engineer neglected to…"). Instead, use language that encourages systems thinking.
- **Consider your independence and any additional competence required.** Reflect on whether you are independent enough to be fair and impartial, and to be seen as such by others. Also consider what additional competence is needed from others to understand or assess a situation.

Read more
http://bit.ly/3-JC

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Principle 4. Demand & Pressure

Demand and pressures relating to efficiency and capacity have a fundamental effect on performance

Performance needs to be understood in terms of demand on the system and the resulting pressures

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Practical advice

- **Understand demand over time.** It is important to understand the types and frequency of demands over time, whether one is looking at ordinary routine work, or a particular event. Identify the various sources of demand and consider the stability and predictability of each. Ask field experts how they understand the demands.
- **Separate value and failure demand.** Where there is failure demand in a system, this should be addressed as a priority as it often involves rework and runs counter to the system's purpose.
- **Look at how the system responds.** When the system does not allow demand to be met properly, more pressure will result. Consider how the system adjusts and adapts to demand, and understand the trade-offs used to cope. Listen to field experts and look for signals that may indicate trouble.
- **Investigate resources and constraints.** Investigate how resources and constraints help or hinder the ability to meet demand.

Read more
http://bit.ly/4-DP

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Principle 5. Resources & Constraints

Success depends on adequate resources and appropriate constraints

Consider the adequacy of staffing, information, competency, equipment, procedures and other resources, and the appropriateness of rules and other constraints.

Systems Thinking Principles

Practical advice

- **Consider the adequacy of resources.** With field experts, consider how resources (staff, equipment, information, procedures) help or hinder the ability to meet demand, and identify where there is the opportunity for improvement.
- **Consider the appropriateness of constraints.** Consider the effects of constraints (human, procedural, equipment, organisational) on flow and system performance as a whole. Reflect on the implications for individuals and the system when people have to work around constraints in order to meet demand.

Read more
http://bit.ly/5-RC

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Principle 6. Interactions & Flows

Work progresses in flows of inter-related and interacting activities

Understand system performance in the context of the flows of activities and functions, as well as the interactions that comprise these flows.

Systems Thinking Principles

Practical advice

- **Understand and measure flow.** Investigate the flow of work from end to end through the system. Map the variability of flows and anything that obstructs, disrupts, delays or diverts the flow of work (e.g. preconditions not met, constraints, or unusual events). Consider how flow is measured, or could be measured, and the role of field experts in measuring and acting on flow.
- **Analyse and synthesise interactions.** Consider how to model past, present or future system interactions between human, technical, information, social, political, economic and organisational elements. Think about what systems methods to use and how to involve relevant field experts to help understand the interactions.

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http://bit.ly/6-IF

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Principle 7. Trade-Offs

People have to apply trade-offs in order to resolve goal conflicts and to cope with the complexity of the system and the uncertainty of the environment

Consider how people make trade-offs from their point of view and try to understand how they balance efficiency and thoroughness in light of system conditions.

Systems Thinking Principles

Practical advice

- **Take the field experts' perspectives.** Data collection and interpretation are limited to what field experts can tell us. Assume goodwill and seek to understand their local rationality to consider how people make trade-offs from their point of view, balancing efficiency and thoroughness in light of system conditions.
- **Get 'thick descriptions'.** A thick description of human behaviour (Geertz, 1973) is one that explains not just the behaviour, but its context as well, such that the behaviour becomes meaningful to an outsider. This comprises not only facts but also commentary and interpretation by field experts. Use these thick descriptions in investigations of routine work and adverse occurrences.
- **Understand the system conditions.** Use observation and discussion to understand how and when trade-offs occur with changes in demands, pressure, resources and constraints.

Read more
http://bit.ly/7-TO

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Principle 8. Performance Variability

Continual adjustments are necessary to cope with variability in demands and conditions. Performance of the same task or activity will vary

Understand the variability of system conditions and behaviour. Identify wanted and unwanted variability in light of the system's need and tolerance for variability

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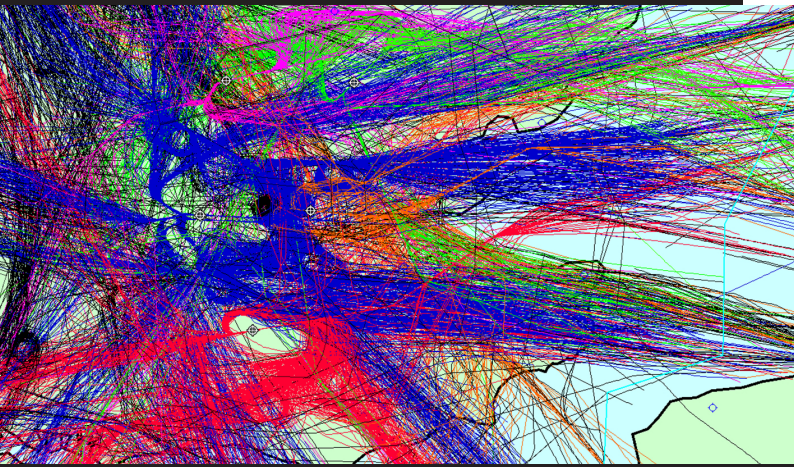

Practical advice

- **Understand variability past and present.** Try to get a picture of historical variation in system performance. Consider what kind of variation can be expected given the experience base, how performance varies in unusual ways, and what is wanted and unwanted in light of the system's need for, and tolerance of, variability.
- **Be mindful of drift.** Variability over the longer term can result in drift into an unwanted state. Consider what kind of measurements might detect such drift.
- **Understand necessary adjustments.** Operators must make continuous adjustments to meet demand in variable conditions. The nature of these adjustments and adaptations needs to be understood in normal operations, as well as in unusual situations.

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http://bit.ly/8-PV

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Principle 9. Emergence

System behaviour in complex systems is often emergent; it cannot be reduced to the behaviour of components and is often not as expected

Consider how systems operate and interact in ways that were not expected or planned for during design and implementation.

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Practical advice

- **Go 'up and out' instead of going 'down and in'.** Instead of first digging deep into a problem or occurrence to try to identify the 'cause', look at the system more widely to consider the system conditions and interactions.
- **Understand necessary variability.** Try to understand why and where people need to adjust their performance to achieve goals. Instead of searching for where people went wrong, understand the constraints, pressures, flows and adjustments. Integrate field experts in the analysis.
- **Make patterns visible.** Look for ways to probe and make visible the patterns of system behaviour over time, which emerge from the various flows of work.
- **Consider cascades and surprises.** Examine how disturbances cascade through the system. Look for influences and interactions between sub-systems that may not have been thought to be connected, or were not expected or planned for during design and implementation.

Read more
http://bit.ly/9-EM

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Principle 10. Equivalence

Success and failure come from the same source – ordinary work

Focus not only on failure, but also how everyday performance varies, and how the system anticipates, recognises and responds to developments and events.

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Practical advice

- **Understand everyday work.** To understand success and failure, we need to understand ordinary work and how work is actually done. Consider end-to-end flows and interactions, trade-offs and performance variability in the context of the demands and pressures, and the resources and constraints. Use a safety occurrence as an opportunity to understand how the work works and how the system behaves.
- **Observe people in context.** This can be done using a variety of observational approaches, formal and informal. It is not about checking compliance with work-as-imagined, but rather seeing and hearing how work is done (including how people adjust performance and make trade-offs), in a confidential and non-judging context.
- **Talk to field experts about ordinary work.** Observation is important, but alone it is insufficient to understand work-as-done. Talking to people in discussion (e.g. talk-through sessions, focus groups) helps to understand the how and why of work-as-done.
- **Improve resilience with systems methods.** Use systems methods to understand how the system anticipates, recognises and responds to developments and events.

Read more
http://bit.ly/10-EQ