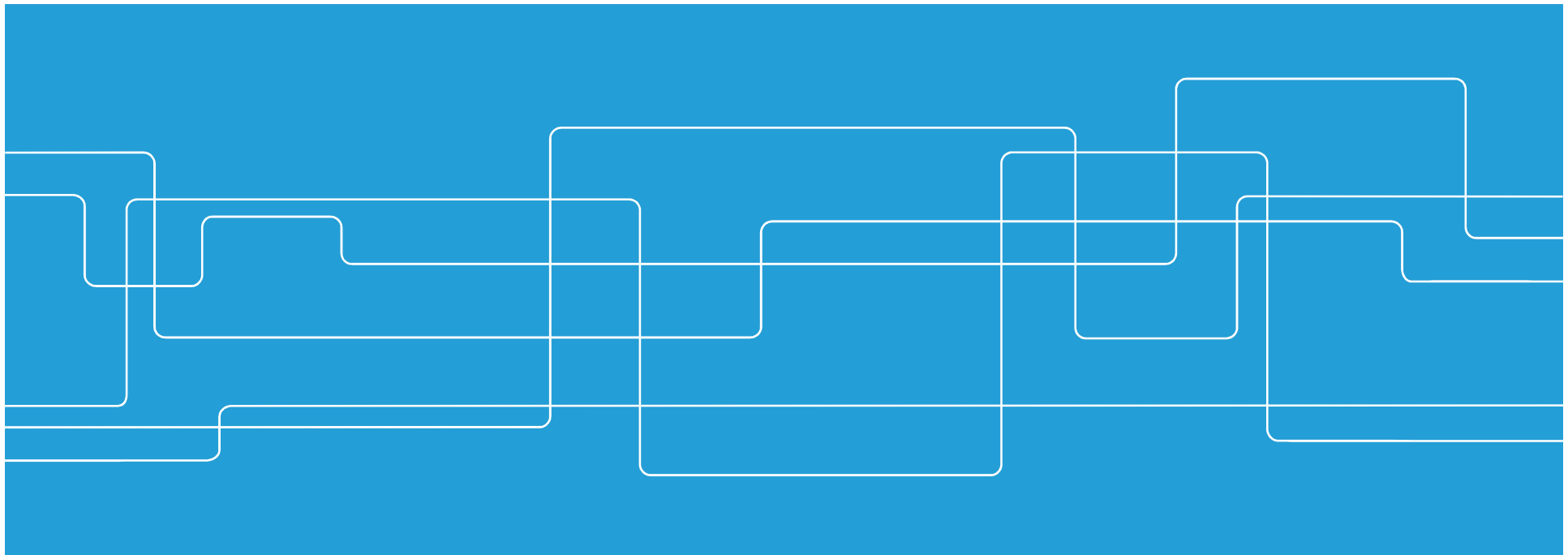




KTH ROYAL INSTITUTE
OF TECHNOLOGY

INFRA – Internalizing noise into a split system of system

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INFRA PROJECT

This presentation is a state of art discussion of the project.

The project still has 18 mths to go.





Issue with noise – background for research

- **General**
 - Airports situated close to metropolitan areas
 - Growth of metropolitan areas surrounding airport
 - More local inhabitants exposed to aviation noise
 - Increase of traffic
- **Case**
 - New runway changed noise exposure and perceived noise
 - Neighbours filed complaint
- **Research** initiatives to address noise in aviation
 - INFRA is funded by TRV through KTH centre for sustainable aviation



Noise in aviation and its mechanisms

- 1) Reduce noise by increasing distance between the noise source and the area effected by noise
 - Change landing approaches
 - Placement / position of airports and runways
 - Placement / position of building areas and neighbours
- 2) Reduce noise from flying and from aircrafts
 - Reduced speed
 - Break with air more silent
 - New technology for engines, airframes and profiles
- 3) Increase amount of noise protection.
 - Noise protecting windows, noise fences, facing windows and doors away from noise
- 4) Less air traffic
 - Share and spread out traffic and noise
 - Fly less...



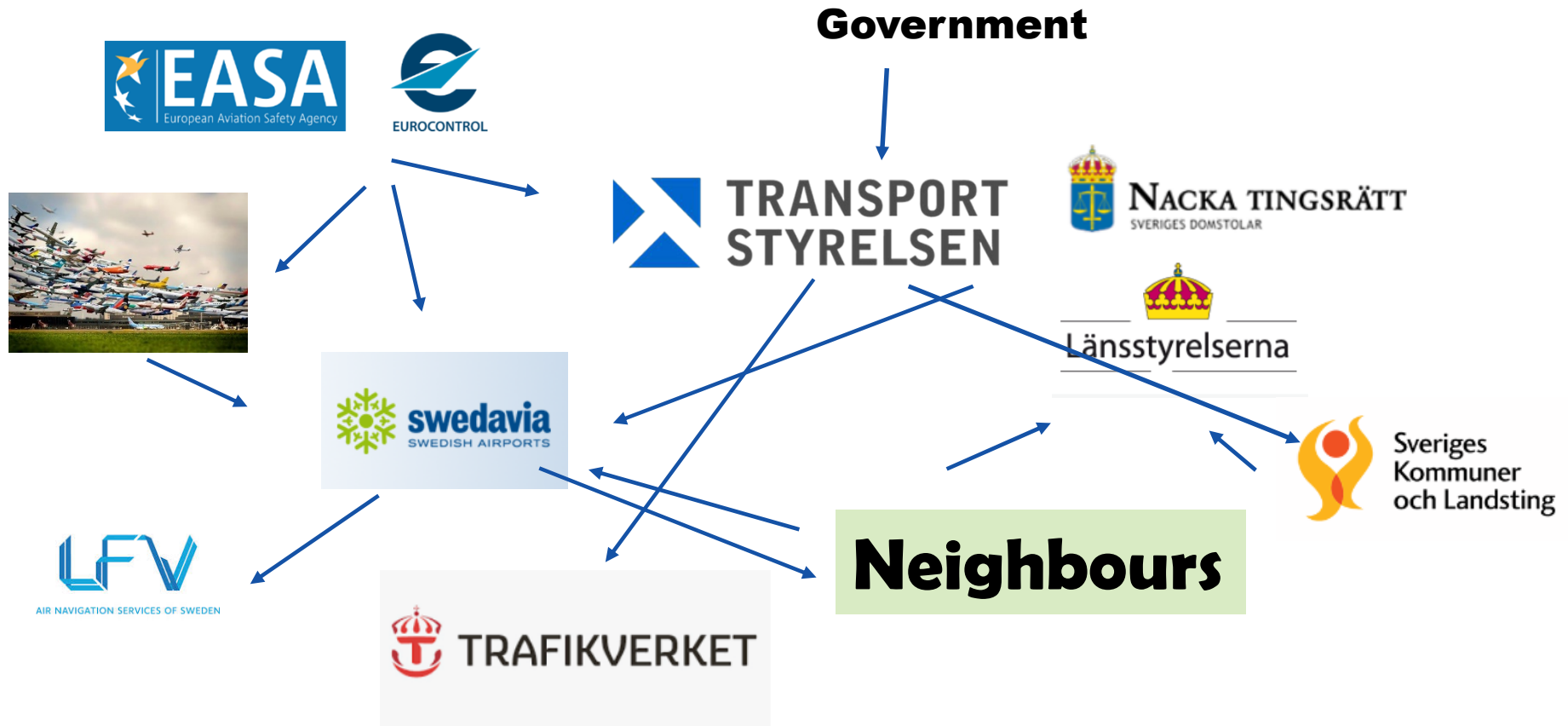
System change – inevitable!

- Regardless of initiative and suggested solutions...
- A system change is inevitable to reduce noise and related issues.
- The "system of interest" is the infrasystem - aviation
- A system change is needed since no single stakeholder or actor can reduce noise issues alone.



INFRA

– aviation studied as an infrastructural system



Still not comprehensive!



Understanding our system of interest

- Actors and functions in this system or network are interdependent and have relations with others.
- These relations are of great importance and is crucial for how our aviation system define noise issues, produce noise and handle potential reduction of noise or issues related to this.
- Analysis of this system, its structure, actors, relations, is a first and important step in understanding how it works and system change and development.
- System model?



Value of our system model

With this infrastructural system model of aviation, the complexity of required system changes to reduce noise becomes more accessible to all actors in the network.

Understanding systems perspectives – systems thinking

This system model may also facilitate an internalisation of noise and other external stressors towards sustainable aviation allowing for a more holistic approach to requirements for implementation of changes in the future.



Method selection and data collection

Broad interview study

- General system theory concepts (system of system)
- Sociotechnical models

Comparison with other infrastructural system and change

Sociotechnical system models (firms, business, industry, society)

Theory mapping challenge

- Large technical system
- Multiple Level Perspective
- Actor Network Theory



Broad interview study

- Transportation agency
- Transport administration
- Airports
- Air service providers
- Environmental protection agency
- Neighbours
- House and land owners
- Municipals
- County board
- Land and environmental jurisdiction



Different perspectives create dilemmas

Noise and emissions – Local and Global – Now and Then

- Noise reduction initiatives potentially increase emissions
- Priority on climate and environmental aspects may escalate noise issues
- Noise affects individuals locally in time and space
- Emissions affects the environment globally and long-term

Noise and safety

- Innovations and alternative flight paths may exist but may not be assessed safe enough

Accessibility and noise.

- Politicians raise demands for increased accessibility and growth
- Increased aviation to largest cities is of national interest
- Swedish airports need to be competitive
- National noise regulations may affect competitiveness of European airports

Regional growth and noise

- Municipals and regions want to grow with more people, industry and transport
- Desperate for housing in large cities, limits airports growth potential

Discrepancy on how to interpret guidance for noise levels

- Different actors interpret guidance different for their purposes

Examples of earlier infrastructure system change





Technical system or artefact?

- Traditional 'artefact' engineering are focused on stand-alone objects with a specific technical function.
- Systems engineering is focused on the design of complex combinations of technical artefacts.
- The meaning of the notions of scale and complexity is highly context-dependent.
- A technical artefact from one perspective may appear as a complex technical system from another.
- Aircraft can be considered as technical artefacts within a high-level analysis of civil aviation as a public transport system, but complex technical systems by themselves when looked upon from the point of view of aircraft design...
- **So, it depends!**



System models and representations

System level models



Increasing structuration of activities in local practices

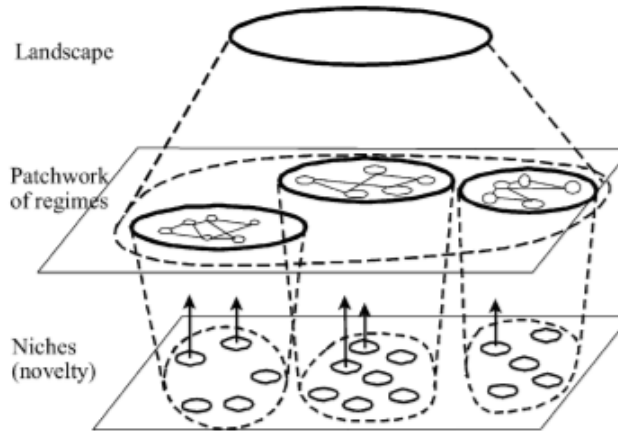
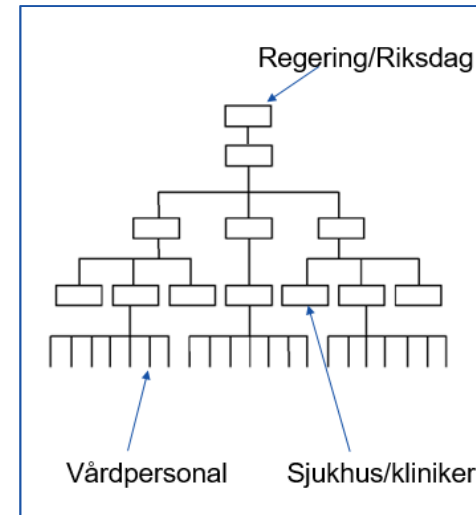
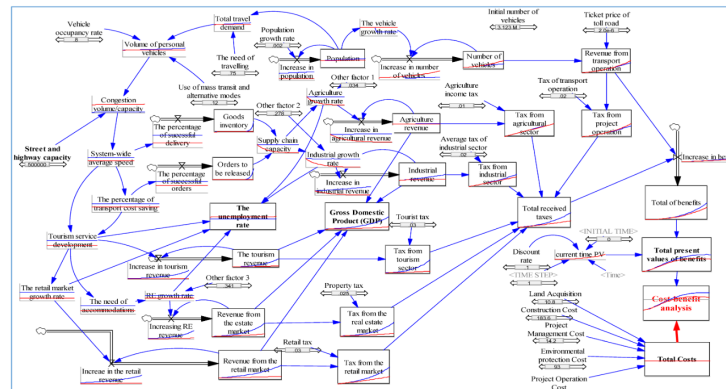
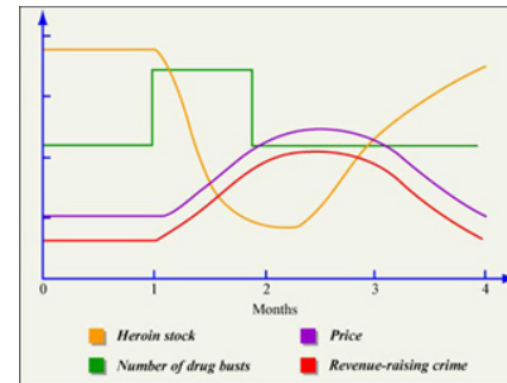


Fig. 8. Multiple levels as a nested hierarchy (Geels, 2002a).



Hierarchical models



Dynamic models

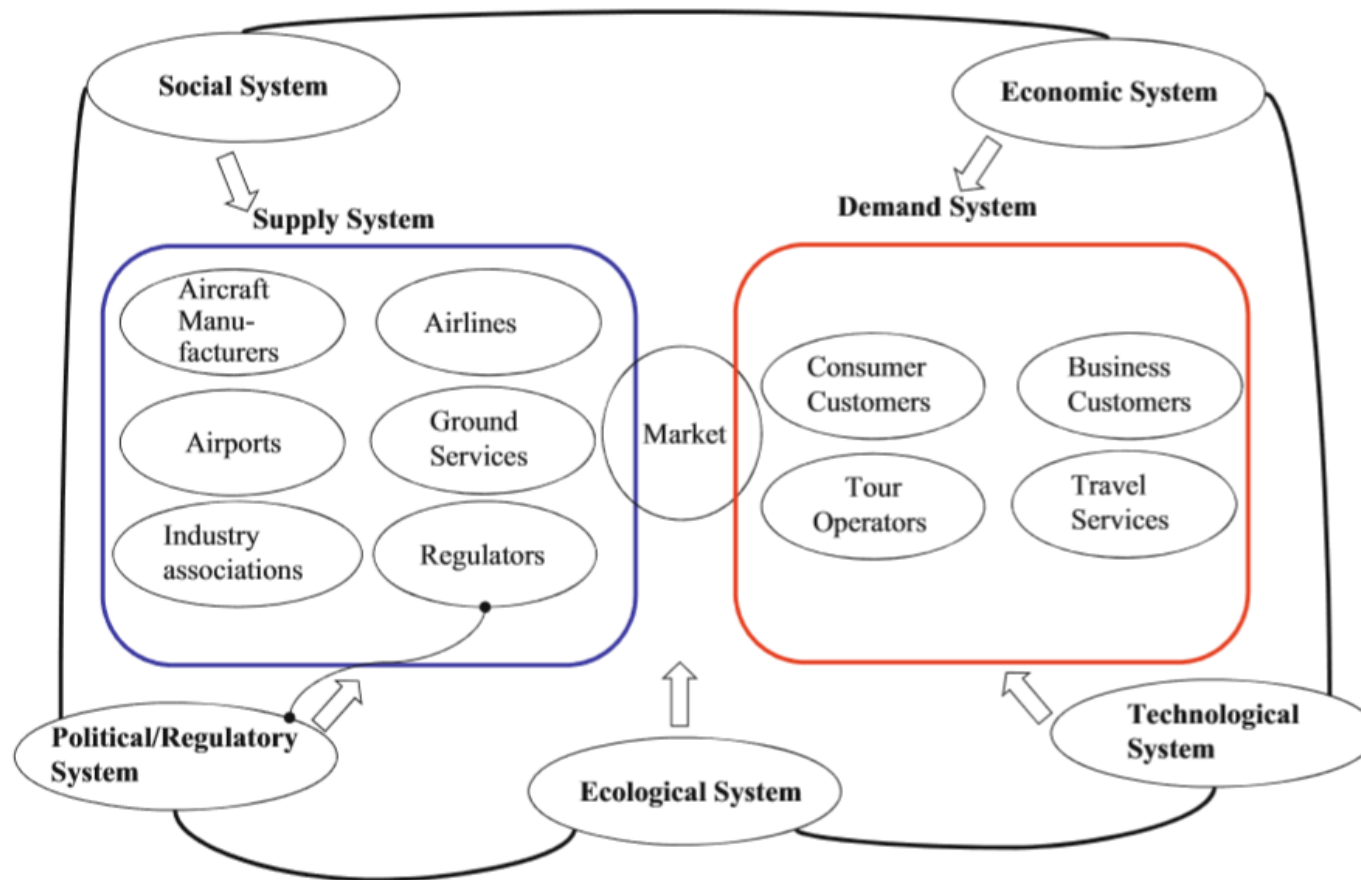


Modeling perspectives

Different aspects can be represented in the model:

- Structural – components, sub-system, parts
- Functional – process with input and output – what it does
- Behavioral/Processual – how
- Communication
- Actors and roles
- ...

The aviation system (sociotechnical)



The aviation system (Source: Bieger/Wittmer)



What kind of system is "our" aviation?

The aviation system model includes different environments, such as the **economic, ecological, social, technological and political** environments, which are the platform of the aviation market.

The fact that there are various fields of development indicates that the industry development is **not only influenced by the industry actors themselves also by its structures and institutional** surroundings.

- Bieger, Wittmer



System boundaries and internalisation

External – what is outside

Internal – what is inside

Externalities – cost or benefit that affects a party that did not choose to incur in that cost or benefit

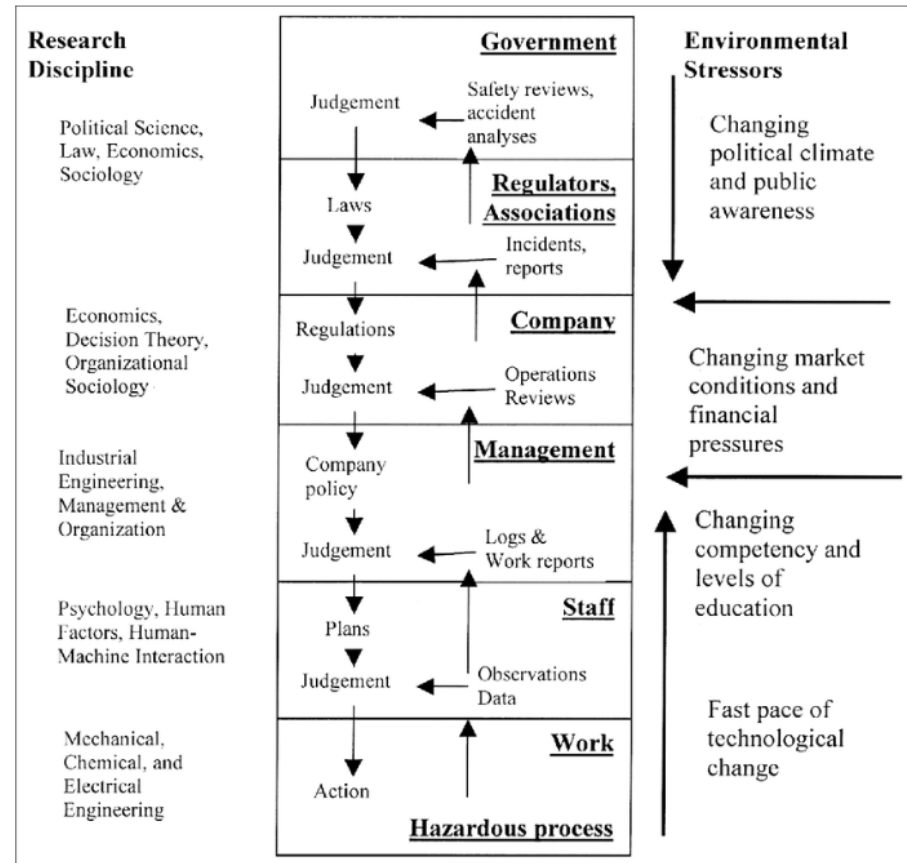
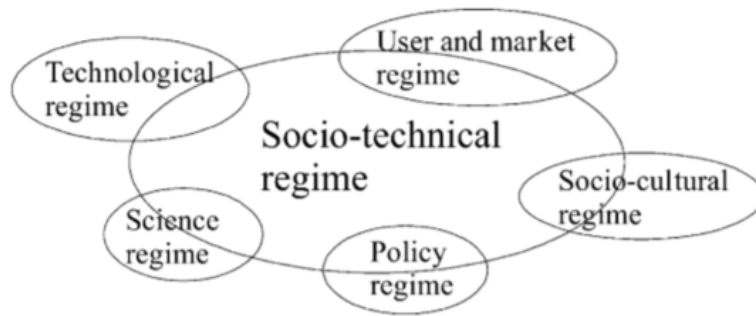
Internalisation – changing what is internal

Noise is a bi-product

- an externality about to become internalised..



System perspectives of regime / research



The socio-technical system involved in risk management (Rasmussen, 1997)



Theories of LTS and MLP

In the INFRA project, aviation is analysed as a large technical system (LTS) – an *infrasystem*. Our purpose is to investigate how *noise* is perceived and handled systemically.

Hughes and others stresses that a mature LTS is deeply embedded in society and not easily changed or transformed. The system culture in a mature socio-technical system such as aviation is conservative.



Alignment

Goal conflicts at a political level

Balancing goals for transport top-down

- Climate and sustainability
- Growth and accessibility



Split system of systems

Our key finding is that the aviation system is split into two actor networks when it comes to noise management: the *network of noise* exist in parallel with the *network of growth*.

Results show that a split system from top-down strategies, through policies and laws, through city planning and companies and industry sector induce dilemmas, even conflicts and breaches of trust all the way down to individual neighbours.



As if system of systems was not enough...

If one mature system or network that is deeply embedded in society is challenging to change then two mature networks may be more than twice as challenging to transform.

This is different from common challenges known in system of systems, where at least the intention, will and trust to manage interoperability among system for a common functionality exist.

Our findings suggests that it may be more than twice as challenging to transform a *split system* than the already known challenge to transform only one mature system. Including two opposing actor networks differs from common challenges known in “system of systems”, where at least the intention, will and trust to manage interoperability among system for a common functionality exist.



Summing up

With our system model of aviation, the complexity of required system changes to reduce noise becomes more accessible to all actors in the network.

Our system model may also facilitate an *internalisation* of noise and other external stressors towards sustainable aviation allowing for a more holistic approach to requirements for implementation of changes in the future.



Frågor?

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