

Short overview of the project Resilience 2050

Faster recovery after the impact of disturbances

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Knowledge for Tomorrow



Problem

- Disturbances influence operational activities of the ATM system

*How can the operational **state** of the system be restored faster?*



Project goals

- Resilience is a property of ecological, socio-ecological and socio-technical systems
- **Applying** resilience on the ATM system
- Implementation of a **new resilient concept** of the ATM system, considering only physical and safety restrictions
- The concept incorporates a **holistic approach**, that will encompass all substantial flight phases
- The implementation is based on **one level of detail**, thus each phase of flight will be depicted with the same granularity



Theoretical approach and pattern recognition

- **State based** description of the system
- **Performance indicators** serve as state variables, thus a performance based representation is used, which calculates the deviation between the actual state and the **reference state R** (as a set of different agreed system states)
 - given a disturbance **D** (*type, intensity, duration, time of occurrence*) occurs, the implications of **D** on the system **S** (*scope, boundaries*) are investigated over a **distinct period of time** on a **distinct hierarchical level**
 - The behaviour of the system, i.e. the propagation of the **selected performance indicators** over time, is analyzed
 - By means of data mining, **resilient pattern** and interdependencies within the ATM system, due to an occurring disturbance, are investigated



Implementation of the performance based approach

- Among other things, the ATM system as a **socio-technical system** shows
 - complex structures of components in different space and time scales
 - complex interdependencies between the various stakeholders
 - stochastic influences
 - hierarchical structures
- Importance of the human role in the ATM system, with regard to **collaborative decision making** in the case of disturbances
- Current methods and applications show
 - **different scope** and **level of detail**
 - cover **different aspects** of the ATM system



Assessing actions to improve resilience

- A **simplified generic** ATM model, which allows to analyse **current ATM subsystems** and **future resilient designs** by considering the **human role** is being developed
- New methods and procedures to improve resilience are evaluated and compared between a
 - current simplified ATM system and
 - a new model of the ATM system that incorporates resilient design principles



Illustration holistic approach regarding the flight phases – gate to gate perspective

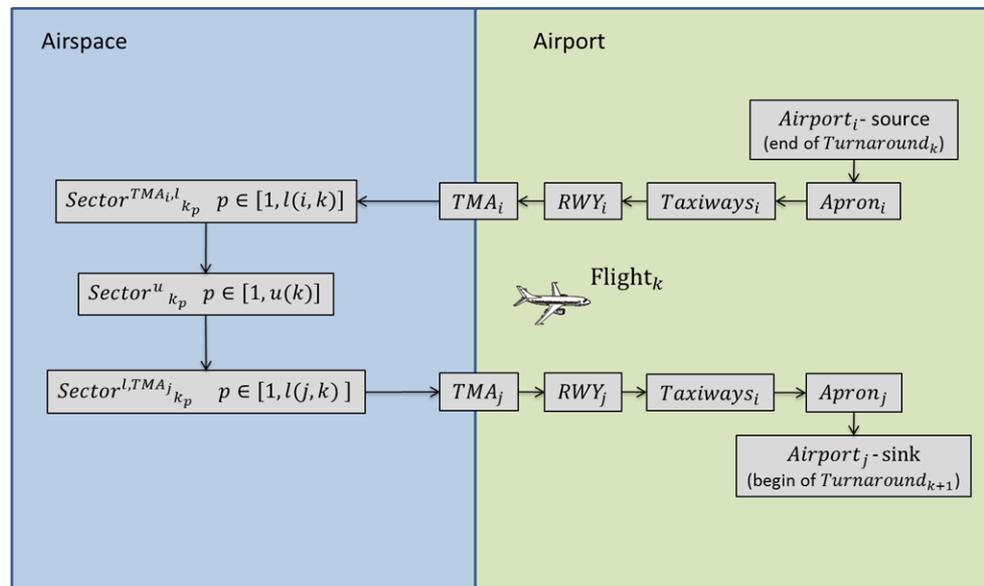
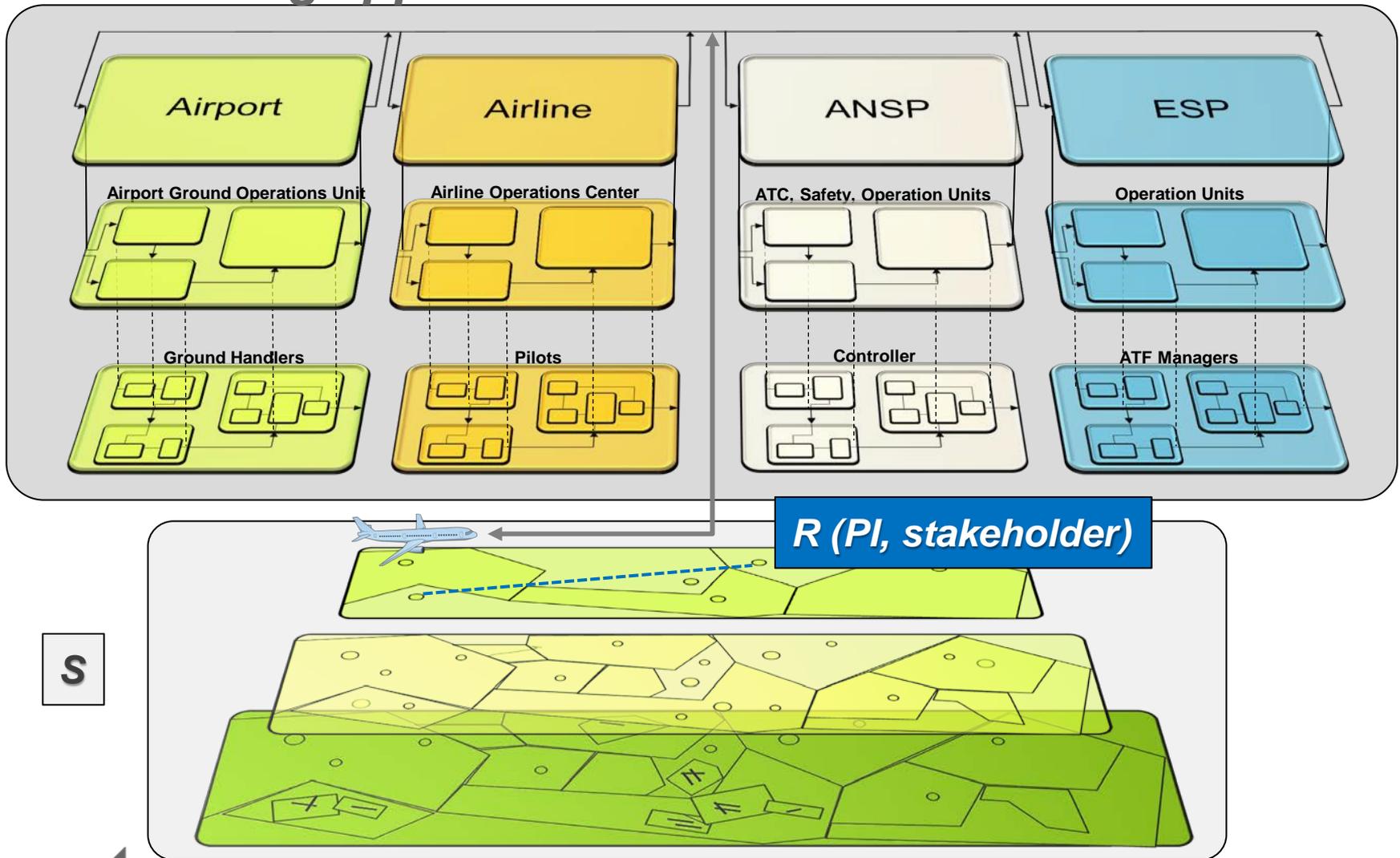
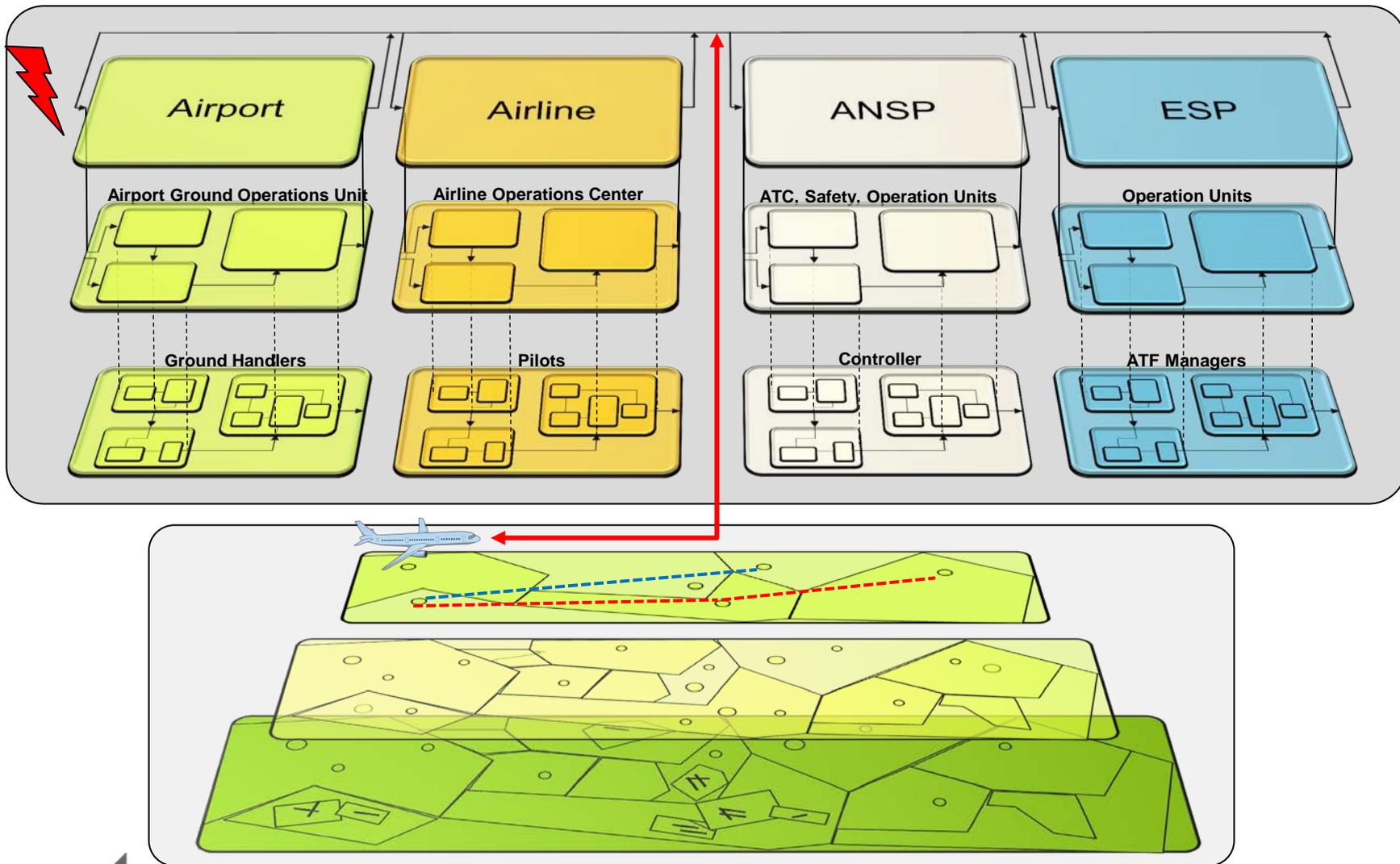


Illustration of state based description and modeling approach



System behaviour

D



Pending questions

- How are reference states **R** depicted: **qualitatively** and **quantitatively**?
 - how does a stakeholder define its reference (normal) state, depending on the given performance indicators?
 - are there commonly agreed reference states for the whole system and if so, how are the different views „weighted“?
 - in case of a weather related disturbances, in which way are evasive actions created (what exceptional states are valid)
 - what are appropriate actions in discussion that help to enhance resilience



***Thank you
for your attention!***

