

# COE CST Tenth Annual Technical Meeting

## Interoperable Air and Space Traffic Management

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Commercial Space Transportation



# Agenda

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# Team Members



Deutsches Zentrum  
für Luft- und Raumfahrt  
German Aerospace Center

- Principal Investigator: Sven Kaltenhaeuser
- Team: Dr. Dirk-Roger Schmitt, Frank Morlang,
- Student: Carmo Kluecker



- Organization
  - **DLR German Aerospace Center**  
Institute of Flight Guidance  
Associate Member of the COE CST

# Task Description

- With global growth of the commercial space industry there is a developing demand for space flight operations in and over Europe. Air Traffic Management (ATM) is playing a key role to address this challenge.
- The goal is to prepare the European ATM system to enable a safe integration of space vehicle operations (SVO) in a sustainable and efficient way. To enable global operations, interoperability of implemented technologies and procedures is an essential requirement and a specific focus of the DLR work program.

# Goals

- Categorization of relevant space flight operations and assessing their impact on European airspace using the DLR Space and Air Traffic Management (SATM) testbed.
- Development of measures and procedures for enabling efficient ways to optimize airspace usage for space flight operations while minimizing airspace segregation.
- Development of concepts and prototypes for a seamless, safe and secure implementation of space flight operations into the ATM using System Wide Information Management (SWIM) and related open and standard mainstream technologies.

# Results

## **Enhanced Controller Working Position for integrating Spaceflight into Air Traffic Management *via Master Thesis by Carmo Klueker***

### ***Objective:***

***Development and validation of a concept visualizing information at the controller working position (CWP) to enable controllers to initiate appropriate measures to protect aircraft from falling debris***

# Results

Research question:

1. What information does an air traffic controller (ATC) need to respond appropriately to non-nominal events during space activities?
2. How can this information be effectively visualized at the controller working position (CWP) so that he/she can perform the required actions?

# Results

1. What information does an air traffic controller (ATC) need to respond appropriately to non-nominal events during space activities?

## Information requirements

- Location of the hazard area (HA)
- Period of activation of the HA
- Aircraft potentially at risk

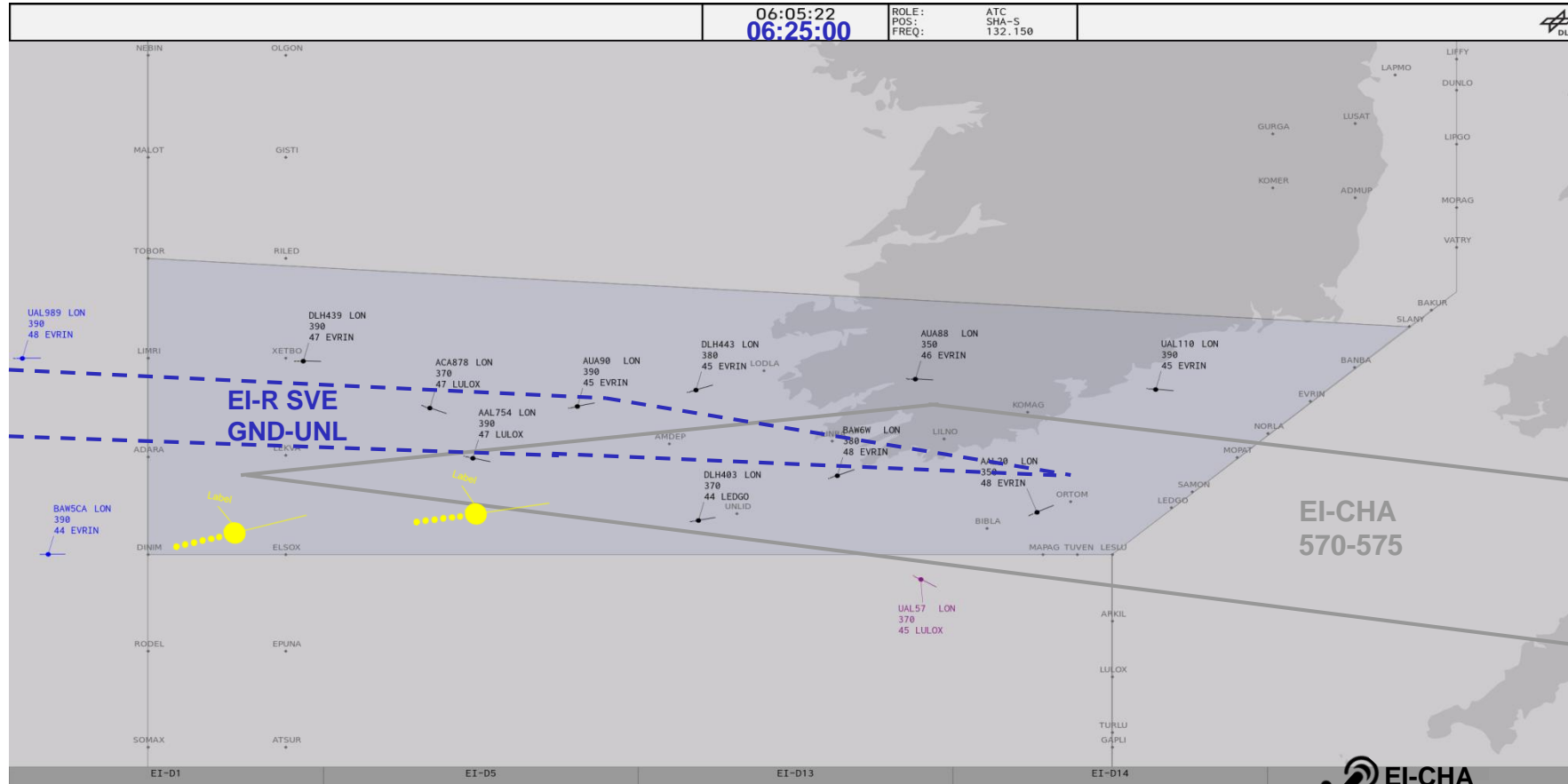
## Design requirements

- No information overload
  - Intuitive / user-friendly
  - Usage of known elements
- Ecological Interface Design



# Results

2. How can this information be effectively visualized at the controller working position (CWP) so that he can perform the required actions?



# Results



- Highlighting of affected aircraft increased awareness regarding the potential risk.
- Presentation of the HA according to other special used airspace is reasonable.
- Time representation in UTC accelerates the traffic management planning.
- Knowing about the contingency HA helped to prepare mentally and to assess the effects.

**The situation was manageable!**

# Publications

- Kluenker, Carmo (2019), Integration von kommerziellen Raumflügen in das Luftverkehrsmanagement, Master Thesis, Technical University of Berlin / DLR Institute of Flight Guidance
- Kluenker, Carmo (exp. 2021); Enhanced Controller Working Position for integrating Spaceflight into Air Traffic Management, 12th International Conference on Applied Human Factors and Ergonomics, AHFE

# Conclusion

- A concept to respond flexible and effectively to failures during launch and re-entry has been developed and evaluated.
- A Human Machine Interface (HMI) has been designed to visualize information at the controller working position.
- Operational experts evaluated the concept under the aspect that it focuses on the essential information required by controllers and avoids unnecessary complexity.
- Further research should consider the coordination processes between controllers, as this may result in new requirements for such a concept.

# Future Work

- Identifying optimization potential of operational mechanisms and procedures for SVO in a Pan-European aviation system
- Applying advanced ATM concepts such as Flexible Use of Airspace, Flight Centric ATC and Dynamic Sectorization
- Enhanced functions for space flight SWIM services including all ATM planning and execution levels.