# Automation in ATM System Design

*Human Factors and System Safety Seminar*

Dr. André Perott



**DFS** Deutsche Flugsicherung

# Outline

- **Motives for Automation**

- **Automation Strategy at DFS**

- **Conclusion**

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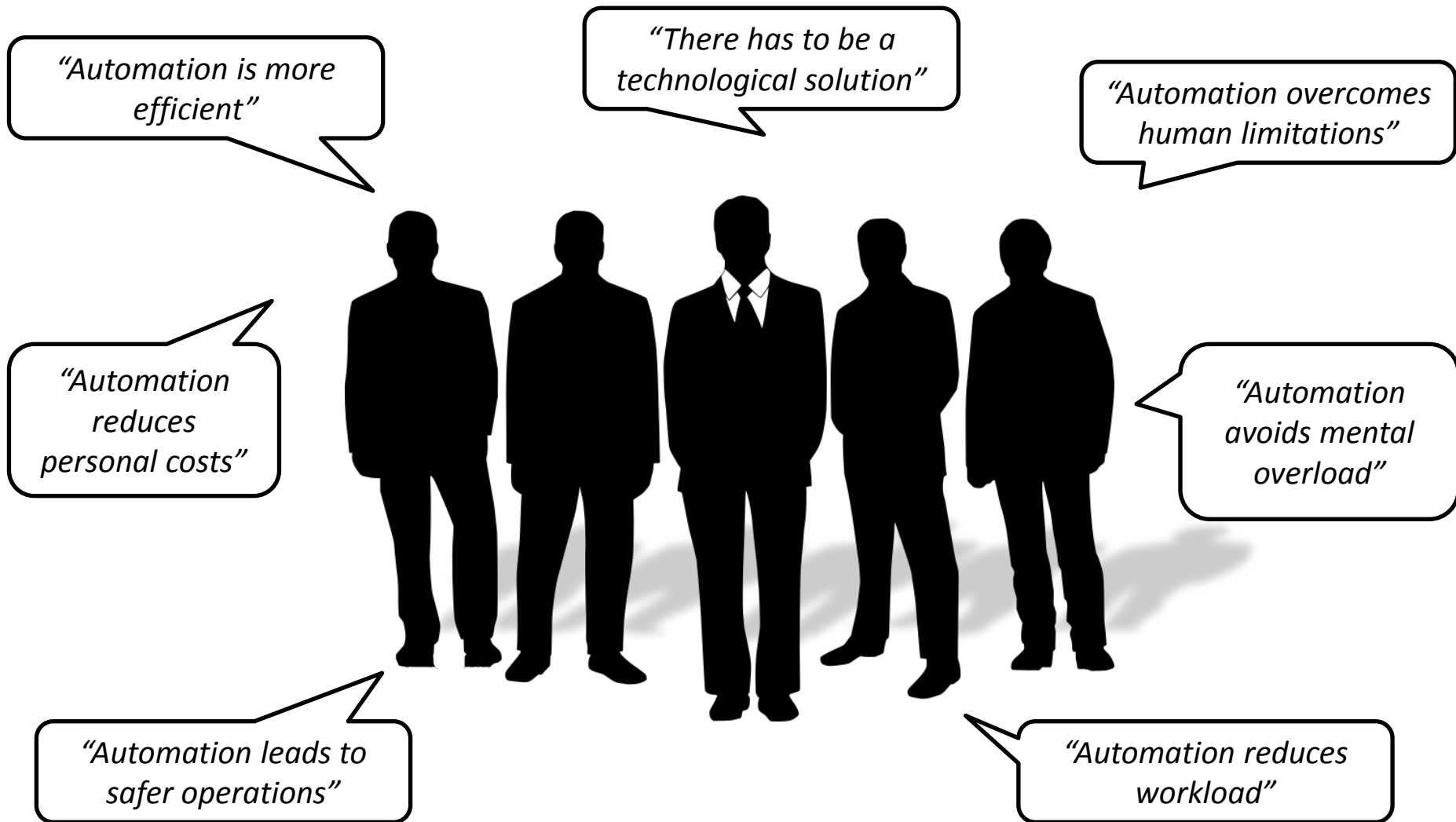
# Introduction

# Current Challenges in Air Traffic Control

- **Air Traffic Control** (ATC) in Europe is under tremendous pressure to develop and change.

- **High-level goals for the Single European Sky** in 2012 to be met by 2020 and beyond:

  - Enable a *3-fold increase in capacity* which will also reduce delays both on the ground and in the air

  - Improve *safety by a factor of 10*

  - Enable a *10% reduction* in the effects flights have on the *environment*

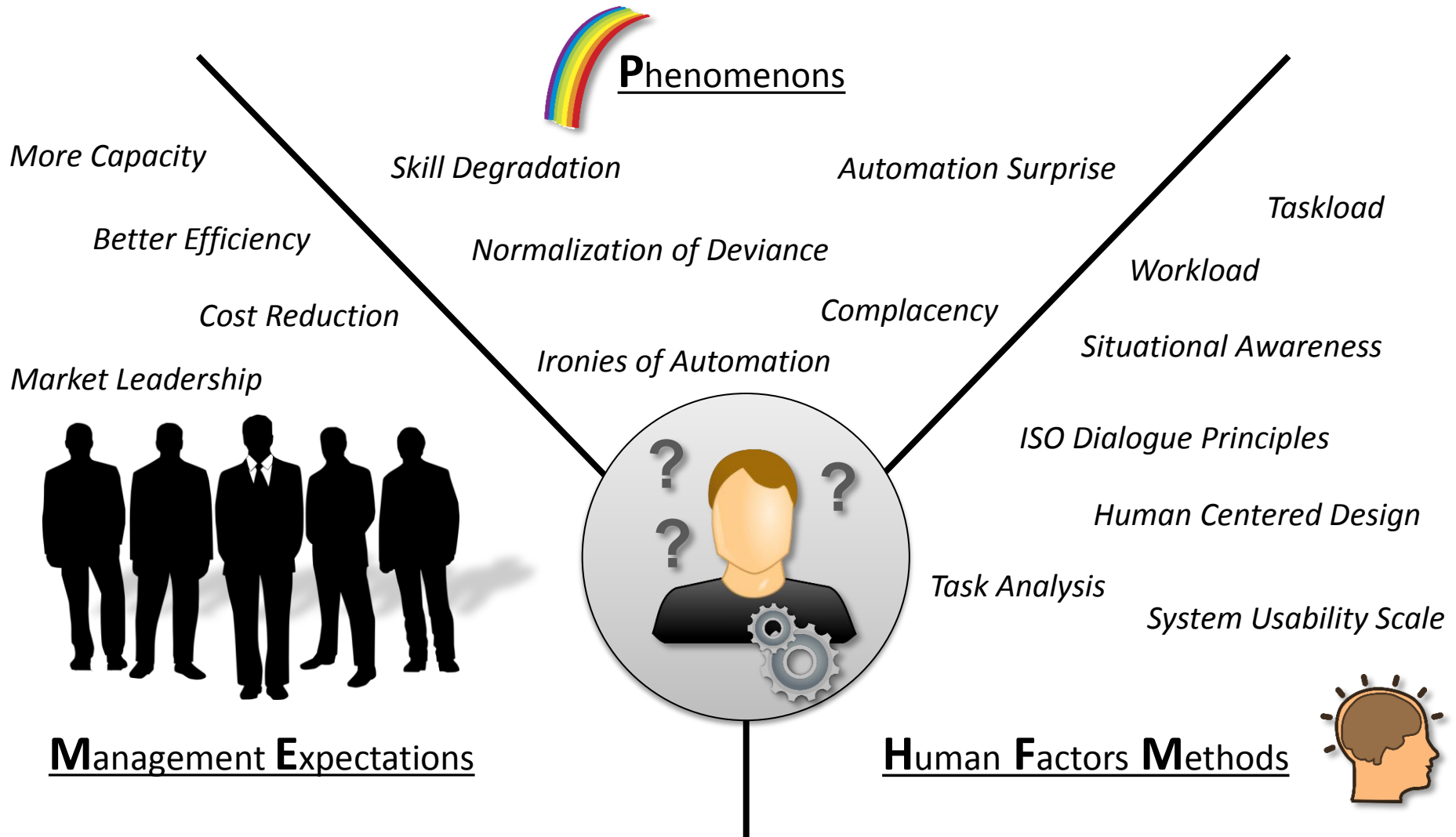  - Provide *ATM services* to the airspace users at *a cost of at least 50% less*

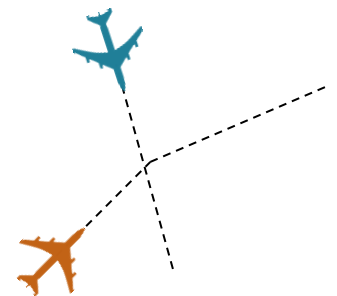SESAR (2015)

# The Promise of Automation

# But how to implement good automation?

**P**henomenons

More Capacity

Skill Degradation

Automation Surprise

Taskload

Better Efficiency

Normalization of Deviance

Workload

Cost Reduction

Complacency

Situational Awareness

Market Leadership

Ironies of Automation

ISO Dialogue Principles

Human Centered Design

Task Analysis

System Usability Scale

**M**anagement **E**xpectations

**H**uman **F**actors **M**ethods
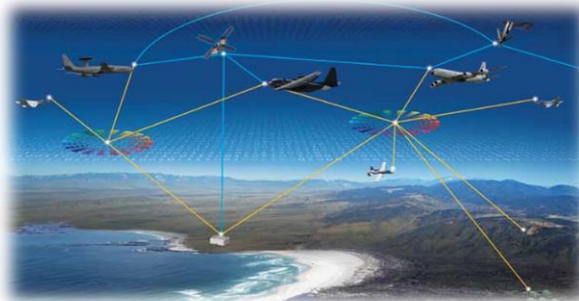
# From Problem Setting to Problem Solving

Context of Use

Problem Setting

# Automation Strategy at DFS
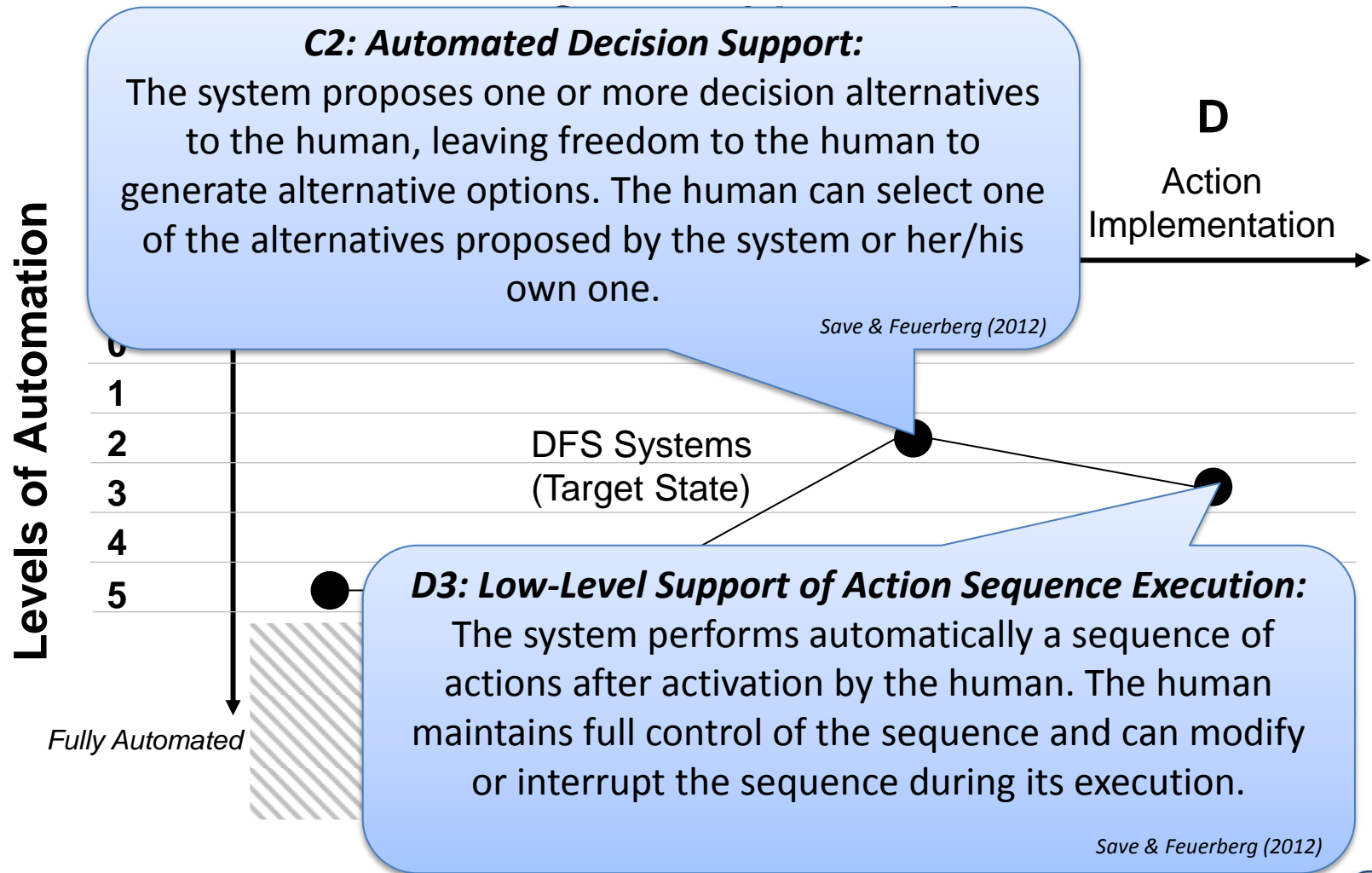
# What is Automation?

Automation is the <u>process</u> and its <u>result</u> of passing tasks (and activities) to a machine that were previously executed by humans.

Hauß & Timpe (2002)

1. What is the desired automated **target state** and how do we recognize it?

2. How can we achieve this target state and which **intermediate steps** are necessary (process of automating)?

3. How does it impact the **overall organization** (selection, qualification, training, procedures, roles, etc.)?

# DFS - Desired Target State

**C2: Automated Decision Support:**
The system proposes one or more decision alternatives to the human, leaving freedom to the human to generate alternative options. The human can select one of the alternatives proposed by the system or her/his own one.

*Save & Feuerberg (2012)*

**D**
Action Implementation

**Levels of Automation**

0
1
2
3
4
5

DFS Systems
(Target State)

*Fully Automated*

**D3: Low-Level Support of Action Sequence Execution:**
The system performs automatically a sequence of actions after activation by the human. The human maintains full control of the sequence and can modify or interrupt the sequence during its execution.

*Save & Feuerberg (2012)*

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# Process of Automating
# Levels of Implementation

**Decision Support Systems**

Strategic direction for increasing capacity

➩ **Design**

**Support of Information Analysis**

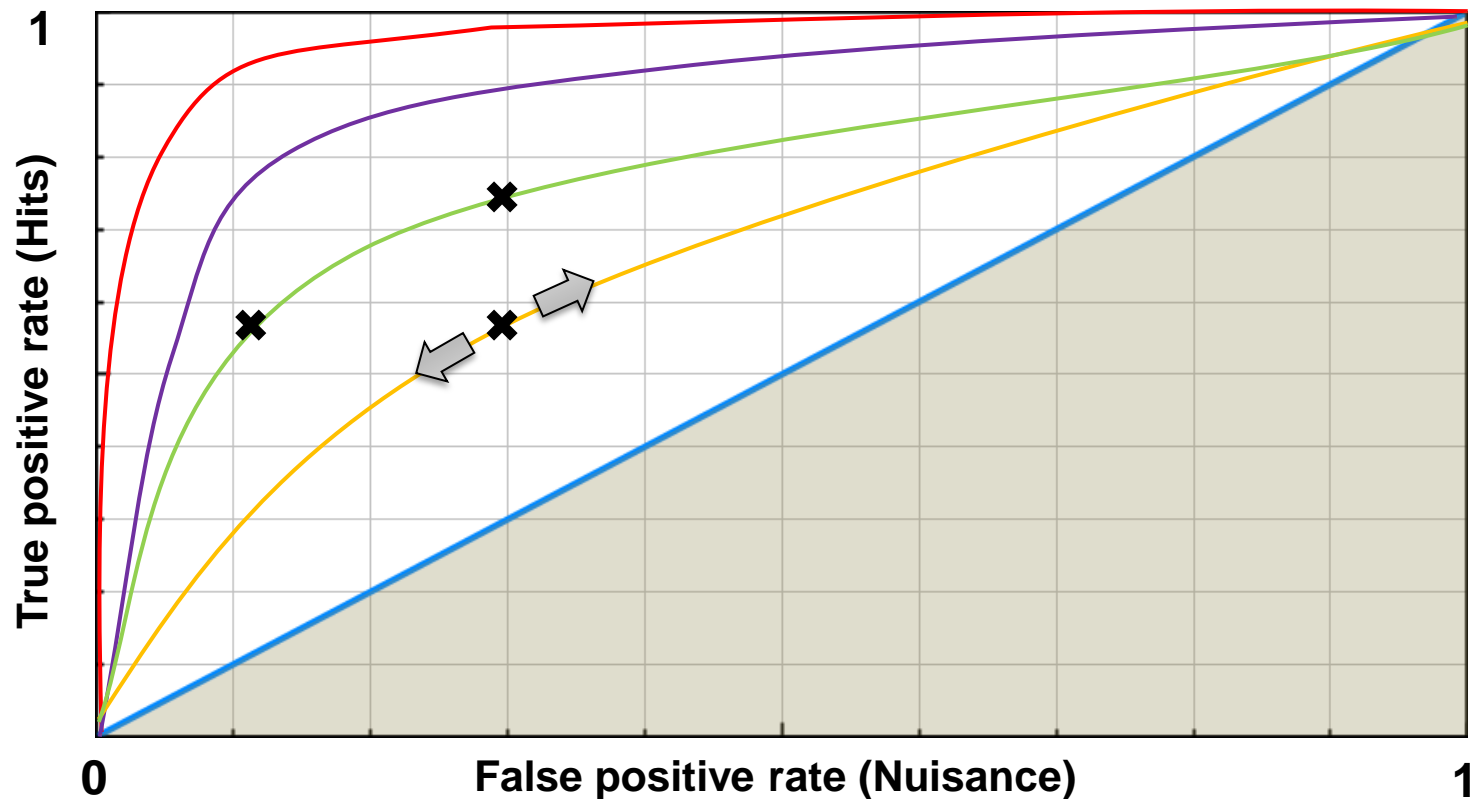Highly automated sub systems

➩ **Integrate**

**Conflict Detection**

Basis for every automated support

➩ **Optimize**

# Optimization of Conflict Detection
# Receiver Operating Characteristic (RoC)

# Process of Automating Levels of Implementation

**Decision Support Systems**

Strategic direction for increasing capacity

➡ **Design**

**Support of Information Analysis**
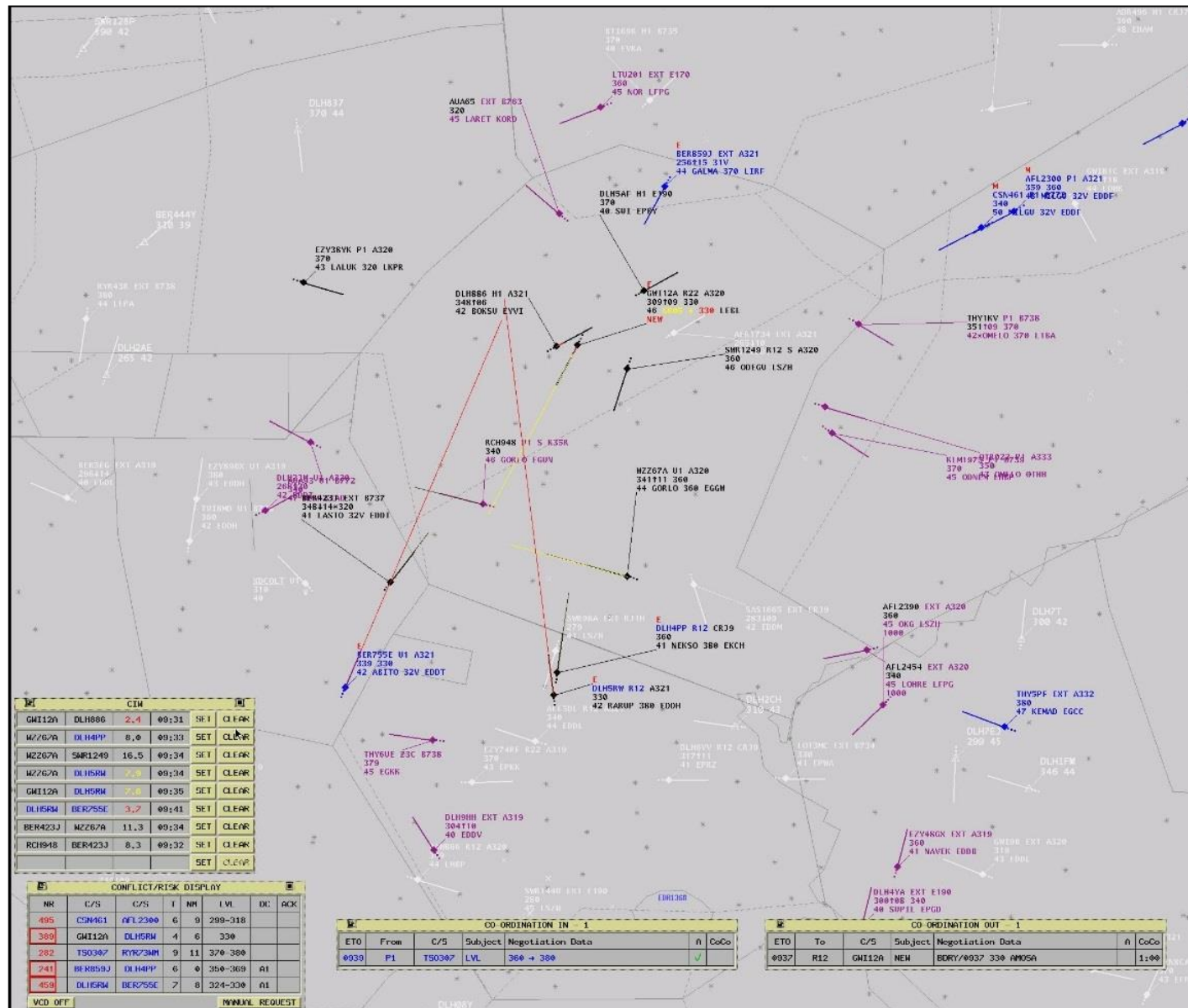
Highly automated sub systems

➡ **Integrate**

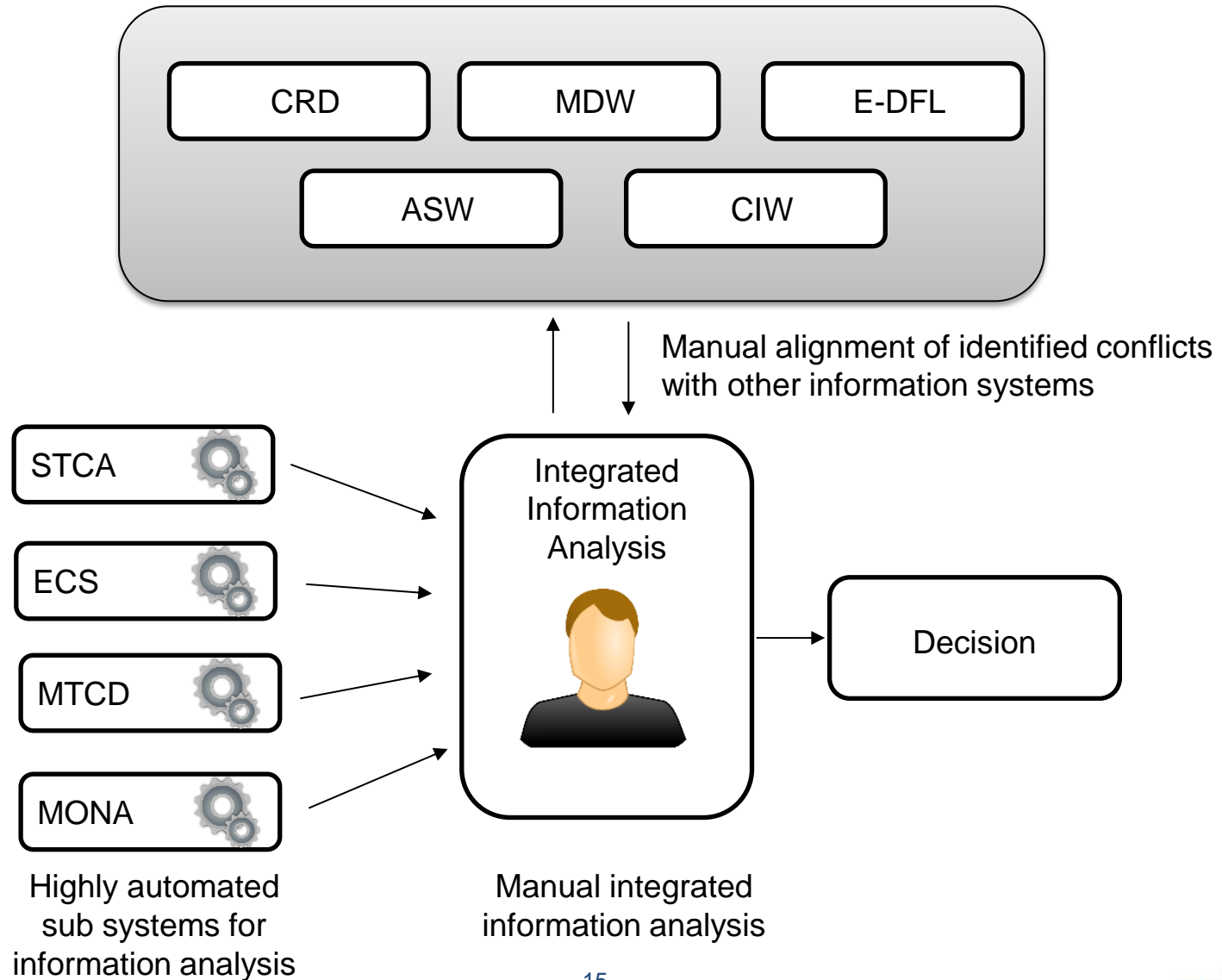**Conflict Detection**

Basis for every automated support

➡ **Optimize**

# Support of Information Analysis
# Current Stage of Automation



CRD   MDW   E-DFL

ASW   CIW

Manual alignment of identified conflicts with other information systems

STCA

ECS

MTCD

MONA

Integrated Information Analysis

Decision

Highly automated sub systems for information analysis

Manual integrated information analysis

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# Process of Automating
# Levels of Implementation

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**Support of Information Analysis**
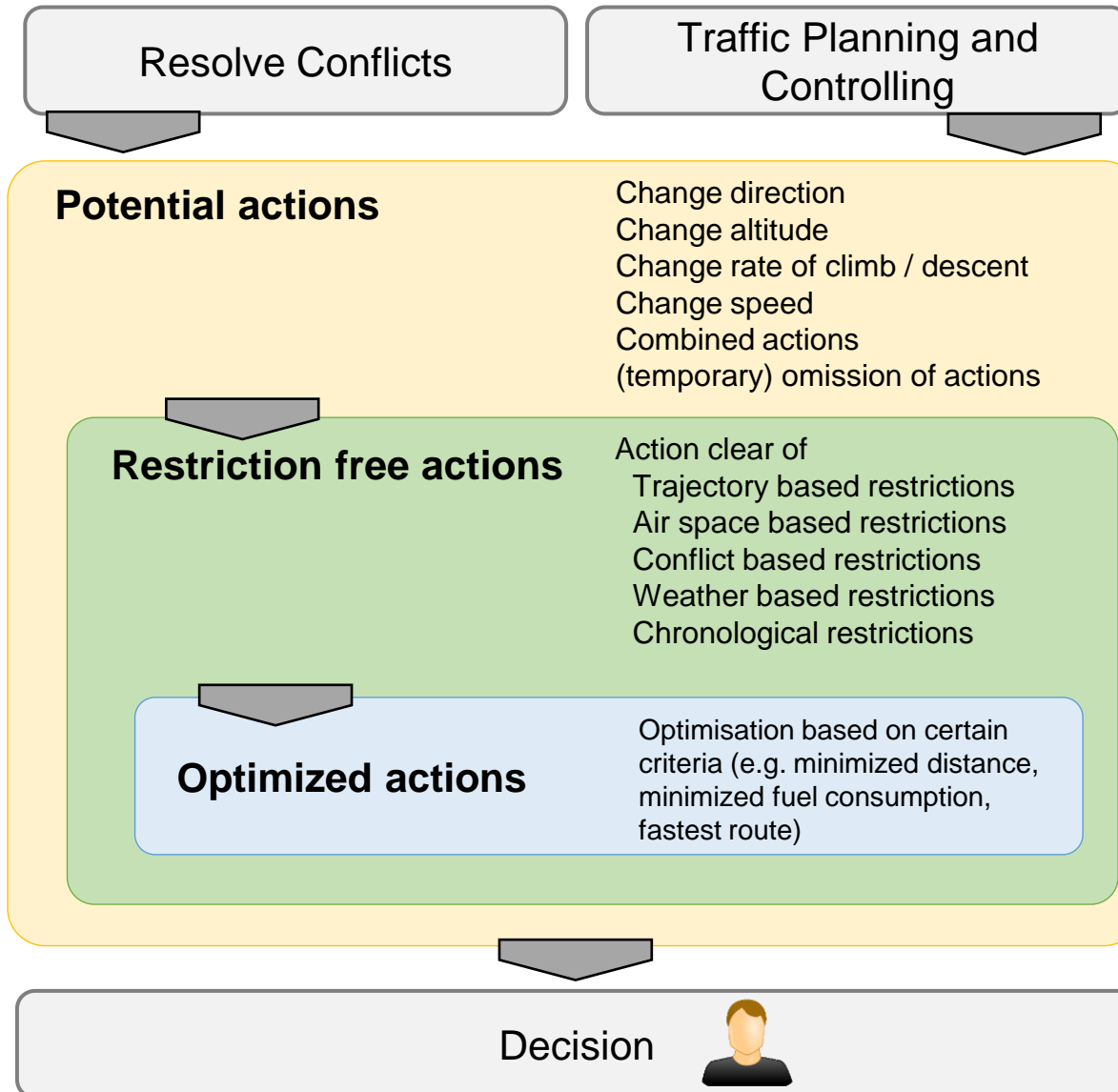
Highly automated sub systems
➡ **Integrate**

**Conflict Detection**

Basis for every automated support
➡ **Optimize**

# Support of Decision and Action Selection
# First Conceptual Thoughts

# Conclusion

# Conclusion

- Automation is considered as one of the key factors to encounter cost and production pressure.

- There is a trend to focus on automation technology instead of the automation purpose (based on the context in which technology is used).

- A automation strategy helps to align different technological developments by providing a consolidated automation purpose.

- DFS suggests three steps for purposeful enhancement of automation:

  - Optimization of current conflict detection tools

  - Integration of (partly) automated sub systems

  - Conceptual design of new decision support tools

- Extension to a company wide automation strategy by incorporating organizational aspects (e.g. selection, training, roles, procedures).

- On an international level: Shift from a currently technology driven discussion (e.g. SESAR, iTEC) to a purpose driven discussion.

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# Thank You!

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# Literature

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