Study of Increased Automation in ATM (SONIC – PJ18 Solution 57)

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DISSEMINATION EVENT, EUROCONTROL, 21st MARCH 2023

These projects have received funding from the SESAR 3 Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreements No 101017626 and 872320

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Motivation

1. SONIC/PJ18-57 solution generated insights into how automation can be introduced in future trajectory-based operations, providing initial methods on how to evaluate the introduction of increased levels of automation as well as exploring how this can aid decision-making.
2. These are expected to positively influence future design of tools and systems with automation at different levels which can help manage the ATCO and flight crew workloads, support collaborative working between them and also contribute to manage the overall traffic capacity within airspaces.
3. Two threads of early exploratory research were completed:

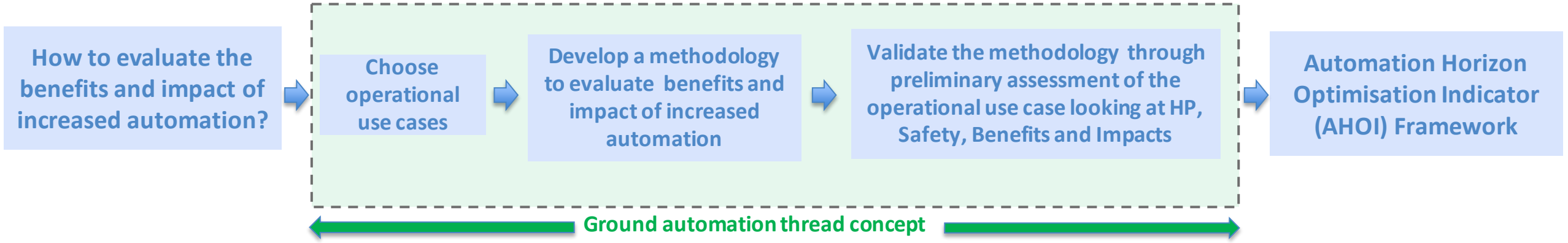
Airborne Automation thread (Thales AVS):
To analyse increased facilitation, anticipation and coordination in flight operations, using automation support means

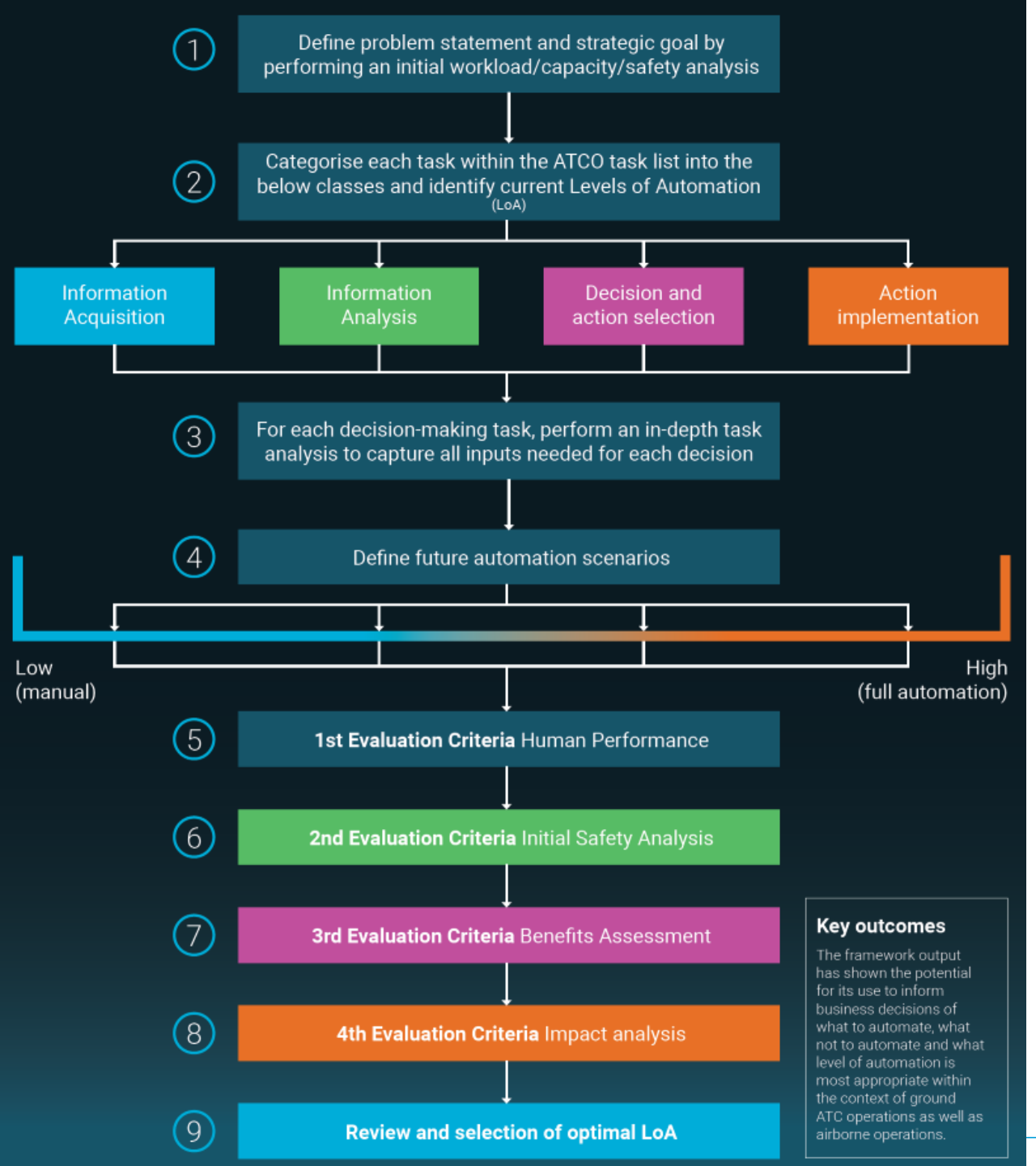
Ground Automation thread (NATS):
To identify, develop and validate a mechanism for evaluating the benefits and impacts of greater levels of automation in ground ATC tasks

EUROCONTROL THALES NATS AIRBUS indra

Ground automation thread research journey:

Research design and methodology

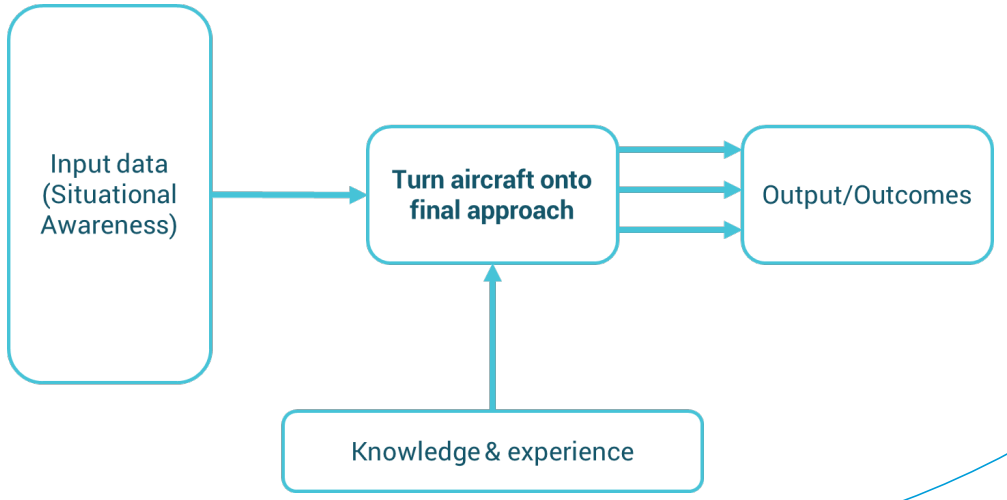


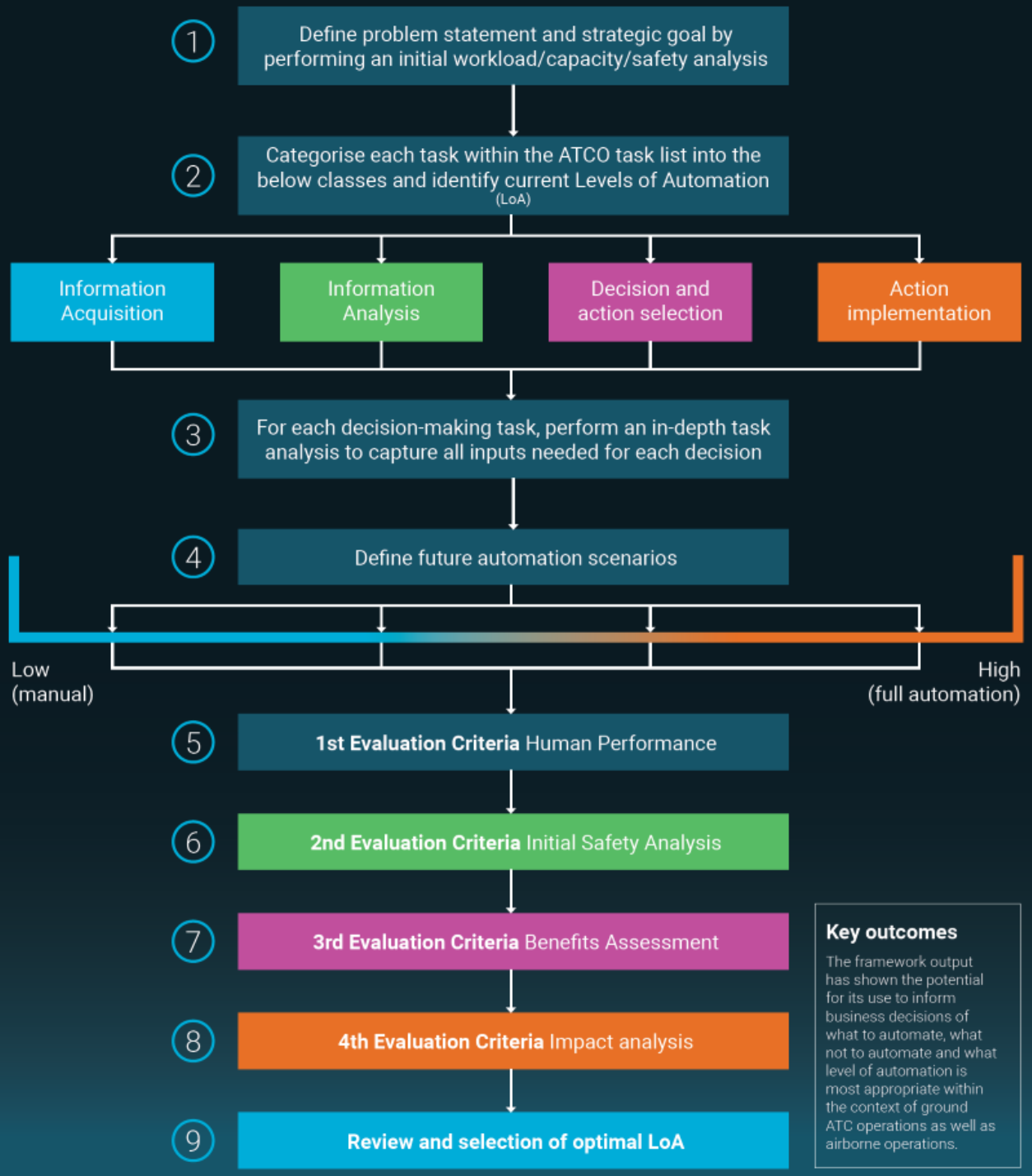


1. Increase runway throughput by automating ATCO tasks on final approach

2. Eg: Turn aircraft onto final approach → Decision and action selection

3. Task analysis for: Turn aircraft onto final approach





4. Automation scenarios for *Turning aircraft onto final approach*:

- **ATCO enabled decision-making**: The system proposes when to turn the aircraft onto final leg and upon ATCO confirmation, it issues the clearances as and when needed.
- **Autonomous decision-making**: The system decides when to turn the aircraft onto final leg and when to issue the clearances to ensure the required separation is maintained.

5. Initial Human Performance assessment of the defined future automation scenarios

6. Initial Safety assessment of the defined future automation scenarios looking at inherent aviation hazards and preliminary causal factors

1. Define problem statement and strategic goal by performing an initial workload/capacity/safety analysis

2. Categorise each task within the ATCO task list into the below classes and identify current Levels of Automation (LoA)

- Information Acquisition
- Information Analysis
- Decision and action selection
- Action implementation

3. For each decision-making task, perform an in-depth task analysis to capture all inputs needed for each decision

4. Define future automation scenarios

Low (manual) — High (full automation)

5. **1st Evaluation Criteria** Human Performance

6. **2nd Evaluation Criteria** Initial Safety Analysis

7. **3rd Evaluation Criteria** Benefits Assessment

8. **4th Evaluation Criteria** Impact analysis

9. **Review and selection of optimal LoA**

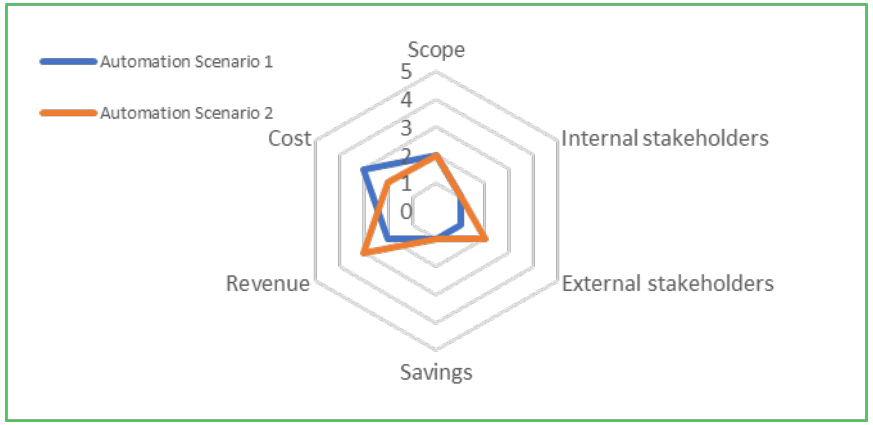
Key outcomes

The framework output has shown the potential for its use to inform business decisions of what to automate, what not to automate and what level of automation is most appropriate within the context of ground ATC operations as well as airborne operations.

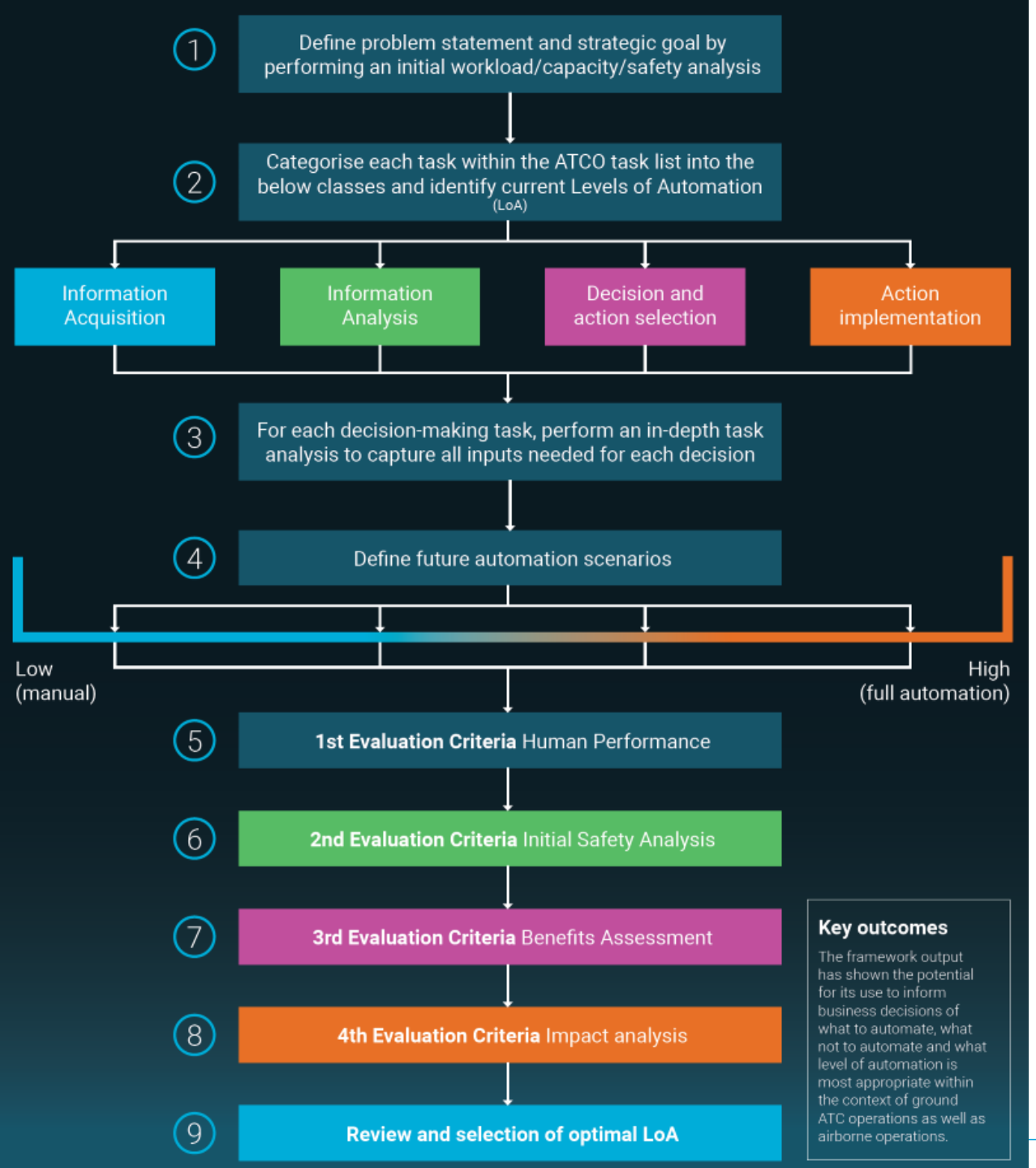
Initial Benefits Assessment

7. Benefits mapping and scoring of the defined future automation scenarios

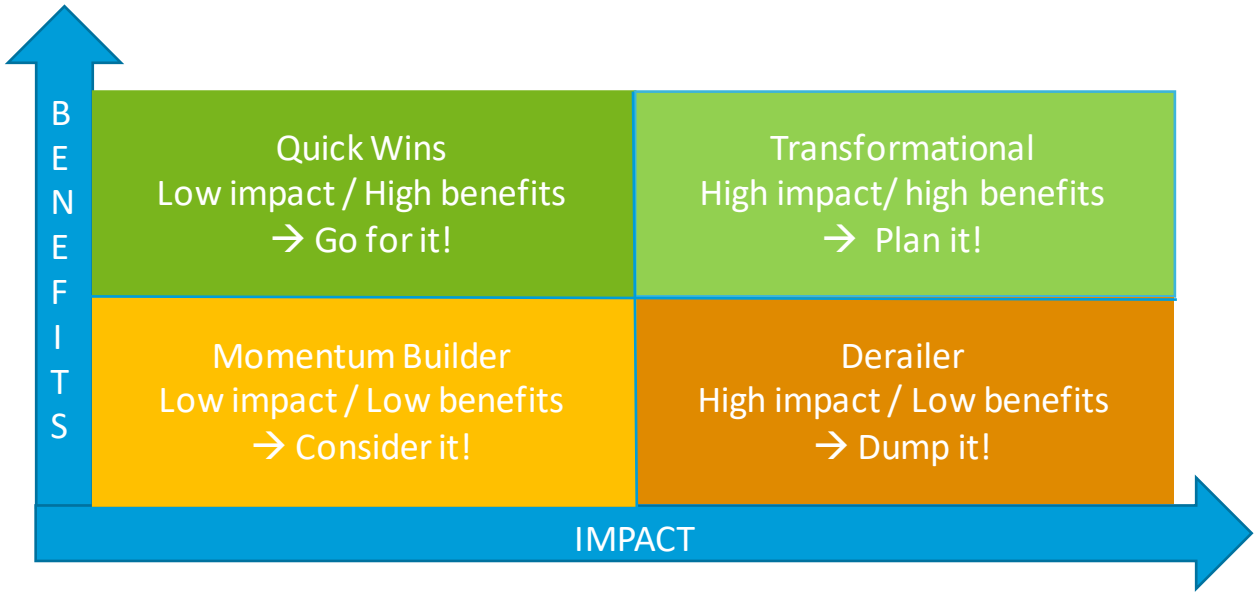
Initial Impact Assessment



8. Initial impact assessment and scoring of the defined future automation scenarios



- Benefits scale: 0 (Disbenefit), 1 (No change), 2 (Low), 3 (Medium), 4 (High)
- Impact scale: 1 (Minimal), 2 (Minor), 3(Moderate), 4(Significant), 5(Severe)



Example output to support a strategic decision by stakeholders

Use case name: Aircraft spacing on final approach for runway optimisation

Goal: The goal of this use case is to identify the appropriate level of automation which can be deployed to support the ATCOs in maximising the runway throughput. The support is expected to target the decision and action selection tasks by assessing the optimal level of automation for the task to **judge the aircraft turn onto final leg** during final approach phase.

Automated Solution 1 (ATCO enabled decision-making)

FIN receives strip from INT and incomms a/c. System reviews current a/c status, including a/c downlinked information. The system then proposes when to initiate the initial 180kts speed reduction. Upon ATCO confirmation, the system will issue the clearance when needed. The system then checks and proposes adjustments, if needed, for the heading on downwind leg. Upon ATCO confirmation, the system will issue the clearance if needed. The system then proposes when to best turn the a/c onto base leg and then onto final leg to ensure the required separation is maintained. Upon ATCO confirmation, the system will issue the clearances as and when needed. Upon confirmation of a/c being established on final approach, the system then issues the descend clearance and the final speed reduction to 160kts by 4DME. The system then issues the TWR frequency and informs the controller that the a/c is ready to be outcommed. FIN then moves the strip to worked bay and outcomms the a/c.

Automated Solution 2 (Autonomous decision-making)

FIN receives strip from INT and incomms a/c. System reviews current a/c status, including a/c downlinked information. The system then decides when to initiate the initial 180kts speed reduction and issues the clearance. The system then checks and adjusts, if needed, the heading on downwind leg. The system then decides when to best turn the a/c onto base leg and then onto final leg and when to issue the clearances to ensure the required separation is maintained. These turns can be displayed if requested by the ATCO. Upon confirmation of a/c being established on final approach, the system then issues the descend clearance and the final speed reduction to 160kts by 4DME. The system then issues the TWR frequency and informs the controller that the a/c is ready to be outcommed. FIN then moves the strip to worked bay and outcomms the a/c.

Safety

1. Initial hazards identified
2. Initial causal analysis

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2. Initial causal analysis revealed no areas of safety concern
3. No major safety issues identified as a result of increased levels of automation

Human Performance

1. The number of aircrafts landed per hour expected to potentially increase

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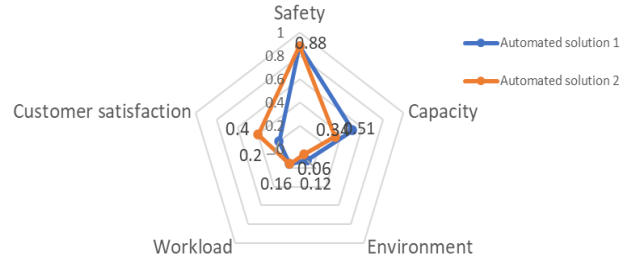
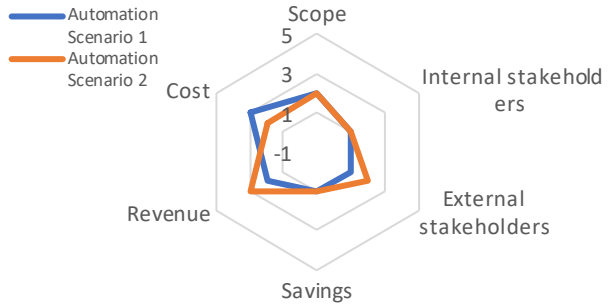
2. Positive impact expected on ATCO workload
3. Need to train ATCOs for new tool

Initial Benefits Assessment



Initial Impact Assessment



Key Notes and Assumptions

1. Technology Y is expected to be available by 202x.
2. A change to regulation by CAA will introduce new policy will facilitate deployment of Automation Solution 2.
3. Automation Solution 1 is dependent on training for the ATCOs to use the automated tools proposed.

Recommendations based on AHOI

1. Automated Solution 1

Quick Wins
Low impact / High benefits
→ Go for it!

2. Automated Solution 2

Transformational
High impact/ high benefits
→ Plan it!

Summary of key outcomes of ground automation thread research

Developed and validated a framework to investigate how the preliminary benefits and impact of increased levels of automation in ground ATC tasks can be measured through safety, human performance, potential benefits and impact studies

The framework output has shown the potential to inform business decisions of what to automate, what not to automate and what level of automation is most appropriate within the context of ground ATC operations as well as airborne operations.

The solution generated insights into how automation can be introduced in future **Trajectory-Based Operations**, providing initial methods on how to evaluate the introduction of increased automation as well as exploring how this can aid decision-making.

The framework was built using the SESAR Levels of Automation Taxonomy (LOAT) for framing the automation scenarios, however this can be replaced by any other automation taxonomies e.g. ATM Master Plan levels of automation.

Pushing the envelope through increased levels of automation is complex. However the AHOI framework helps to streamline the process when it comes to future design, prototyping and validation of automation tools and systems.

Trajectory Prediction Common Service (PJ18 Solution 88)

SUJAN PERERA

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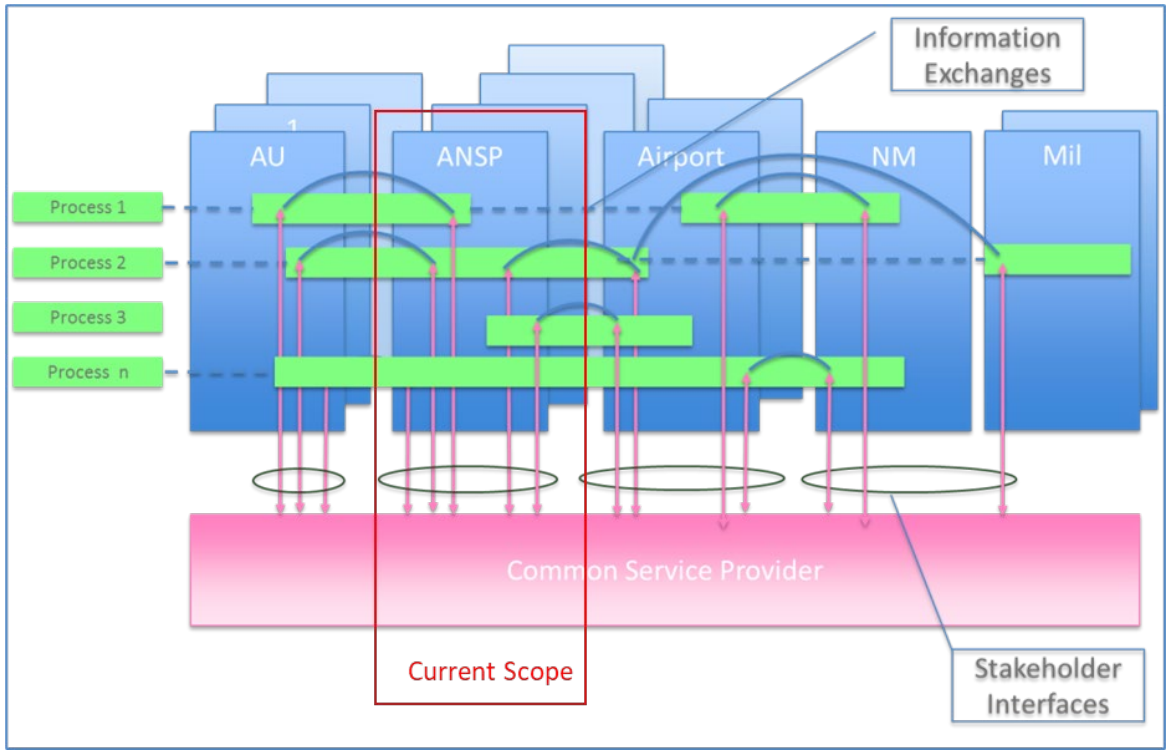
Trajectory Prediction Common Service (TPCS)

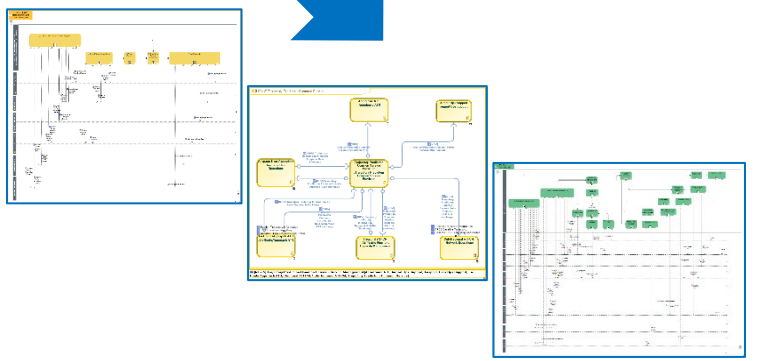
ATM Master Plan, Airspace Architecture Study (AAS)

The Future



Common Services Approach

TPCS uses EATMA content to create a Common Service intended to support trajectory exchanges



TPCS drives Cost Efficiency & Defragmentation in Deploying SESAR TBO concepts

THANK YOU FOR YOUR ATTENTION

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