Enhanced Collaborative Airport Performance Management

SINTEF Open Day Aviation, 26 September 2019

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The SESAR PJ04 TAM project

- This presents work was carried out as part of SESAR 2020 Wave 1 (2017-2019) with funding from the SESAR Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement No 733121
- The development will continue in SESAR 2020 Wave 2 (2019-2022)

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JOINT UNDERTAKING

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Enhanced Collaboration in an Airport Operations Center, https://youtu.be/qZNWU8atKZo

The difference between A-CDM and TAM

Airport Collaborative Decision-Making (A-CDM)

- Planning separately towards shared milestones (TOBT, TSAT, CTOT) in the pre-tactical phase (2 hours).
- Normally no support of analytical tools to see the system-wide impacts on decisions.

Total Airport Management (TAM)

- Planning in close cooperation to improve efficiency and predictability of the airport operations.
- Not only milestones but taking into consideration the capacity of key resources (runways, crews, de-icing, stands, terminals), i.e., planning holistically.
- Focus on evaluating the system-wide impacts on decisions before they are taken.
- This planning process takes place in a process called Total Airport Demand-Capacity Balancing (TA-DCB).

Total Airport Demand-Capacity Balancing (TA-DCB)

Total Airport-DCB is achieved through:

- Pro-active assessment of the available total airport capacity including stand, manoeuvring area (turnaround), taxiway and runway capacities, given the prevailing and/or forecast weather and other operational conditions.
- Comparison of the available capacities with the most up to date demand information.
- Pro-active identification of imbalances and identify the affected timeframe, trajectories, location of the imbalance.
- Sandbox what-if capabilities to analyse different possible solutions/measures.

Benefits are expected in the following KPAs:

- Predictability and Punctuality, Environment, Capacity, Cost Efficiency and Human Performance.

Rationale: Airport DCB should not only focus on the runway but should also include any intelligence/algorithm for terminal, stand, turnaround and taxiway capacities, providing an A-DCB solution that analyses the demand at the airport in a holistic way.

Airport Operations Centre Support Tools

Airport systems supporting the **multi-stakeholder decision making environment** in:

1. The overall impact assessment of a deviation from the plan and its consequences on the airport performance or the deviation from performance targets previously set,
2. The decision-making processes aiming at managing and documenting the consequences of a deviation and the recovery phase.

These airport support systems are fed by the AOP and reflect all capabilities introduced by:

- the extended What-If sandbox probing,
- the Total Airport DCB approach and
- previously not incorporated data related to environmental performances and restrictions.

The concept of the tool developed by SINTEF

- Supports a guided task driven process
  - The APOC supervisor guides the process by issuing specific tasks to APOC stakeholders as the collaborative planning in the APOC progresses
- Provides DCB charts with up to date information
  - Always updated demand- and capacity profiles for key resources (any resource or group of resources)
  - Allows for variable time resolution and zooming
  - Demand aggregation:
    - By "rate" (the number of events within the interval)
    - By " integrated demand" (based on the size duration within the interval)
- Provides local and system-wide KPIs
- Provides scenario management
  - To fully support What-if, comparison of alternatives or a-priori planning of still uncertain future situations.

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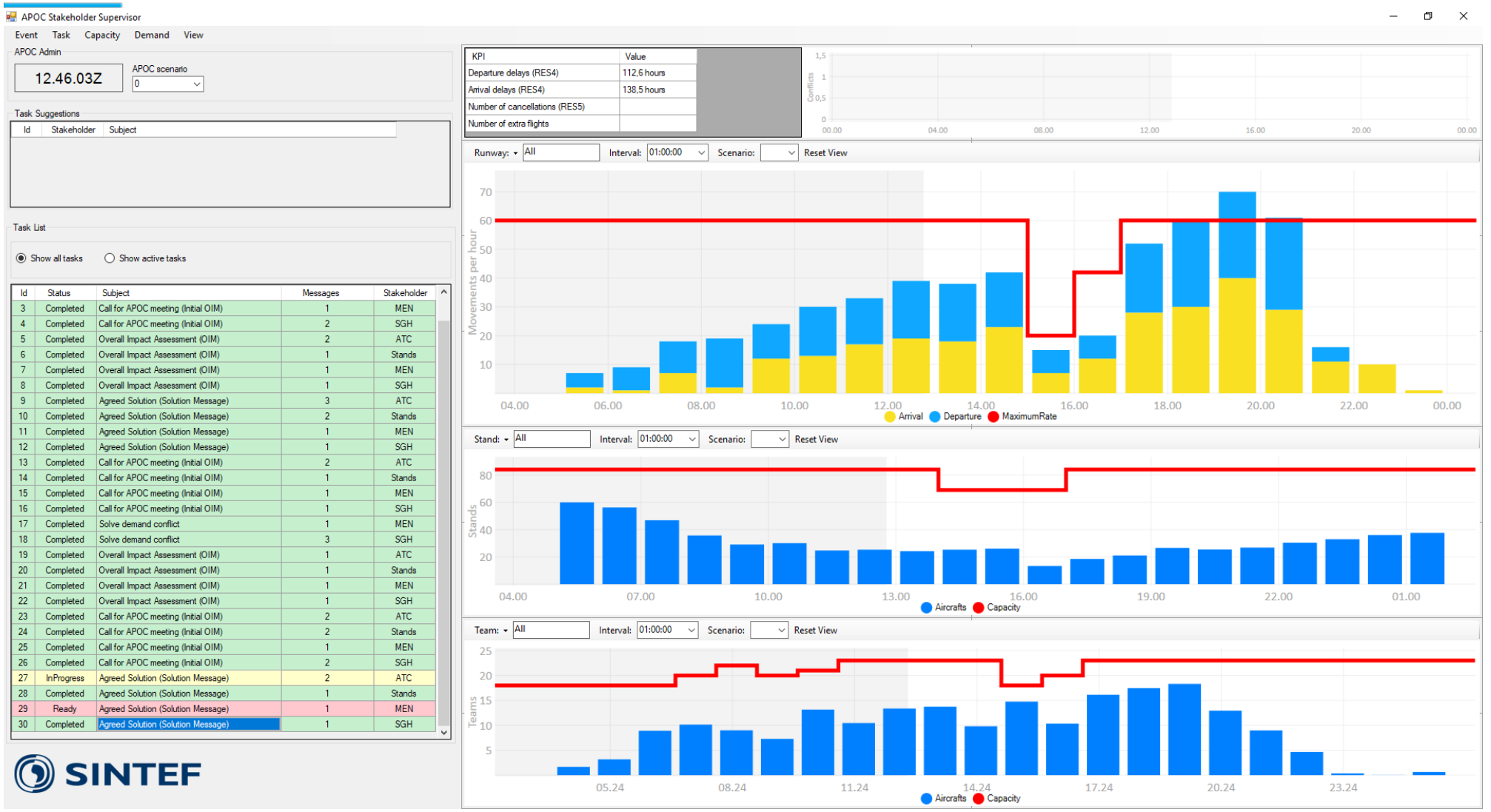
The APOC supervisor's view



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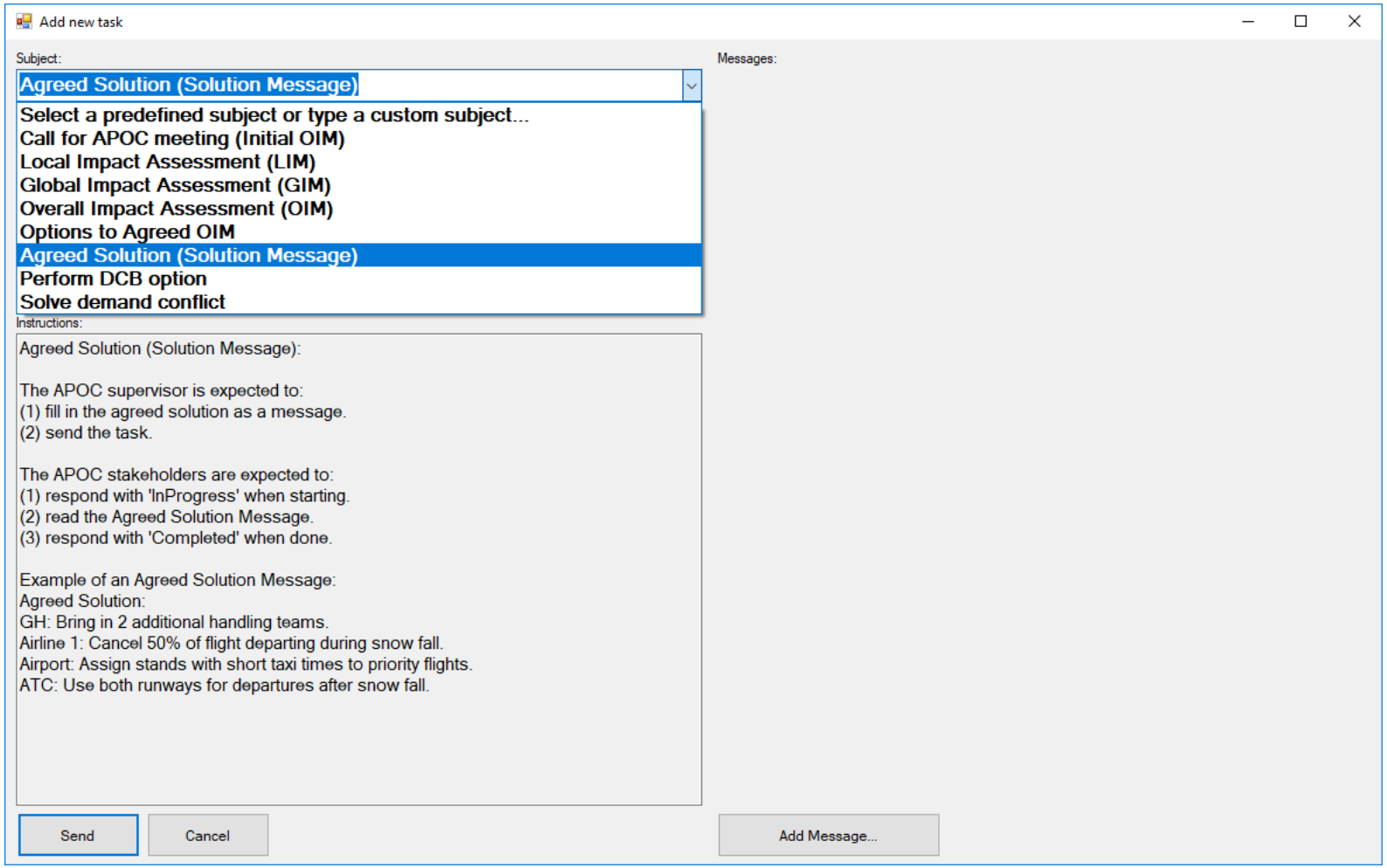
Tasks created from predefined templates



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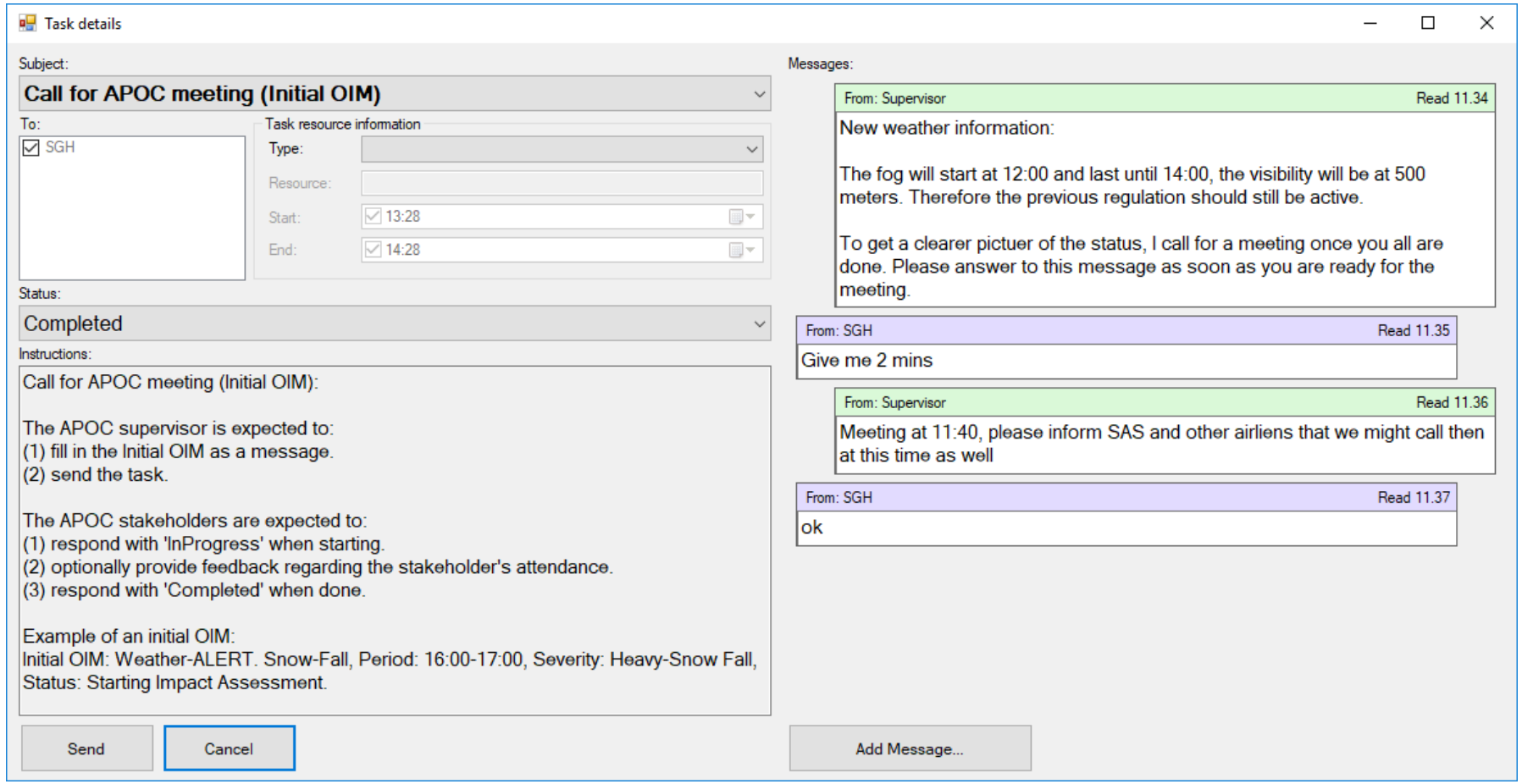
Example of a task with associated communication messages



The ANSP/Tower stakeholder's view

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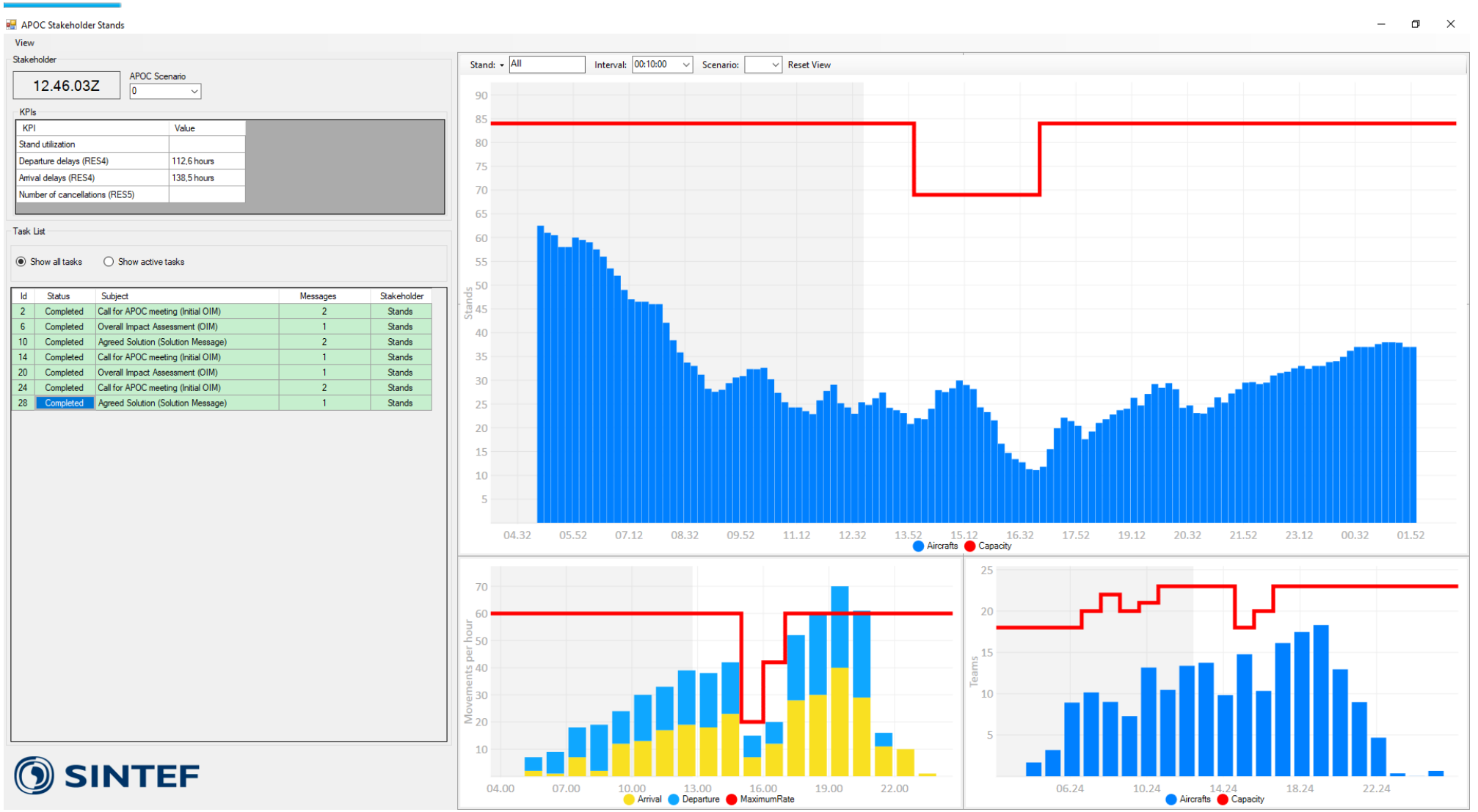
The airport stakeholder's view (stand allocation)



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The ground handler stakeholder's view (SGH)

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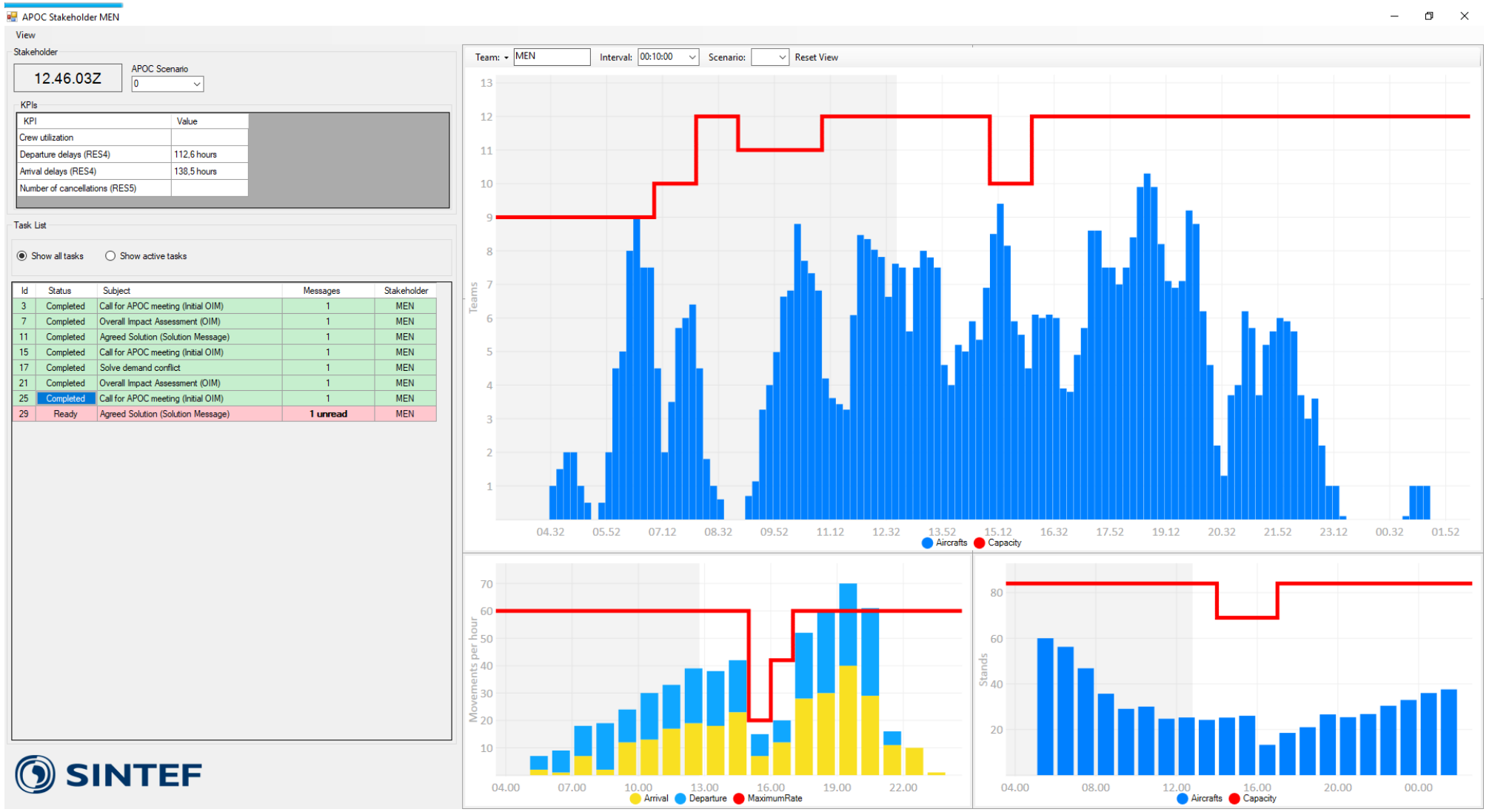
The ground handler stakeholder's view (MEN)



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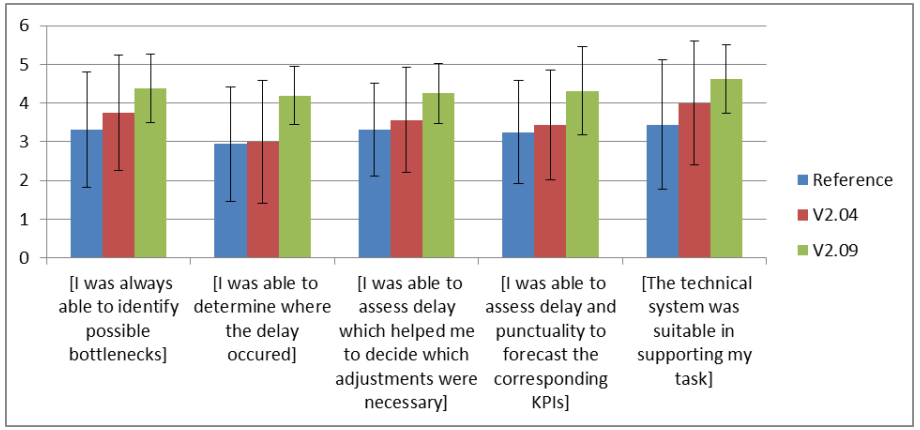
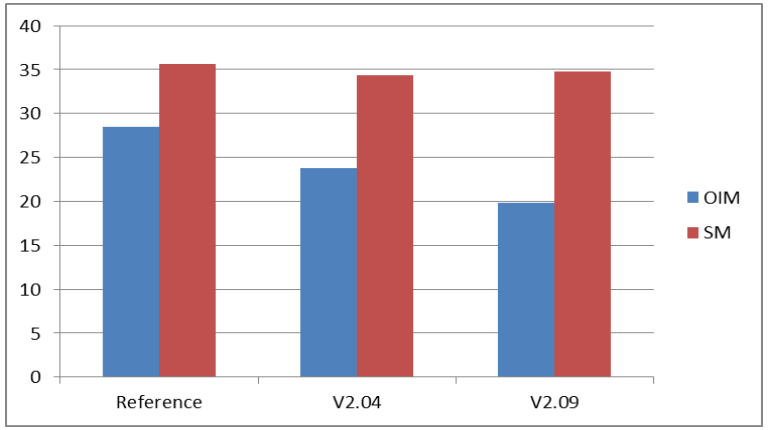
Some results from the validation exercise January 2019

Feedback regarding situation awareness



Aggregated time (in minutes) of impact assessment (OIM) and solution finding (SM)



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SELECTED FEATURES

Scenario-based analysis

- Planning possible scenarios (what-if) offline (in a sandbox) before the best solution is made publicly available (i.e., sent to the AOP)
- Understanding trade-offs between alternatives
- System requirements
  - The involved systems and communication protocols must be "scenario enabled"

System design inspired by "event sourcing" and "version control systems"

- Captures all changes to an application state as a sequence of events (changes)
- Transaction systems
- Advantages
  - Enables better estimation and prediction (using estimation filters)
  - Enables system-wide "undo", and playback
  - Documents the planning process
  - Enables re-use (by merging) of successful plans from previous "similar" situations (e.g., using machine learning)

Traditional design (keeps only the latest value):

Time 06:50: TOBT = 06:53

Event sourcing (keep the history of incremental changes):

Time 00:00: Scenario=0, Initial TOBT=06:30
Time 05:30: Scenario=0, TOBT: 06:30 => 07:00
Time 05:31: Scenario=1, TOBT: 06:30 => 06:40
Time 05:35: Scenario=1, TOBT: 06:40 => 06:50
Time 05:47: Scenario=1, TOBT: 06:50 => 06:52
Time 05:49: Scenario=1, TOBT: 06:52 => 06:53

Optimization support in the APOC

- The idea is that the tool can monitor the DCB profiles for capacity conflicts and the KPI's against alert levels for performance deterioration.
- Triggers an optimization algorithm that recommends resolution sequences to the APOC supervisor, e.g.:

> *"The snow removal at RWY 19L planned at 07:30Z will affect 12 flights. To minimize the impact, you should look into the option of asking ATC to move 3 departures and 3 arrivals to RWY 19R, delay 2 departures and hold 1 arrival. Thereafter there may be a need for each airline to cancel 1 departure each."*

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