



Enhanced Collaborative Airport Performance Management

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The SESAR PJ04 TAM project

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- The development will continue in SESAR 2020 Wave 2 (2019-2022)



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.



The APOC supervisor's view

APOC Stakeholder Supervisor

Event Task Capacity Demand View

APOC Admin

12.46.03Z APOC scenario: 0

Task Suggestions

Id	Stakeholder	Subject

Task List

Show all tasks Show active tasks

Id	Status	Subject	Messages	Stakeholder
3	Completed	Call for APOC meeting (Initial OIM)	1	MEN
4	Completed	Call for APOC meeting (Initial OIM)	2	SGH
5	Completed	Overall Impact Assessment (OIM)	2	ATC
6	Completed	Overall Impact Assessment (OIM)	1	Stands
7	Completed	Overall Impact Assessment (OIM)	1	MEN
8	Completed	Overall Impact Assessment (OIM)	1	SGH
9	Completed	Agreed Solution (Solution Message)	3	ATC
10	Completed	Agreed Solution (Solution Message)	2	Stands
11	Completed	Agreed Solution (Solution Message)	1	MEN
12	Completed	Agreed Solution (Solution Message)	1	SGH
13	Completed	Call for APOC meeting (Initial OIM)	2	ATC
14	Completed	Call for APOC meeting (Initial OIM)	1	Stands
15	Completed	Call for APOC meeting (Initial OIM)	1	MEN
16	Completed	Call for APOC meeting (Initial OIM)	1	SGH
17	Completed	Solve demand conflict	1	MEN
18	Completed	Solve demand conflict	3	SGH
19	Completed	Overall Impact Assessment (OIM)	1	ATC
20	Completed	Overall Impact Assessment (OIM)	1	Stands
21	Completed	Overall Impact Assessment (OIM)	1	MEN
22	Completed	Overall Impact Assessment (OIM)	1	SGH
23	Completed	Call for APOC meeting (Initial OIM)	2	ATC
24	Completed	Call for APOC meeting (Initial OIM)	2	Stands
25	Completed	Call for APOC meeting (Initial OIM)	1	MEN
26	Completed	Call for APOC meeting (Initial OIM)	2	SGH
27	InProgress	Agreed Solution (Solution Message)	2	ATC
28	Completed	Agreed Solution (Solution Message)	1	Stands
29	Ready	Agreed Solution (Solution Message)	1	MEN
30	Completed	Agreed Solution (Solution Message)	1	SGH

KPI

KPI	Value
Departure delays (RES4)	112.6 hours
Arrival delays (RES4)	138.5 hours
Number of cancellations (RES5)	
Number of extra flights	

Conflicts

Runway: All Interval: 01:00:00 Scenario: Reset View

Movements per hour

Stand: All Interval: 01:00:00 Scenario: Reset View

Stands

Team: All Interval: 01:00:00 Scenario: Reset View

Teams

Tasks created from predefined templates

Add new task

Subject:

- Agreed Solution (Solution Message)
- Select a predefined subject or type a custom subject...
- Call for APOC meeting (Initial OIM)
- Local Impact Assessment (LIM)
- Global Impact Assessment (GIM)
- Overall Impact Assessment (OIM)
- Options to Agreed OIM
- Agreed Solution (Solution Message)
- Perform DCB option
- Solve demand conflict

Messages:

Instructions:

Agreed Solution (Solution Message):

The APOC supervisor is expected to:

- (1) fill in the agreed solution as a message.
- (2) send the task.

The APOC stakeholders are expected to:

- (1) respond with 'InProgress' when starting.
- (2) read the Agreed Solution Message.
- (3) respond with 'Completed' when done.

Example of an Agreed Solution Message:

Agreed Solution:
GH: Bring in 2 additional handling teams.
Airline 1: Cancel 50% of flight departing during snow fall.
Airport: Assign stands with short taxi times to priority flights.
ATC: Use both runways for departures after snow fall.

Send Cancel Add Message...

Example of a task with associated communication messages

The screenshot shows a 'Task details' window with the following sections:

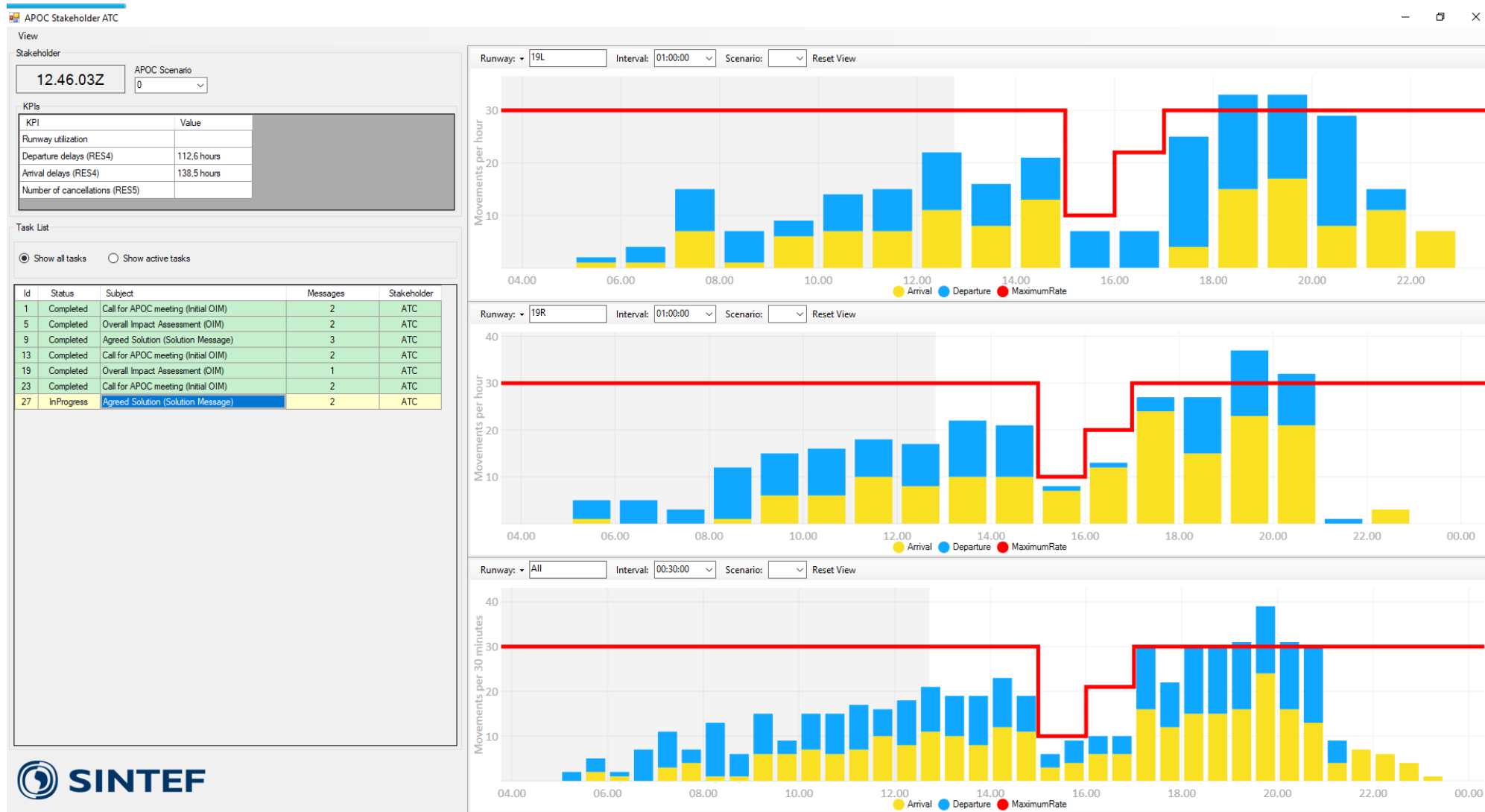
- Subject:** Call for APOC meeting (Initial OIM)
- To:** SGH
- Task resource information:** Type, Resource, Start (13:28), End (14:28)
- Status:** Completed
- Instructions:**
 - Call for APOC meeting (Initial OIM):
 - The APOC supervisor is expected to:
 - (1) fill in the Initial OIM as a message.
 - (2) send the task.
 - The APOC stakeholders are expected to:
 - (1) respond with 'InProgress' when starting.
 - (2) optionally provide feedback regarding the stakeholder's attendance.
 - (3) respond with 'Completed' when done.
 - Example of an initial OIM:
Initial OIM: Weather-ALERT. Snow-Fall, Period: 16:00-17:00, Severity: Heavy-Snow Fall, Status: Starting Impact Assessment.

Messages:

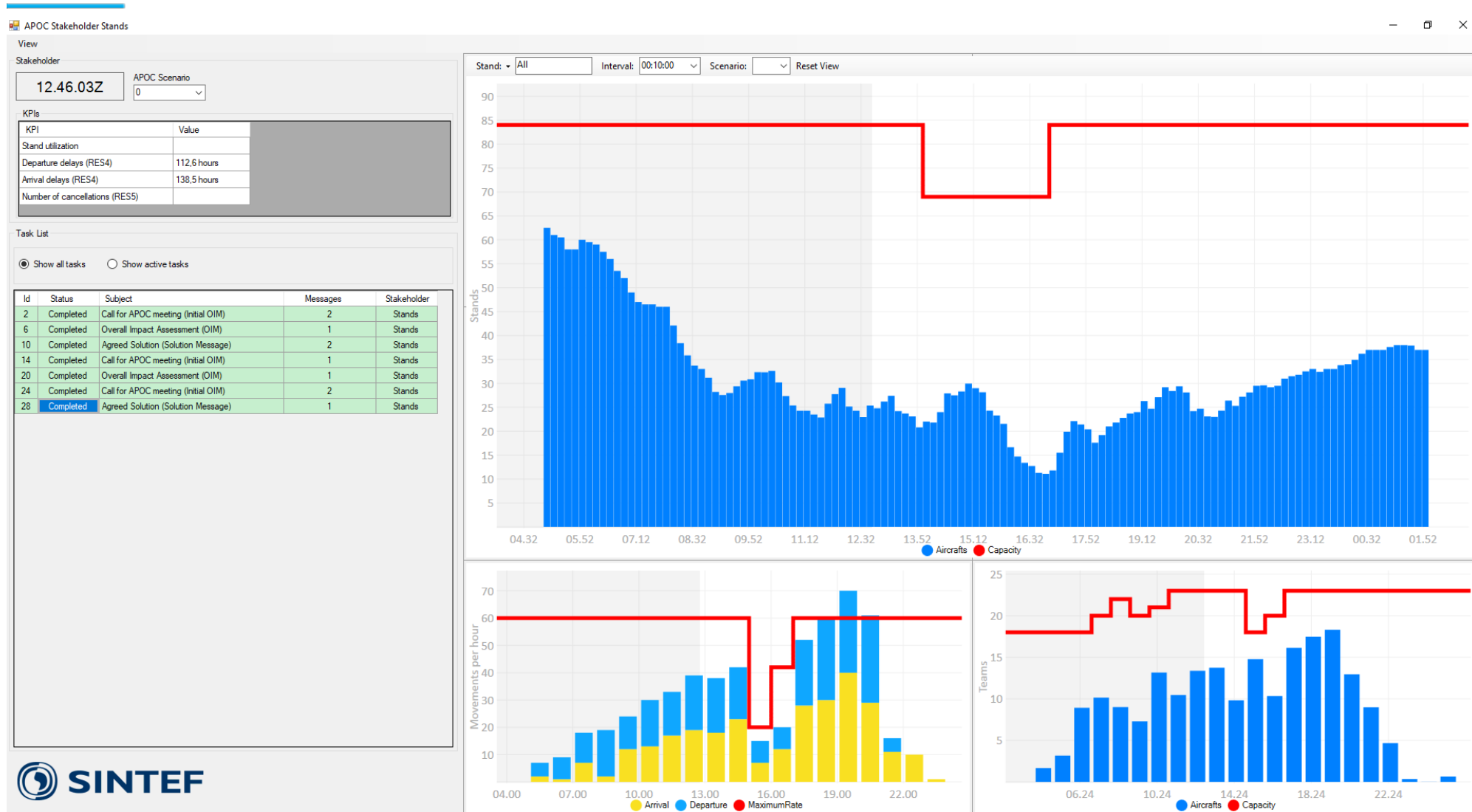
- From: Supervisor (Read 11.34)
New weather information:
The fog will start at 12:00 and last until 14:00, the visibility will be at 500 meters. Therefore the previous regulation should still be active.
To get a clearer picture of the status, I call for a meeting once you all are done. Please answer to this message as soon as you are ready for the meeting.
- From: SGH (Read 11.35)
Give me 2 mins
- From: Supervisor (Read 11.36)
Meeting at 11:40, please inform SAS and other airlines that we might call then at this time as well
- From: SGH (Read 11.37)
ok

Buttons: Send, Cancel, Add Message...

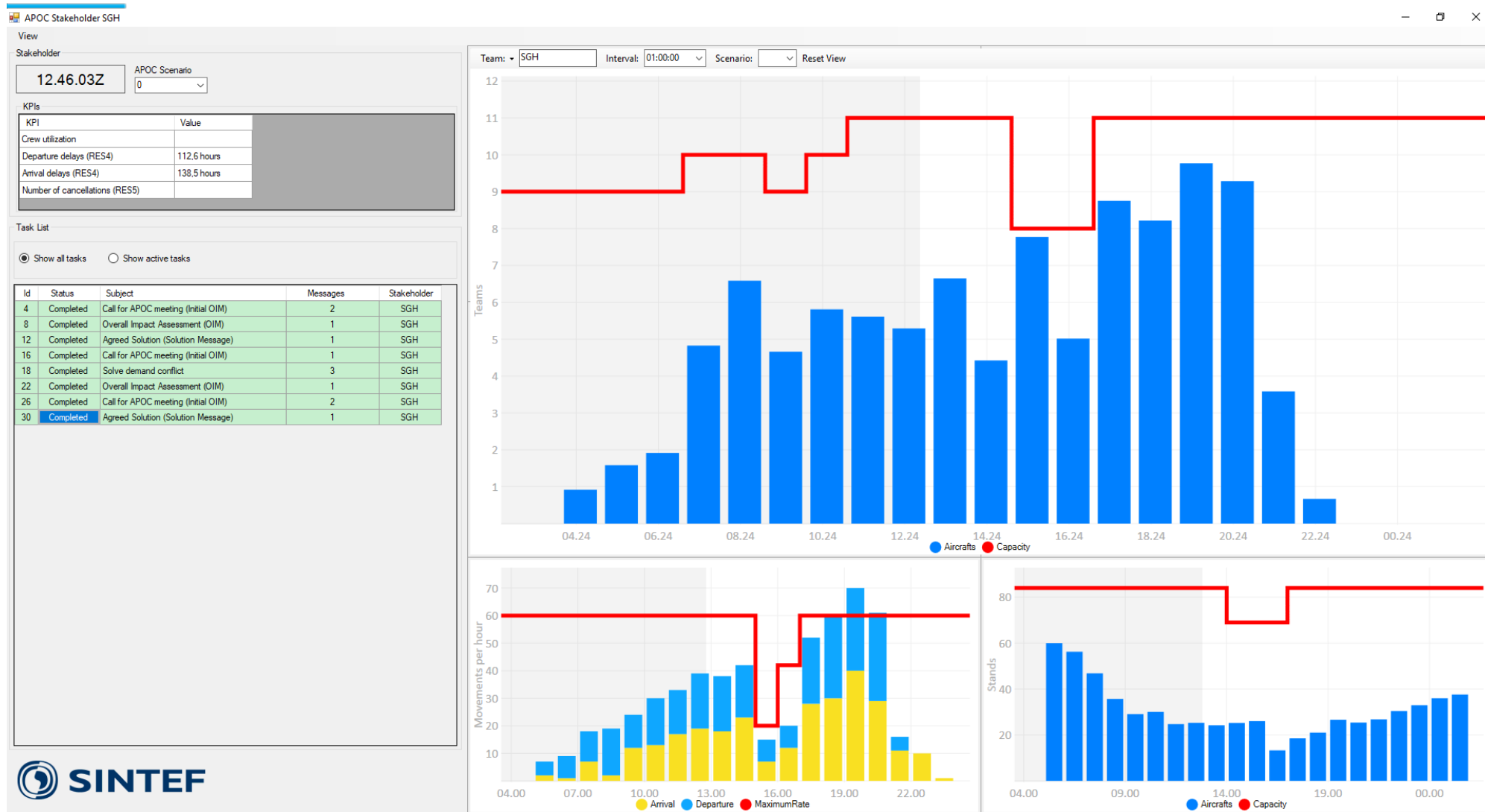
The ANSP/Tower stakeholder's view



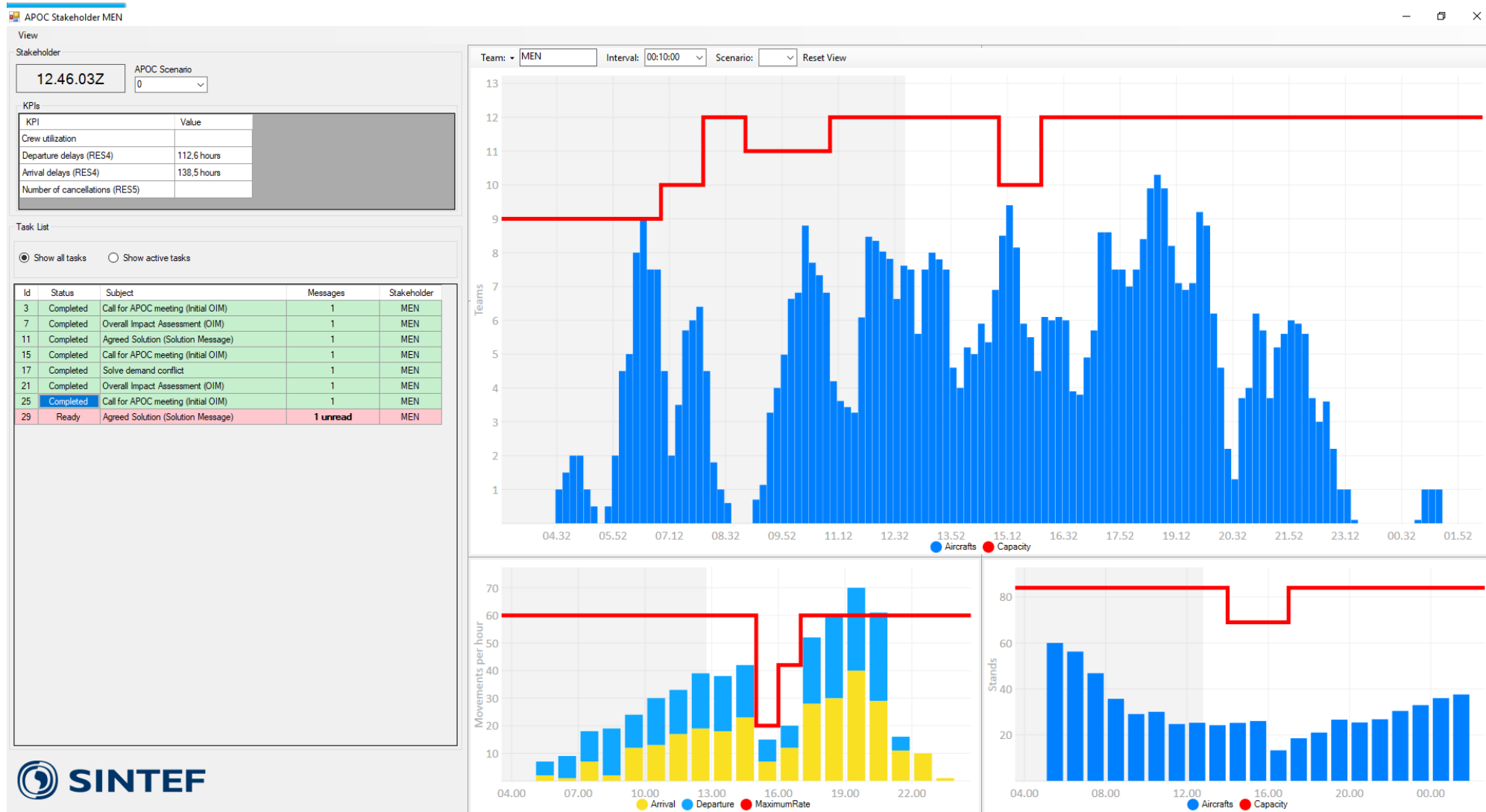
The airport stakeholder's view (stand allocation)



The ground handler stakeholder's view (SGH)

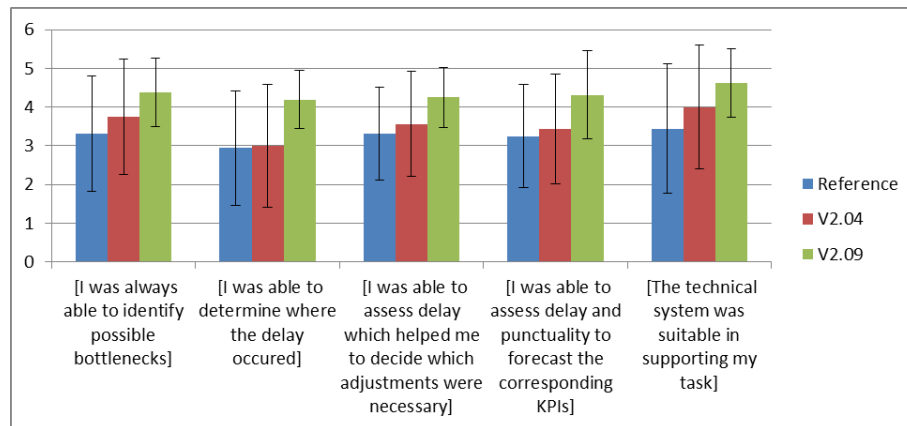


The ground handler stakeholder's view (MEN)

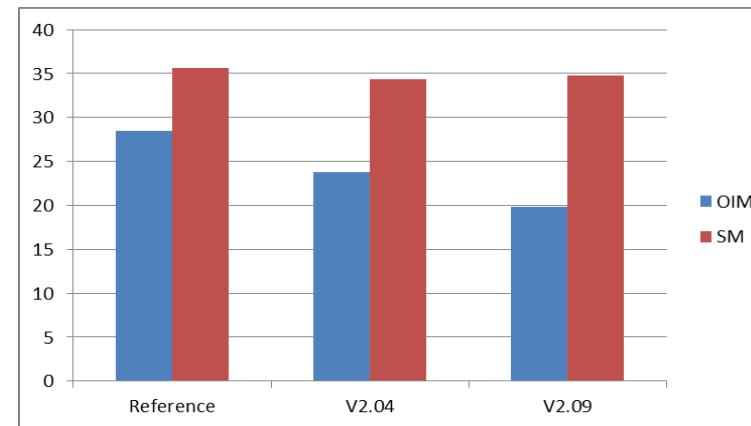


Some results from the validation exercise January 2019

Feedback regarding situation awareness



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



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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