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Queue and capacity management

From an operational point of view

Queue and capacity management involves continuously assessing passenger flow through the security checkpoint and adjusting available capacity to meet current and expected demand. The operational manager monitors waiting times, queue lengths, occupancy and throughput to understand the current situation, while reviewing forecasts to anticipate peak periods and potential capacity constraints.

When queues build up or bottlenecks emerge, the manager assesses where the problem originates and takes appropriate action, such as redeploying staff, opening or closing control points, or adjusting passenger routing. This includes monitoring crowding in surrounding areas and supporting the safe handling of disruptions, incidents and evacuation when necessary.

The manager follows up on the effect of these actions and reviews historical trends and performance against agreed KPIs to identify recurring issues, document results and improve future staffing and capacity planning.

User story 1: Real-time view of queue status

As an operational manager at the e.g. security checkpoint

I want to see the real-time status of queues and process areas in the security checkpoint, including wait time, queue length, number of people and throughput, so that I can assess the current load and take necessary operational measures quickly.

Operational value

- This function provides a situational picture of the security checkpoint in real-time, and enables me to react before the queue situation develops negatively.

Acceptance Criteria

- The user should be able to see real-time data for defined queue and process areas in the security checkpoint.
- The solution should be able to show:
  - Actual and estimated waiting time
  - Queue length
  - Number of people in the area
  - Throughput
- It must be clear which areas are monitored and how they are defined.
- The information shall be updated at a frequency that makes it suitable for operational use.
- The user must be able to distinguish between measured values and estimated values.
- The solution will make it visible if data quality or measurement uncertainty affects the display.
- The user shall be able to use the information as a basis for measures such as:
  - Redeployment of personnel
  - Opening or closing control points
  - Passenger flow adjustment

User story 2: Predicted waiting time and queue development

As an operational manager at the e.g. security checkpoint

I want to see the expected waiting time and expected development in the queue picture for the coming period, so that I can work proactively with staffing, capacity management and prevention of operational disruptions.

Operational value

- This feature makes it possible to move from reactive to proactive operations by alerting me of an expected capacity challenge before a situation actually occurs.

Acceptance Criteria

- The user should be able to see the predicted wait time for defined areas in the security checkpoint area.
- The user should be able to see the expected queue development for a defined time horizon.
- The prediction should be based on:
  - Real-time data
  - Historical data
  - relevant operational data where available
- The solution should be able to update predictions when operating conditions change.
- The user should be able to use the prediction to identify expected spikes and bottlenecks.
- The solution should be able to highlight how secure or uncertain the prediction is.
- It should be possible to follow up the accuracy over time to assess the model's usefulness in operational operations.

User story 3: Detection of queue build-up and bottlenecks

As an operational manager at the e.g. security checkpoint

I want the solution to automatically identify queue build-up, bottlenecks and abnormal passenger flows, so that I can quickly understand where deviations occur and take targeted action.

Operational value

- This makes it possible to detect problems earlier than with manual observation alone, especially during peak periods or in areas with complex passenger flows.

Acceptance Criteria

- The solution should be able to identify incipient and ongoing queue build-up in defined areas.
- The solution must be able to identify bottlenecks in the process flow in the security check.
- The solution will be able to detect abnormal passenger flows.
- The detection should also work when:
  - The queue changes shape
  - The queue moves
  - The queue occurs outside the permanently marked queue area
- The user should be able to see where the bottleneck arises and how it affects the flow further in the process.
- The solution will visualize deviations in a way that is easy to understand in daily operations.
- Any restrictions related to terminal setup, sight lines, or sensor placement should be clear to the user.

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User story 4: History, analysis and trend data

As an operational manager in the e.g. security control

I want access to historical measurements and trend data for queues, waiting times, occupancy and throughput, so that I can analyze development over time, identify patterns, evaluate measures and document goal achievement.

Operational value

- This functionality provides a basis for learning, improvement work and documentation, and supports both day-to-day operations and more strategic capacity planning.

Acceptance Criteria

- The user should be able to retrieve historical measurements for defined areas and processes.
- It should be possible to analyze development and trends over time for:
  - Waiting time
  - Queue length
  - Area occupancy
  - Throughput
- The user should be able to compare:
  - Different dates
  - Weekdays
  - Time periods
  - Seasons
  - Areas or processes
- The solution should support filtering per region, process, and time period.
- The user must be able to use the data to follow up on KPIs and contractual matters.
- It must be possible to export data or reports for further analysis and documentation.
- The solution will ensure consistency and traceability in historical data over time.

User story 5: Area occupancy and crowd gatherings

As an operational manager at the e.g. security checkpoint

I want to be able to monitor the number of people and density in defined zones in and around the security checkpoint, so that I can assess capacity utilization, detect crowding and support safe handling of deviations, incidents and evacuation.

Operational value

- This functionality strengthens both operations and safety by providing an overview of how many people are in critical areas and where the load is highest.

Acceptance Criteria

- The user must be able to see the number of people within defined zones and areas.
- The user should be able to see occupancy or density in these areas.
- It must be possible to delimit the areas in a way that corresponds to operational needs.
- The solution must be able to support the assessment of:
  - Capacity utilization
  - Crowding
  - Security
  - Evacuation
  - Irregular events
- The user should be able to identify areas with elevated loads or abnormal accumulations.
- Visualization of occupancy and density should be intuitive and quick to interpret.
- The solution should clarify relevant limitations in accuracy or coverage.

User story 6: KPI visualization

As an operational manager or responsible for follow-up of the e.g. security checkpoints

I want to be able to see and follow up on KPIs on several levels, compared to real-time data and historical results, so that I can assess goal achievement, uncover deviations and prioritize improvement measures.

Operational value

- This functionality links operational status with management information and makes it possible to follow up on both daily operations and long-term improvement goals.

Acceptance Criteria

- The user should be able to see relevant KPIs for the security checkpoint at several levels, such as:
  - Airport
  - Terminal
  - Security area
  - Process
  - Queue
  - Time period
- KPIs must be able to be compared with real-time measurements as well as historical data.
- The user should be able to see the KPI status in a view that makes it easy to identify deviations.
- It should be possible to link threshold values to KPIs.
- The user should be able to navigate from the overall KPI overview to more detailed information.
- The solution will support operational follow-up as well as reporting and improvement work.

User story 7: Data access and integration with Avinor's data platform

As a data architect at Avinor (with reference to Appendix 1 attachment 2, sheet TEC Data Exchange)

I want access to data from the queue- and capacity system through documented interfaces to Avinor's data platform such that Avinor can combine the data with real-time data from other airport systems in its own dashboards.

Operational value

- User can use the data in both the supplier's solution and a shared operational overview with data from other airport systems. Access through Avinor's data platform also supports further analysis and new use cases.

Acceptance Criteria

- The Customer can retrieve data programmatically and use it in Avinor's own solutions.
- The solution supports near-real-time data, incremental extracts and scheduled extracts, including the handling of updates and deletions.
- The data model and metadata are documented, versioned and available in a format that supports understanding, cataloguing and combining the data with information from other systems.
- The Customer can configure relevant extracts. The solution supports structured data formats and efficient transfer of larger data volumes.
- Data can be transferred securely without negatively affecting production performance. The Supplier describes update frequency, available interfaces and relevant limitations.

User story 8: APOC Terminal Supervisor

As a process manager for the terminal

- I would like to have a visual picture of queueing to i.e. security control points and border control points (ideally both in queue length and current and predicted waiting times). This will allow me to better assist with queue management and prioritization in order to minimize operational consequences/delays.
- I would like to have heatmaps/map that shows in real time which area of the terminal has high or low density of people.
  - Example: The arrivals halls – I know how many bags we expect in the next few hours, but a heatmap of the distribution of passengers in the arrivals halls can enable me to better prioritize the spread of the flights on carousels during peak periods to improve the passenger experience and accessibility for passengers and operators (PRM, trolley service at peak).
- Evacuation
  - In the event of a fire or security evacuation, I would like to know how many people are in a given area of the terminal
  - In order to implement measures against crowding in the terminal in irregular situations, I need to know occupancy in different areas and to receive warnings at given threshold values.
- I would like to have actual numbers connected to Avinor's forecasting system so that it is possible to evaluate actuals towards forecast where relevant.
  - I.e. in the case of technical outages, what should be prioritized first – considering where there are crowds, and what does the rest of the day look like?