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Modern airport management – fostering individual door-to-door travel

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Abstract

Airports are intermodal hubs and natural interfaces between ground transport and air transport. In a recent DLR project, an innovative approach is being developed to extend the concept of A-CDM and TAM not only to airport landside and terminal processes but to go even further and incorporate feeder traffic in the management of airport processes. Thus providing travelers with a real door-to-door service and letting airport stakeholders benefit from efficient airport management. The research prototype developed in this project will be depicted in detail and functional principles will be explained.

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Keywords: airport management; Passenger-Trajectory; door-to-door travel; efficient resource management; A-CDM; TAM; Optimode

1. How to incorporate door-to-door travel in proactive airport management

Airports are not just places where airplanes land and take-off but they are also natural interfaces between ground transport modes and air transport. In the door-to-door travel chain it is not sufficient to just focus on a small part of the journey. Attention must be paid to the interlinking of transport modes and different phases of the journey. In recent years substantial improvement could be generated in the field of airport management especially for landside and terminal processes. Concepts like A-CDM (Airport Collaborative Decision Making) and TAM (Total Airport Management) show tangible potentials of improving efficiency and punctuality.

The Advisory Council for Aviation Research and Innovation in Europe (ACARE) has formulated ambitious goals for aviation research in their Flightpath 2050 (European Commission 2011). One of the goals directly affects the door-to-door travel time by claiming that 90% of travelers within Europe shall be able to complete their journey,

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door to door, within 4 hours. However, the situation travelers have to face in today's reality is very different from that. Services of airports, airlines and ground transport providers are not yet linked and there is a potential for improving the overall travel experience of the passenger and at the same time gaining efficiency of airport operations.

In a recent project called Optimode, an innovative approach is being developed at the German Aerospace Center (DLR) to extend the concept of A-CDM and TAM not only to airport landside and terminal processes but to go even further and incorporate feeder traffic in the management of airport processes. Thus the traveler gets a real door-to-door service and a reliable travel experience whereas airport operators and airlines benefit from a more appropriate and efficient resource management.

A research prototype system is developed within the Optimode project to provide advanced situational awareness of airport processes and passengers' status in relation to their individual trajectory and the flights operating at the airport. The management system is validated within a virtual airport environment and a control center for managing processes by airport stakeholders.

1.1. Passenger-Trajectory

To incorporate the door-to-door travel chain of the individual passengers into the operational airport management, a concept was developed, introducing the "Passenger-Trajectory". The Passenger-Trajectory takes up the principles of the trajectory based operations concept developed in the SESAR initiative (SESAR 2007) and puts the individual passenger at the center by monitoring and supporting the individual door-to-door journey. The introduction of the Passenger-Trajectory concept optimizes the movement of passengers in time and space by taking into account the constraints imposed by ground transport and airport schedules (i.e. rail arrival times, aircraft departure and arrival times) and the desirable departure and arrival times of the passengers from/to their origin/destination.

The Passenger-Trajectory defines the 4-dimensional points in space and time during the passengers' travel chain for each individual traveler. This will require disclosure of travel plans by the traveler. In return he or she could receive more precise and reliable information about changes in schedules or interruptions. Moreover, the passenger can even be provided with a real-time connection management via an automated interface, e.g. via a mobile device.

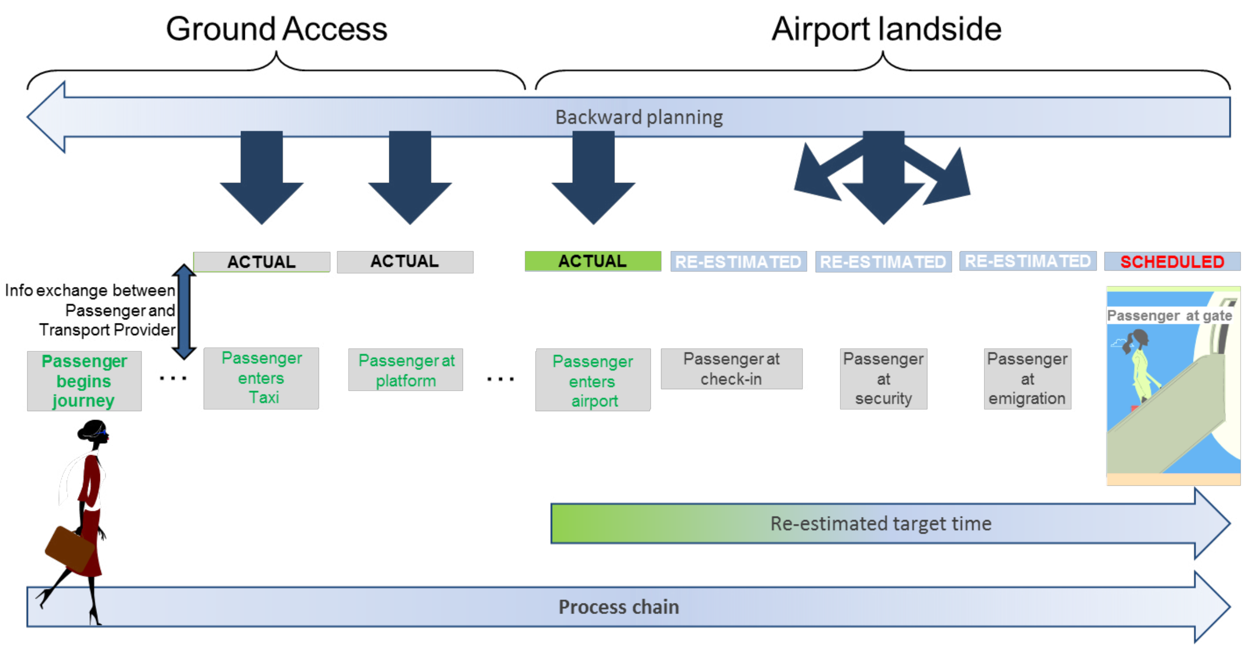

Figure 1: Principle of the Passenger-Trajectory

Figure 1 shows a schematic illustration of the Passenger-Trajectory. The Passenger-Trajectory is initialized with scheduled times within the process chain and provides and monitors target, estimated and actual times accordingly. This is in analogy of the Milestones Approach defined in the A-CDM Implementation Manual (see Eurocontrol 2012). The system uses real time integrated information and short term prediction regarding the actual airport flight schedule, the travel time of the various modes and the terminal processing time (i.e. time spent at the terminal to go through check-in, passport control, security check etc.). The scheduled times are available e.g. from reservation details and historical observed patterns, whilst the updates of actual times can be collected from geolocation data of passengers' mobile devices combined with real time data from transport operators, thus allowing the calculation of accurate estimated times. Such information services are voluntarily for the passenger but will be of added value both for the passenger, who will be able to optimize the journey in terms of time and travel experience, and for air transport stakeholders and transport operators, who will be able to optimize the use of resources and offer improved services to the passenger. In addition, the system will have the capability (through short term forecasting and simulation) to develop look-ahead strategies for airport terminal and airport accessibility transport service resource allocation and passenger information.

1.2. Proactive Passenger Management

Modern airport management requires a more holistic approach to the whole travel chain and aims at a better situational awareness of airport landside processes and an improved resource management. Main keys to this are a proactive passenger management, as introduced by Classen and Rudolph (2015), and capitalizing on the Total Airport Management (TAM) approach. Unlike common passenger management's reactive approach, a proactive passenger management utilizes an early knowledge about the passengers' status and the expected situation in the terminal along with resulting system loads and resource deployment. An appropriate and modern management compatible with the TAM approach will also be considering dependencies of airside and landside operations as well as costs and performance.

Proactive passenger management means an operational approach where the management and control of airport terminal infrastructures, services and passenger processes are conducted based on knowledge about the dynamic system status more in advance. Today passenger management at airports is rendered on an ad hoc basis, see Helm et al. (2014). Apart from planning ahead based on experienced data during the weeks before the actual day of operations and some last adjustments the day before there is no or only little knowledge about the actual situation to be expected. Therefore current passenger management can only react. Proactive Passenger Management will act rather than react.

It is a concept where planning and control of the terminal processes is facilitated by a decision support system that provides a situational awareness not just of the actual moment but also about the expectable future of the actual day of operations. For this purpose DLR developed a complex forecast system that provides the operations management staff with information about

- actual and future status of the passenger flow
- passengers' waiting times
- passengers' timeliness at the gate

This forecast, which was specifically developed within DLR, calculates an estimate of the number of passengers who reach the gate at a certain time. Ideally, this time should be set x minutes prior to the off-block time of the flight. In addition, the forecast calculates a time where all passengers reach the selected flight subject to the actual and expected situation at the airport (e.g. actual number of passengers on flights and in building, delayed incoming flights, resource availability, gate changes etc.). This time was introduced by Classen and Rudolph (2015) as a new milestone called "Estimated Passenger at Gate Time (EPGT)" and helps determining a reliable off-block time at an early point in time prior to a flight's departure.

The forecast functionality described above can be enriched with the sampling points of the Passenger-Trajectory (e.g. via mobile devices or stationary sensors) resulting in more accurate feedback about the actual status of each passenger. In addition this real time information can be used for an improved short term prediction of the airports' future situation. This in turn enables an airport management system to control processes and resources more appropriate.

This concept can support an optimized allocation of stakeholders' resources and enable airport terminal short term performance assessment. This application of A-CDM and TAM principles can lead to more efficient utilization of all stakeholders' resources and the transport system in its entirety.

1.3. Key Performance Indicators

Within the Optimode project Key Performance Indicators (KPI) have been developed and are used to analyze and evaluate status, performance and behavior of airport operations. Management measures are based on these KPIs and can then in turn again be analyzed and evaluated concerning their impact. In this paper three KPIs are exemplarily described and will also be used in the research prototype system which is described in more detail in chapter 2.

The KPI "Boarding Score" gathers the number of air travelers who reach their flight in time and are not left behind due to disturbances in their travel chain or at the airport. It is expressed as a percentage of all air travelers whose Passenger-Trajectory foresees to use a flight or a set of flights starting from the examined airport in a given scenario. Thus the ideal value would be 100%. The Boarding Score can differ depending on the observation level by describing either the whole airport or a specific terminal or an airline or even a specific flight.

The KPI "Passenger Pass-Through Time" describes the total amount of time a passenger needs to move through the considered (airport-) infrastructure. Usually this comprises the overall time between the moments when a passenger enters the airport terminal and when leaving the last required process point (e.g. security checks or passport check) before entering the gate waiting area thus being ready for boarding. The value is captured by analyzing the n last Passenger-Trajectories for the different sections of measurements (outbound, transfer, inbound passengers).

The KPI "Passenger Waiting Time" is a measure for the time a passenger needs for a processing point at the considered airport. There are different types of process points such as check-in, security checks or passport control. In actual fact this KPI therefore is not a single KPI but a set of KPIs. The KPI "Passenger Waiting Time" does not only describe the waiting time but will also comprise the actual processing time of the respective process point. This KPI therefore has a direct influence on the level of service perceived by the passenger.

2. Development of a prototypical passenger and airport management system

In the Optimode project a research prototype system is developed to examine the optimization potential of airport operations by utilizing the Passenger-Trajectory. To enable a real door-to-door service to passengers, feeder traffic information is included in the airport management. This is an important progress compared to earlier research prototypes, e.g. depicted by Helm et al. (2014). It is expected that these features will improve airport managers' situational awareness of current and future airport processes including the passengers' status more comprehensively.

The main scope of the following description focuses on the tool named PAirMan (Passenger Airport Manager) which is designed as a managing tool for airport stakeholders. To provide a global overview of the whole system in which PAirMan is integrated, the overall Optimode system architecture is described first.

2.1. System Architecture

Figure 2 depicts the modular system architecture as a whole. A modular design for the overall system as well as for each tool has been chosen to allow for flexible changes of single functionalities and hence the system behavior. It enables system validation in different modes and from different perspectives of stakeholders.

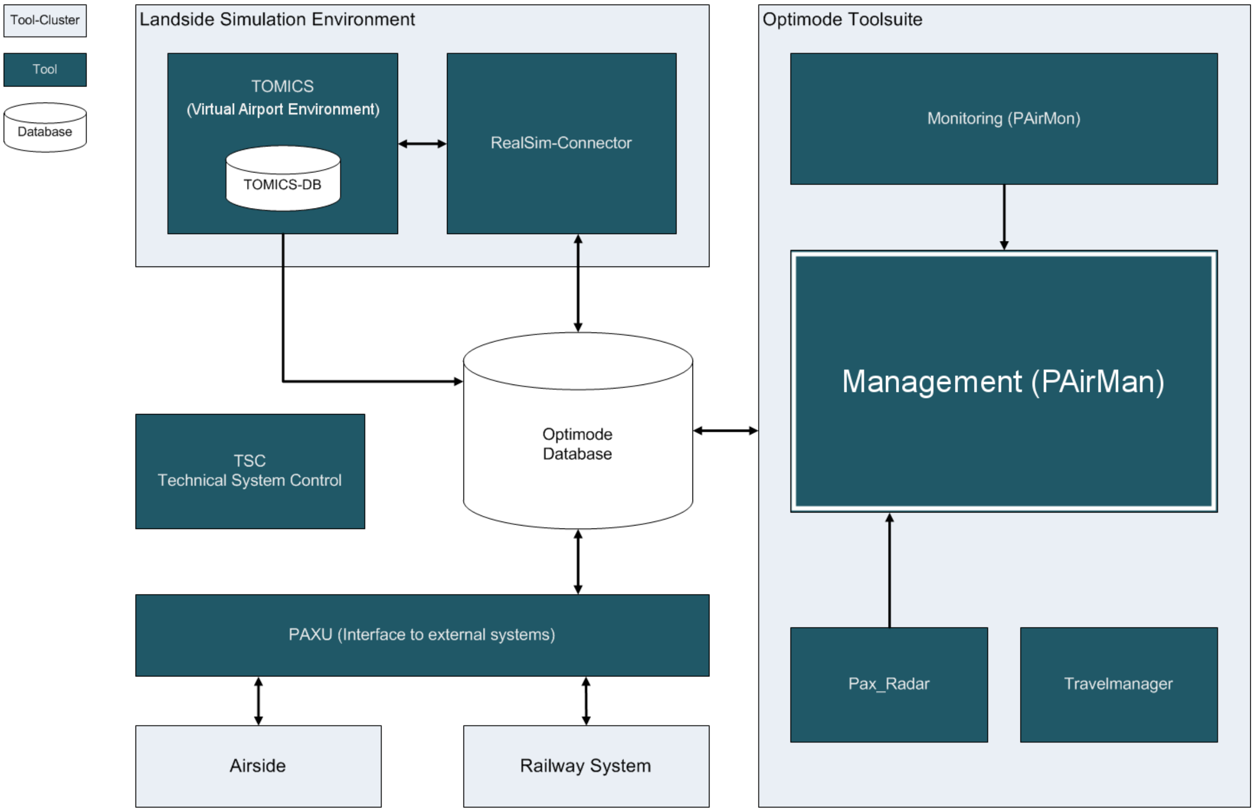

Figure 2: Optimode System Architecture

A central element in the system architecture is the Optimode database that contains all necessary master and dynamic data as well as system parameters and resulting data of the single modules. Master data is a fixed set of data that will not be modified during a system run and contains e.g. details about worldwide airports, airlines and aircraft. The airport model used in this project is a generic airport representing a typical medium sized European airport and is designed to map all required test scenarios. Layout data of terminals and buildings of the airport as well as details about process points and the level of security, as defined by Milbredt et al. (2015), for building areas are also included in the database as master data. A process point is a hypernym comprising check-in facilities, security lanes, passport control stations and gates etc.

The dynamic data is structured in scenarios that specify the behavior of a system run. A scenario is described by its schedules for flights, public ground transport and process points. Additional information is provided concerning in- and outbound connections of transfer passengers. As process points must be operated by personnel a human resources pool is also part of the database. To control a scenario, information about an active system run is used such as a timestamp for synchronizing all system modules from the simulations and analyzing methods up to the management tools. Each single modification of the schedule is tracked to allow a detailed reconstruction of events and their impact on the entire system.

The next tool cluster is the simulation environment for the airport landside. The term “landside” is defined as the area where a passenger enters the airport until leaving it through the gate into the aircraft. The simulation tool TOMICS (Traffic Oriented MICrosopic Simulator) builds the core of the virtual airport environment. It includes a separate database to encapsulate the ideal simulated world from the real management tools. Between those two worlds a fuzzy filter was implemented to reduce precision of the full digital simulated system to a level of diffuseness you can gain with today’s sensor systems at a real airport. Thus the management tools know where people are located at the airport but can not identify persons individually, unless this person passes a checkpoint. A module called RealSim-Connector serves as an interface between these two worlds and is able to store relevant simulation results via the mentioned fuzzy filter into the central Optimode database. In the other direction changes in the real world are passed to the ideal simulated world which allows active and dynamic airport management as in real life.

The Passenger and Airport Exchange Unit (PAXU) acts as an interface between landside system and external tools. Among those are airside tools dealing with all events concerning aircraft and ground handling. Ground transport systems, like the railway system with a station at the airport, are integrated as an external tool cluster providing data about incoming and outgoing trains.

The Optimode Toolsuite is a collection of all tools designed and implemented for stakeholder specific airport management. The tool PAirMon is in charge of monitoring the whole transport hub in the actual and a possible future state. Among this monitoring data there is an overview of the actual utilization of process points, flight movements and other dynamic data. Individual data about passengers' process status at the airport can be gathered by sensors (e.g. cameras) or control stations, such as a boarding pass scan at security entrance. Future nodes in the Passenger-Trajectory timeline can then be re-calculated to gain more reliable arrival times at the gate. All monitoring details are used to calculate key performance indicators that can be used to evaluate the current and future state of an airport.

The tool PAirMan represents the stakeholder specific management layer with backend functionality and a graphical user interface (GUI). The main objectives are to generate situational awareness of the monitored data and to provide a functionality to control airport operations suitable for the current and predicted situation. This tool is in the main scope of this paper and will be described in detail in section 2.2.

The Pax_Radar is an innovative visualization of the flight related passenger status and has already been introduced by Urban et al. (2012). Results of the Pax_Radar are also included in the user interface of the PAirMan.

The Travel Manager is a tool intended for the passenger as end user. Therefore, it is designed for small displays (e.g. smartphones) to inform a passenger about latest details and forecast results of his journey. Any delays, gate-changes or estimated gate arrivals belong to the provided data.

The technical system control (TSC) is a collection of helpful functionalities to control the system, create new scenario data or the generation of technical documentations.

2.2. Passenger and Airport Manager

The Passenger and Airport Manager (PAirMan) is designed for flexibility and as an adjustable web application. The design of the graphical user interface (see figure 3) is focusing on three most important requirements in one dashboard. At a first glance each stakeholder shall gain situational awareness – a comprehensive understanding of the airport's current and future situation. This holistic understanding is generated by the visualization of performance indicators and an appropriate alerting in case of exceeded thresholds.

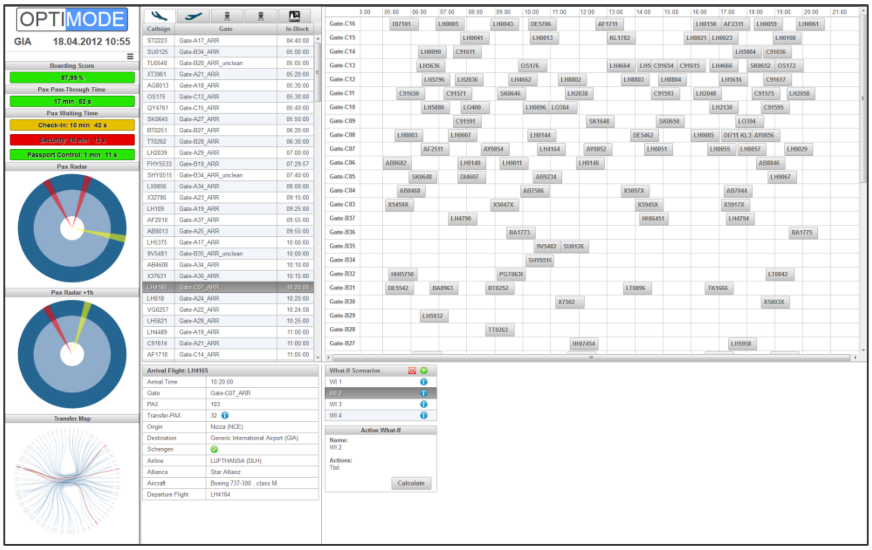

Figure 3: Graphical user interface for PAirMan

Operational decisions are mostly based on details that cannot be revealed by highly aggregated indicators. As a result there is a requirement for the provision of detailed data in the graphical user interface. Due to the large amount of details available and to avoid overflow of information it is necessary to find a balance between data that can always be seen and specific data which is only made available on demand after a user interaction.

The situational awareness comprises the stakeholder’s own field of responsibility as well as the interaction of his field with that of other stakeholders in the whole system. As a stakeholder can only act within his responsibility, access to stakeholder specific roles and sets of actions are required. An airline stakeholder for example will be able to see all indicators and necessary data but will only be able to perform actions within his field of responsibility, such as delaying a flight.

Basic layout

According to the specified requirements a graphical user interface with the basic layout shown in figure 4 has been developed. As the reading direction of Latin languages is from left to right people with this linguistic background (e.g. Europeans) are also used to the perception of displays in that sense. This behavior has been turned into the basic layout by showing the highest aggregated data on the left while aligning details towards the right side.

The left part of the GUI depicts indicators and alerting in order to provide quick situational awareness of the airport’s situation at a glance. The center view shows time tables in data grids and further details. Finally the right view represents the area for user interaction for the airport management.

The following sections provide a description of visualization details that partly or completely fill one of the listed views.

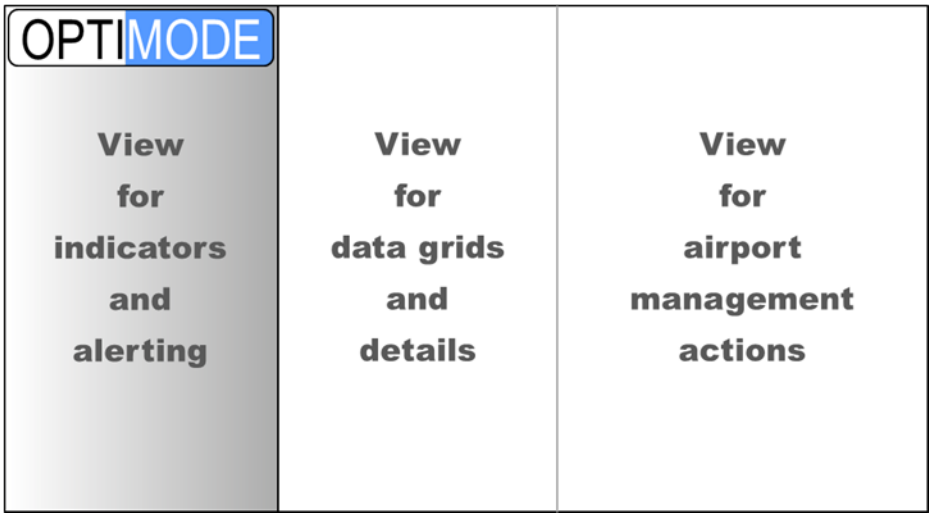

Figure 4: Basic layout of PAirMan

Indicators and alerting

The key performance indicators defined in chapter 1 have been developed to describe the transport hub airport in a holistic way. Being the most important numbers to assess the passenger flow the indicators are located at the top of the left view. For each indicator threshold values are defined for the alerting mechanism. These thresholds distinguish between acceptable, warning and fatal state and highlight that state with the colors green, orange and red. A mouse click on an indicator opens a history chart showing the course of the actual day (see figure 5). Historic values are stored minute-by-minute over the day for each indicator.

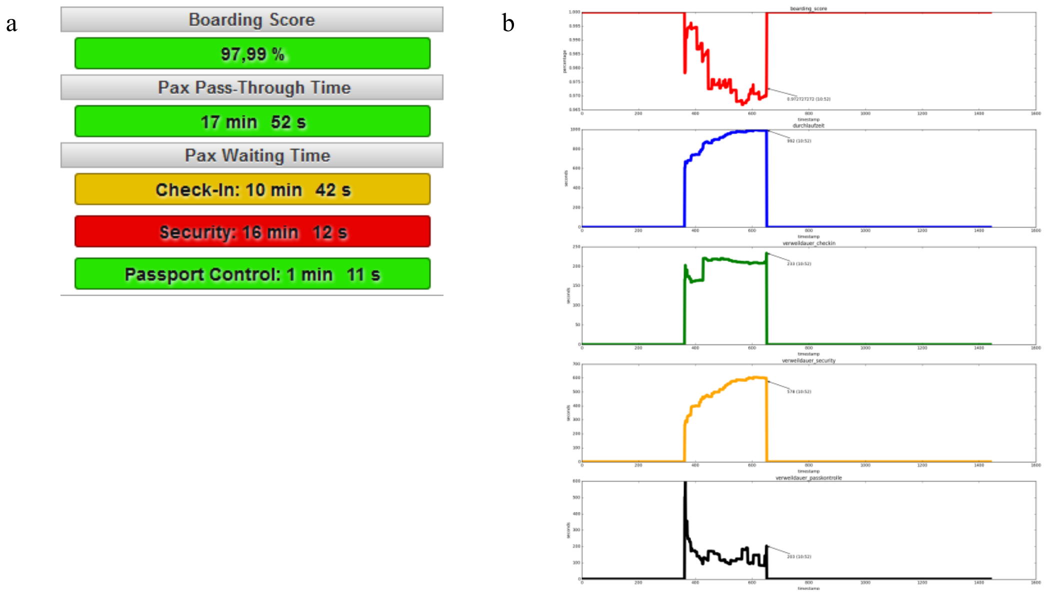

Figure 5: (a) Indicators; (b) Indicators’ historic values

Pax Radar

The passenger radar (short Pax_Radar) is an innovative visualization tool that has already been introduced by Urban et al. (2012). As the Pax_Radar is rich in detail the dashboard version (see figure 6) is abstracted by providing a simplified and eye-catching visualization to foster situational awareness as part of the management tool PAirMan. The radar represents a logarithmic and radial timeline with the center as the actual time and the outer radius as 24 hours in the future. Further timed increments are the white circle representing the last five minutes and the light blue circle with three hours in advance. The difference between the actual time and the target off-block time of a plane defines the distance of a flight from the center.

Each gate of the airport is assigned to one segment of the radar. By default this segment is not visible thus indicating a non-critical system state. With the passenger in focus and the goal to facilitate the passenger to reach his connecting flight the system forecast delivers a calculated future value for the boarding score KPI. Only flights within a defined timed warning horizon (here 70 minutes) are observed. If, based on this forecast, all passengers reach their flights departing at a gate the related segment is not highlighted. As soon as the boarding score of a flight declines to a value between 90 percent included and 100 percent excluded the related segment is highlighted with a yellow warning color. A value below 90 percent is indicated by a red signal color. The threshold values can also be adapted to different local requirements.

There are two instances of the passenger radar in the dashboard view. The first represents the airport's actual situation and the second shows the forecast of the situation as expected one hour in future.

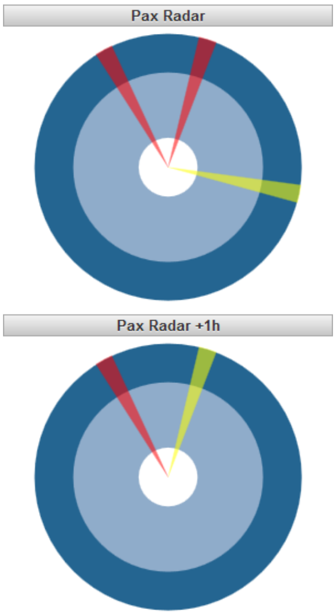

Figure 6: Passenger radar as dashboard version

Transfer Map

While the passenger radar considers all passengers of the relevant flights, the transfer map explicitly focuses on transfer passengers. The idea behind this visualization is to display the actual used transfer connections of the daily flights at an airport in a chord diagram. The basic scheme of the transfer map is a radial arrangement of flight numbers that are grouped first by arrival/departure and secondly by the gate. Figure 7 depicts the transfer map with the arrival flights on the left half of the circle and the departing flights on the right half. The different gates are symbolized by a little larger gap between the texts. A path between two flights illustrates passengers transferring from an arriving flight to a departing flight. This visualization provides a quick overview of the transfer dependencies.

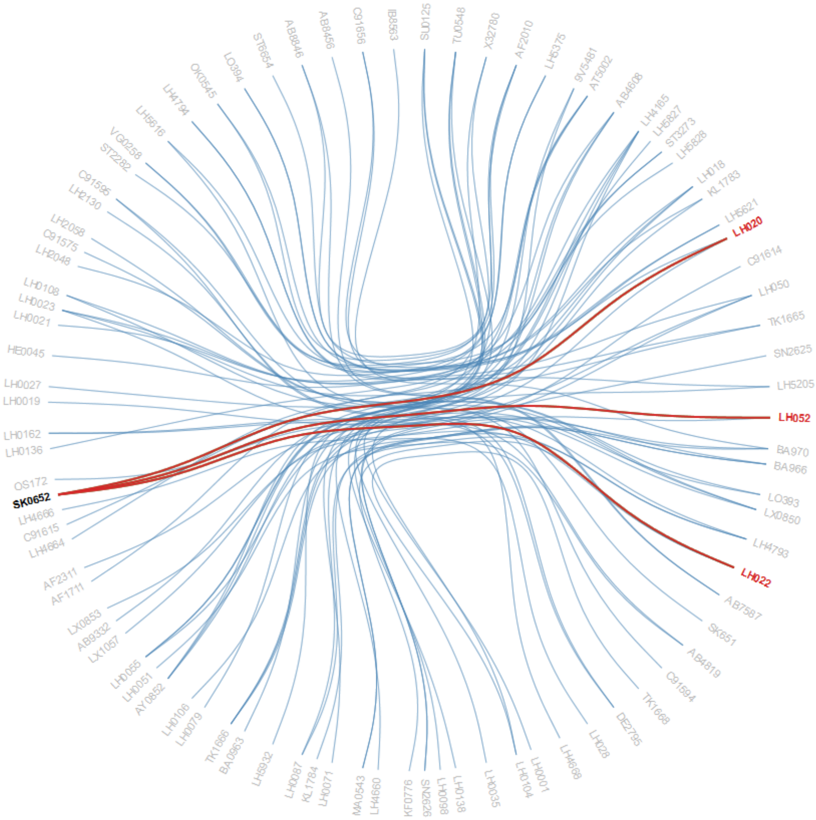

Figure 7: Transfer Map

The map can be used to highlight critical transfer paths, thus improving situational awareness and fostering smooth transfer operations. Analogous to the warning system of the dashboard version of the passenger radar the transfer paths become yellow if the boarding score of a departing flight is between 90 and 100 percent. Below 90 percent it becomes red.

The transfer map can reveal further information by using it in an interactive way. By default the density of the lines is very high and it is almost impossible to match a departing flight with an arriving flight. A user can move the mouse pointer over a specific flight. Then a text box will become visible displaying flight and connection details such as information about the flight's passengers, the target flight connections etc. Additionally the transfer paths for this flight are emphasized by thick lines having a darker color and bold text for all flight numbers involved. A click on a chosen flight number will latch the highlighting and it will be kept until another flight number is activated or the mouse moves over another flight number.

To strengthen the role of the airport as an intermodal hub, an extension of the transfer map is planned by also including trains and other public transport in the diagram.

Analogous to the Pax_Radar the transfer map in full detail requires more space than available in a dashboard. Therefore, a condensed dashboard version has also been developed and placed below the passenger radar dashboard on the left view of the PAirMan GUI. The dashboard version also focuses on improving the situational awareness. It is limited to 30 arrival and departure flights. By default the 30 next departing flights and their appropriate arrival flights are displayed. In case of a warning or fatal connection according to the above mentioned boarding score the last departing flights will be removed from this view and replaced by the most critical flight connections. According to the highlighting rules of the standard version of the transfer map the paths are highlighted in the same way in the dashboard version. This allows an airport stakeholder to immediately see a deviation of the process during the day and he can switch to the larger view when needed to acquire details about this deviation.

Data grids and details

As mentioned above a detailed information basis is essential for drawing timely and sustainable decisions. The middle column view therefore displays data grids and further details for a stakeholder (see figure 8). In the Optimode project the stakeholders from airport, airline, rail and security agencies (security check and passport control) provide information to the common database. Based on those information sources, the following tabs are available:

- Arriving flights
- Departing flights
- Arriving trains
- Departing trains
- Airport process points (check-in counter, security lanes and passport control)

A data grid in the upper part of the view provides an overview in terms of timetables. The table in the lower part provides details about one single selected item. As an example figure 8 shows all information about the departing flight LH0071 at Gate-A38 in particular the passenger and transfer count. A mouse over event of the information-icon displays a tooltip with arriving flights feeding in the transfer passengers.

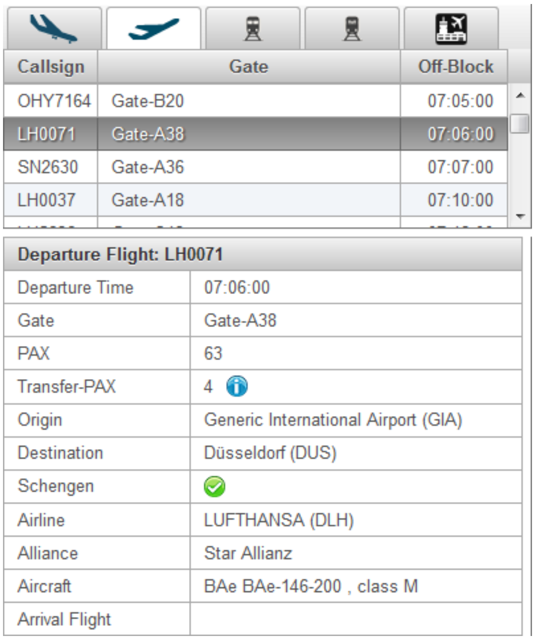

Figure 8: Data grid and details for a selected departure flight

An extension of the grid display is envisaged for the future, adding the Passenger-Trajectory and including alerting visualizations in the data tables.

Timeline chart

The timeline chart in the right part of the dashboard shows an overview timetable with all planned, operational and preceding flights (see figure 9) and is a common visualization for practitioners in airport operations. In vertical direction the chart displays the different gates of the airport and in horizontal direction there is a timeline, moving forward as time passes. Each flight inside the grid is represented by a bar graph allocated to its planned gate, time and duration. The left side of each bar is at the target on-block time, the right side is at the target off-block time of the flight (for definition of time milestones see Eurocontrol 2012). By selecting a flight in the timeline chart, the data grid table in the center of the dashboard shows detail information about the flight. By clicking and holding the mouse button on the timeline or on the background, the operator can pan the display forward and backward in time. The red vertical line shows the actual time or respectively the actual simulation time.

Besides the functionality to display information, the timeline chart is the central unit to perform changes. By selecting a flight the user is able to change the target off-block time by resizing the right end of the bar graph representing that selected flight. To switch the gate position, the operator can drag and drop a flight to a new gate row. All changes are stored in the central Optimode database, where the Passenger and Airport Exchange Unit (PAXU) synchronizes these changes between landside and airside tools.

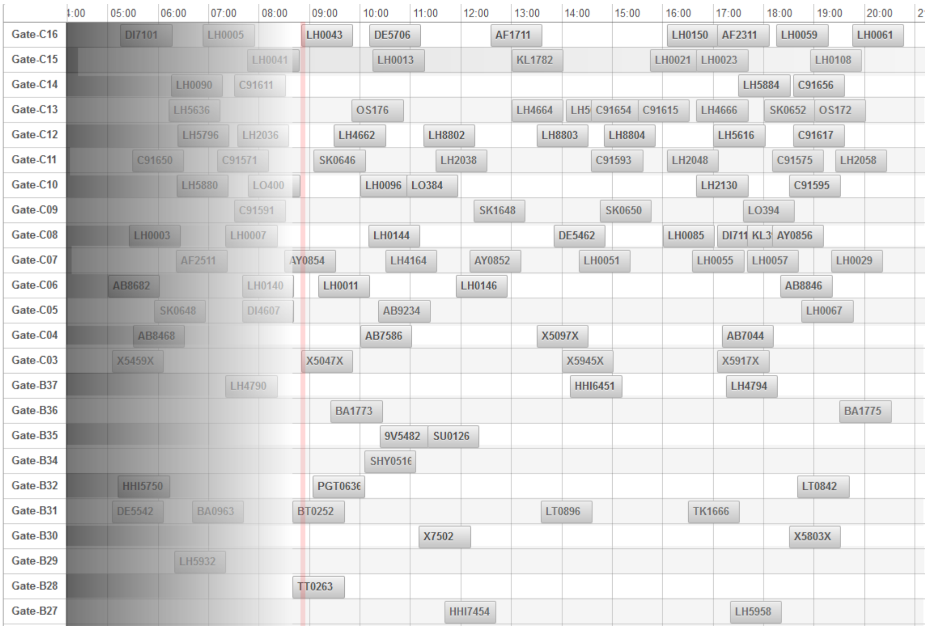

Figure 9: Timeline chart

What-if

The transport hub airport with all its various stakeholders is a complex system. It is hard to estimate the impact of any action performed by one of the stakeholders on the whole system. An action with positive effects for one field of responsibility can at the same time deteriorate the overall system performance. For that reason a common data basis has already been introduced to provide comprehensive situational awareness to all stakeholders involved. The system provides an advanced capability of so called what-if calculations to predict possible effects of a decision before implementing it in reality. By this means all stakeholders can estimate the impact of that decision on their own field of responsibility and on the overall airport in advance – thus consequently implementing the TAM concept. This calculated information is a profound basis for decision support. But according to empirical cognition airport practitioners as potential users of this software shall always have the last power of decision.

Technically a complex procedure had to be implemented by coordinating several steps of calculations of different tools. In addition a comfortable user interface has been designed which is depicted in figure 10. First a user has to create a new what-if scenario by defining a scenario name and description and by adding it to the existing ones. Alternatively the user can select an existing scenario thus switching the complete user interface into the what-if mode. Unlike the default mode in which actions are directly implemented in the system, the what-if mode at first only stores all proposed actions as events in the selected what-if scenario. A scenario can consist of one or more actions such as a gate change or intentionally delaying a flight.

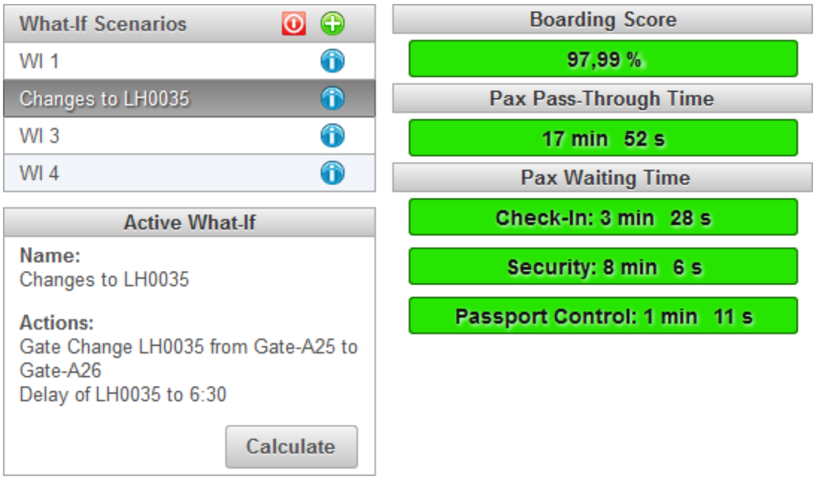

Figure 10: Definition and evaluation of what-if scenarios

As soon as a what-if scenario has completely been defined with one or more virtual actions the user can start background calculations. The first step of this procedure is the creation of a data snapshot. As a lot of data tables are static and thus not affected by what-if functionality only relevant dynamic data is cloned in order to avoid interference of the operational system. Some examples of such dynamic data are the scenario flight plan, the train schedule, the operational plan for airport process points and details of the actual relevant Passenger-Trajectories. To finalize the first step the proposed actions have to be applied to the set of data, together forming the definition of the what-if snapshot.

In a next step two forecast calculations are processed. The first forecast is an agent and network based simulation model. It takes the current airport situation as basis and adds all actual changes of the flight and train schedules and of the operational plan for the different process points. The first output of the simulation is a timestamp for each flight estimating the arrival time at the gate of at least 95% of the booked flight passengers. The second output is a matrix containing the estimated average time in minutes needed to reach nodes in the Passenger-Trajectory over the day. For example the time from a check-in counter to the security check is stored in this matrix for each five minute steps over the whole day. Longer waiting queues will that way result in longer point-to-point values.

The second forecast is a scheduling software focusing on the Passenger-Trajectory. For each passenger it stores a list of scheduled and actual timestamps und calculates estimate times for further nodes in the trajectory. A new forward calculation is required if there are any changes either in the actual passenger process, e.g. by passing a process point or other node, or in the operational airport environment, e.g. in-/decreased waiting times, gate changes etc.

In the final step the what-if scenario must be evaluated. All KPIs displayed in the real time management system are also determined for the what-if scenario. The alerting mechanism evaluates the indicators and prepares the display for a comparison between the real system and the what-if scenario. Therefore any indicators' improvements or deteriorations are highlighted to all stakeholders. This aggregated and common view of a possible future scenario can then be used for a joint evaluation and decision making between the stakeholders.

The system is designed in an expandable way and can be used together with knowledge-based systems. Such knowledge-based systems can be used for system recommendations and refinements. Nevertheless, the user shall have the last power of decision.

3. Conclusion and prospects

In the underlying paper modern concepts of proactive airport management are described. Key elements are the inclusion of ground transport systems and the introduction of the Passenger-Trajectory to foster individual door-to-door travel along with forecast functionalities. For this purpose an integrative management tool is being developed, designed to foster common decision making of the different stakeholders at the airport. By its features the system is expected to support airport operational managers in gaining a common situational awareness supported by multifaceted alerting mechanisms and an appropriate degree of information details. Additionally the management tool provides possibilities to proactively control the airport and to pre-evaluate potential actions by simulating what-if scenarios.

Building upon this, the management tool offers a profound basis for future validation research in order to substantiate the system's benefit. As mentioned there are further ideas to improve and extend the management tool. These improvements include for example a detailed view for Passenger-Trajectory data.

With these improvements in place, an in-depth investigation of the system benefits is envisaged. This will i.a. be performed by comparing the results of specific validation scenarios with and without the Optimode management system. This shall be conducted with real life airport practitioners from different stakeholders, thus bringing in their perspective, expertise and judgement. First test runs with DLR personnel in the roles of the different stakeholders already showed interesting potentials and further potential for improvement in detail.

One very thrilling question is whether and at what point a stakeholder will be able to proactively control a given situation together with other stakeholders with the Optimode system instead of just reacting as in current practice.

As introduced with the Total Airport Management concept, this paper advances the idea of data sharing and really collaborative decision making between different stakeholders. The early situational awareness of the status throughout the whole transport hub allows all stakeholders to act in advance by using modern airport management.

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