INTEGRATION OF LANDSIDE PROCESSES INTO THE CONCEPT OF TOTAL AIRPORT MANAGEMENT

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ABSTRACT

Total Airport Management is a relatively new concept for a comprehensive optimization of airport processes. It is based on enhanced information sharing and communication among all stakeholders as well as on extended and improved forecasts of airport processes. The following paper describes a general concept for integrating landside passenger processes into Total Airport Management. It explains how landside stakeholders can be included in real collaborative decision making, in particular functionalities and Human Machine Interfaces of a prototypical TAM-compatible Passenger Management implementation called "PaxMan". As a result of the improved linking of airside and landside processes, it is shown how airport stakeholders and passengers can benefit from this integration and from proactive airport operations.

Keywords: Total Airport Management, airport landside, passenger process, passenger flow prediction, terminal management, situation awareness

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1. INTRODUCTION

With a constantly growing air traffic it becomes more and more clear that airports represent a major bottleneck for the air traffic system (European Commission, 2011). The performance goals for airports set by the High Level Group in their "Flightpath 2050" accordingly are very ambitious (European Commission, 2011). In order to achieve those goals, new infrastructure cannot be the sole solution as it not only implies immense investments together with long lead times, but also will be impossible in realization in numerous cases. The focus consequently has to be set on efficient use of existing infrastructure with optimized airport operations. A lot of research has been done on single processes already and many improvements have been made in this area (ASD, 2010). However, optimization of single processes only will not be sufficient to meet above mentioned goals. Great potential is still lying in the integration of various separate airport processes and there is need for joint improvements and collaboration. Airport Collaborative Decision Making (A-CDM) was a first step in this direction and its great success underlines the benefits of looking at the airport as a whole. A-CDM introduced a new and enhanced way of information sharing among airport stakeholders leading to a reduction of delays (Sinz and Kanzler, 2012). However, A-CDM has a clear focus on the airside and does not consider landside processes or landside stakeholders. Interdependencies between airside and landside need to be addressed as they are manifold and striking. It is obvious that passengers are not able to fly without a plane ready for departure. On the other hand the airplane will not depart without passengers as a rule. The reasons for delayed or missing passengers are increasing with e.g. new security measures, stricter immigration procedures or higher number of delayed transfer flights. It is hence important to not only improve landside processes but also to integrate and synchronize them together with airside processes in order to optimally advance the overall airport system.

Total Airport Management (TAM) introduces a concept where landside and airside are closely linked. Enhanced information sharing and communication among all stakeholders throughout an airport as well as extended and improved forecasts of airport processes are core elements of this concept (Günther et al., 2006). It is expected that TAM is able to improve the overall performance of an airport and consequently to reduce the overall operating costs and the environmental impact. With regard to the landside the passenger comfort can be enhanced by smoother process flows with less waiting time and less delays.

This paper aims at introducing the concept of Total Airport Management from a landside perspective and at presenting new developments for the landside both conceptual and prototypical including several support tools useable within a TAM environment. For better understanding, the general concept of Total Airport Management will be illustrated in the next chapter. Thereafter, the focus is shifted on the landside aspects and the key elements of a TAM landside are explained more detailed. This is followed by an exemplarily description of a first realized implementation in chapter 4. The benefits and expected results thereof are subsequently presented and the paper ends with a short conclusion.

2. THE GENERAL CONCEPT OF TOTAL AIRPORT MANAGEMENT

The concept of Total Airport Management was originally introduced by DLR and Eurocontrol in 2006 and has been under development since (Günther et al., 2006). The aim is to improve the cooperation of the various airport stakeholders and with it to advance collaborative and coordinated planning of airport operations. In addition, the reduction of delays is one of the major goals as well as a more efficient and more effective resource management for the airport as a whole. The prediction of events and possible responses at an early stage presents another important element of TAM (Depenbrock et al., 2011).

The project "Total Airport Management Suite" (TAMS) was launched to further develop the initial TAM approach and to foster future industrial solutions addressing parts of this new management philosophy. TAMS[2] is a research project funded by the Federal Ministry of Economics and Technology based on a decision of the German Bundestag. As basis for the realization of above mentioned goals several requirements need to be fulfilled. According to the operational concept document of the TAMS project (Depenbrock et al., 2011) those requirements i.a. are:

- enhanced situation awareness,
- transparency of processes,
- a commonly agreed plan,
- a common set of data, and
- decision support.

As a method for indication of airport performance the introduction of central Key Performance Indicators (KPIs) is regarded as necessary. To complete the

[2] The TAMS project partners are: Siemens AG, Deutsches Zentrum für Luft- und Raumfahrt e.V., Barco Orthogon GmbH, INFORM GmbH, Flughafen Stuttgart GmbH and as associated partner ATRiCS Advanced Traffic Solutions GmbH & Co. KG.

requirements for TAM, post-analysis and statistical methods should be available to enable system adaptions and improvements (Dependbrock et al., 2011). Next to those conceptual requirements also some general ones need to be addressed before implementing a TAM system at an airport. Most importantly the compliance of all stakeholders involved has to be ensured and a legal basis has to be developed. In order to ensure fairness during the TAM processes for all stakeholders, some form of regulation like a merit-rating system needs to be established (Günther et al., 2009).

2.1. Stakeholder in the Concept of Total Airport Management

Generally a stakeholder at an airport can be every person or institution who is involved in or affected by airport operations. This definition also includes for example airport neighbours disturbed by noise. In the context of TAM, however, the number of stakeholders is limited to those involved in actual airport operations, namely

- airport operator,
- airlines,
- air traffic control (ATC),
- ground handlers,
- security authorities or service providers as well as immigration authorities

Those five parties (combining security and immigration) are each identified by different and partly conflicting interests in combination with different states of dependence. Airlines and airport for example clearly differ in the favoured length of spare time spent by passenger in the terminal. Ground handlers are likely to be contractually more dependent on the airline than the other way around. For the decision making processes in the framework of TAM this aspects needs to be addressed in the context of data and process ownership as well as for last decision right (Depenbrock et al., 2011).

2.2. Enhanced Information Sharing and Gathering as Basis for Total Airport Management

For best possible decision making the most essential requirement is reliable and up-to-date information. All stakeholders hence need access to all information relevant for their operations implying that all information has to be shared among all stakeholders as far as feasible with regard to privacy regulations. For the range of data collection A-CDM is seen as basis but needs to be enhanced with data provided by integration of different support tools like an arrival or departure manager providing for example more precise timestamps due to new calculations taking into account all stakeholders' restraints at the same time. The time frame of the collected data today has to be extended by predictions to enable accurate forecasts for the whole day of operation (Depenbrock et al., 2011).

2.3. APOC – A Central Element of Total Airport Management

The Airport Operation Centre (APOC) presents a platform for representatives of all stakeholders – so-called agents – to communicate, exchange information and to work collaboratively on upcoming problems. Necessary information, including alerts, is displayed on a video wall as well as on special HMIs at the agent working positions (Depenbrock et al., 2011). An APOC can be realized as a central room for all agents or may just be a virtual connection between the stakeholders' separate operations centres (Günther et al., 2006).

2.4. Collaborative Airport Planning in the Context of Total Airport Management

Collaborative Airport Planning (CAP) constitutes another integral part of the TAM concept. Main characteristics are negotiations to solve operational deviations or problems among all agents concerned and the co-ordination of a commonly agreed plan, named Airport Operations Plan (AOP). Consequences of alterations of the current AOP can be tested with so-called What-if probing and all agents concerned can then negotiate the best commonly agreed solution based on those results. However, the last decision right remains with the process owner (cf. chapter 2.1).

2.5. Key Performance Indicators as Important Characteristics for Airport Performance

To evaluate the adherence of current and planned airport operations to the AOP and agreed performance goals suitable measures are needed. Therefore, parameters that allow for a performance based management and for an advanced controlling of an airport have to be defined. In the context of ATM, the International Civil Aviation Organization (ICAO, 2009) as well as Eurocontrol with the European Operational Concept Validation Methodology (E-OCVM) (EUROCONTROL, 2010) define the two terms Key Performance Indicators (KPIs) and Key Performance Areas (KPAs). Whereas Key Performance Areas define performance subjects to categorize different broad areas related to high-level ambitions and expectations, KPIs are a means to measure past, current and expected performance levels by expressing them quantitatively. To categorize performance subjects ICAO defines 11 KPAs: safety, security, environmental impact, cost effectiveness, capacity, flight efficiency, flexibility, predictability, access & equity, participation & collaboration and interoperability. Several projects (e.g. (ICAO, 2009), (SESAR consortium, 2006) or

(Performance Review Commission/EUROCONTROL, 2009) specified KPIs in relation to these KPAs but only with focus on airside processes.

3. LANDSIDE PROCESSES IN THE GENERAL CONCEPT OF TOTAL AIRPORT MANAGEMENT

Major forecasts all predict a significant growth in the number of passengers for the next decades (e.g. (Airbus, 2010)). The increasing number of passengers especially in combination with increasing security and immigration measures will cause severe difficulties for landside processes at status quo level. The development of methods for holistic landside improvements, like new support tools for passenger flow as an extension of discrete resource management systems common today, will hence become necessary. The next subchapters present one possible solution to improve handling of passenger traffic on the landside. It is presented in the context of TAM in order to value the close link between airside and landside and to underline the importance of a holistic airport operations concept. While some of the introduced innovations might be implemented by themselves, the complete benefit will only be obtainable by applying the concept of Total Airport Management as a whole.

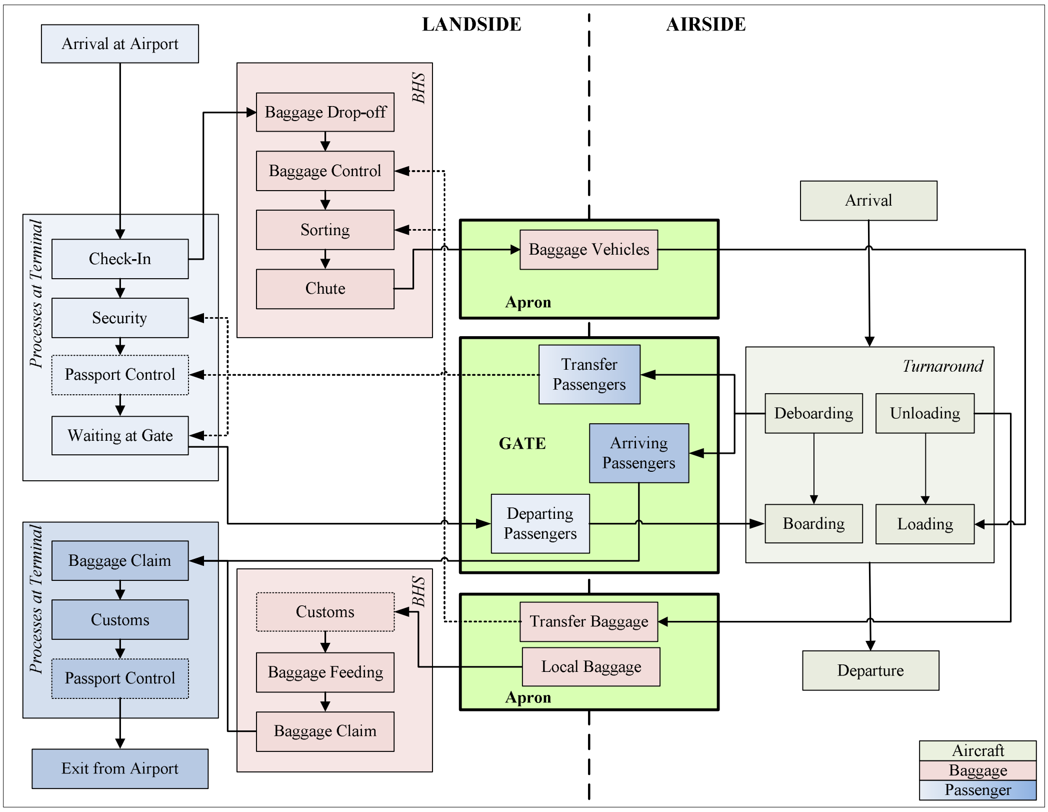
3.1. Definition of Relevant Landside Processes

In the framework of this paper the *landside of an airport* is defined as terminal area and includes all passenger processes from arrival at the airport until boarding the aircraft. To reduce complexity, baggage processes are at the moment only included as far as the baggage is still in possession of the owner, i.e. until drop-off at check-in counters or self-service kiosks. The same applies to intermodal airport connections, which are considered only as input for arrival time distribution. Figure 1 presents an overview of the major processes occurring on the landside. As all processes and the order of processes can vary from airport to airport all descriptions in this paper are based on a generic airport model and might have to be adapted to fit a specific airport. Additionally, depending on various factors such as destination of the flight, passengers may not have to undergo all processes. However, mandatory for all passengers are the processes check-in, security and boarding.

3.2. Determination of Landside Stakeholders

The process landscape for the airport landside is complex due to the large variety of processes and the unpredictability of exact passenger behaviour. The high number of different stakeholders involved in the processes additionally adds intricacy. Knowledge as well as information is partly restricted to process owners and thus a holistic and yet detailed overview of the landside proves difficult. Depending on the airport, different stakeholders will be represented like airport operator, airlines, ground handlers, different police forces, security service providers, custom authorities and immigration authorities. Optimally the intermodal connections of the airport are included too, adding i.e. local public transport providers, railway companies or road authorities. Table 1 gives an overview of the most common correlations between stakeholders and main landside operations including interferences. The process chain for baggage is combined under the term "baggage" due to previously mentioned complexity reasons.

Figure 1: Overview of Landside Processes at an Airport



With so many stakeholders in place there is a high amount of conflicting goals. While for private companies as well as (most) state-owned companies profit will present the main target, authorities like police forces will see other priorities und would rate e.g. security as aim number one even at the risk of higher cost. In doing so, state police forces as autonomous stakeholders will have a stronger position as, for instance, a security service provider dependent on a follow-up contract. The main challenge on the way to good collaboration among the different stakeholders is to overcome these different initial positions by proving that collaborating on overall improvement of the system will lead to benefits for each participant.

Table 1: Common Correlations between Stakeholders and Main Landside Operations

	Airport operator	Airline	Ground handler	Police forces	Security service provider	Custom authorities	Immi-gration authorities
Check-In	O	X O	X				
Security				X O	X		
Passport Control	O	O		X			X
Boarding	O	X O	X				
Baggage	O	O	X O	X		X	
Customs				X		X O	

X: process ownership
O: infrastructure ownership

3.3. Necessary Landside Information

The goal in TAM for the landside is on the one hand to enable enhanced collaboration among the different stakeholders and on the other hand to provide further and more reliable information on passenger processes for all landside stakeholders as well as for the airside linking. In contrast to the airside, the landside has one major disadvantage: planes have a known trajectory and are traceable, passengers not. Even if it would be technical and economical possible to equip passengers with traceable sensors, there are various legal constraints. Hence, at least for the near future, it will not be possible to gain information on the exact location of all passengers and thus there is no information on their individual arrival time at process stations at the airport. All data available on passengers is in most cases restricted to airlines (and in some countries to the immigration authorities) and consists of booking and check-in information. This implies that with online-check-in, a passenger is often registered at the airport for the first time during boarding. This complicates any forecast of passenger arrival times at the gate or previous process stations. First improvements are on their way with some airports introducing additional boarding pass scans at passport or security control allowing at least registering passengers at an earlier stage. New technologies also enable the calculation of waiting queue lengths allowing for more valuable information.

As a remedial measure improved and advance information could be gained from a new research prototype support tool suite called PaxMan (Passenger Manager) of which a more detailed description will be presented in chapter 4. Required as necessary data input, however, are the following:

- Information about resource allocation of process stations, such as planned opening and closing times,
- Information about actual situation throughout the terminal, such as waiting times and waiting queues at process stations,
- Process flows of passengers through terminal (modelling for purpose of forecasts).

Major output timestamp of the PaxMan is the newly introduced Estimated Passenger at Gate Time (EPGT) as the final landside timestamp. Synchronization with the airside process chain is achieved by aligning this EPGT with the Target Off-Block Time (TOBT). Delays in the EPGT will hence lead to the adaption of the TOBT according to the landside delay and vice versa.

3.4. Introduction of Landside Key Performance Indicators

Key Performance Indicators are measures to evaluate the performance of processes or the achievement of defined goals in such a manner that the past, present or expected future is expressed. This implies a need for reliable definitions of such indicators to obtain serviceable and required measures. The planning of operations at airports starts with a rough planning very early, for example on the basis of seasonal flight schedules half a year before the day of operations (day-of-ops). These plans are constantly adapted and enhanced with further information until the day before the day-of-ops. During the day-of-ops performance parameters are used to adjust the planned operations to the actual situation. One major aim of TAM is to prolong the timeframe for such information. This means that not only the actual situation is available for the assessment of the situation but also the expected development. Therefore, performance parameters should also be able to take into account a timeframe covering a few minutes up to several hours in advance. In general selected performance indicators should follow the SMART criteria: KPIs have a Specific purpose, are Measurable, Relevant for the process improvement, Time-related and the defined goal is Achievable (ICAO, 2009).

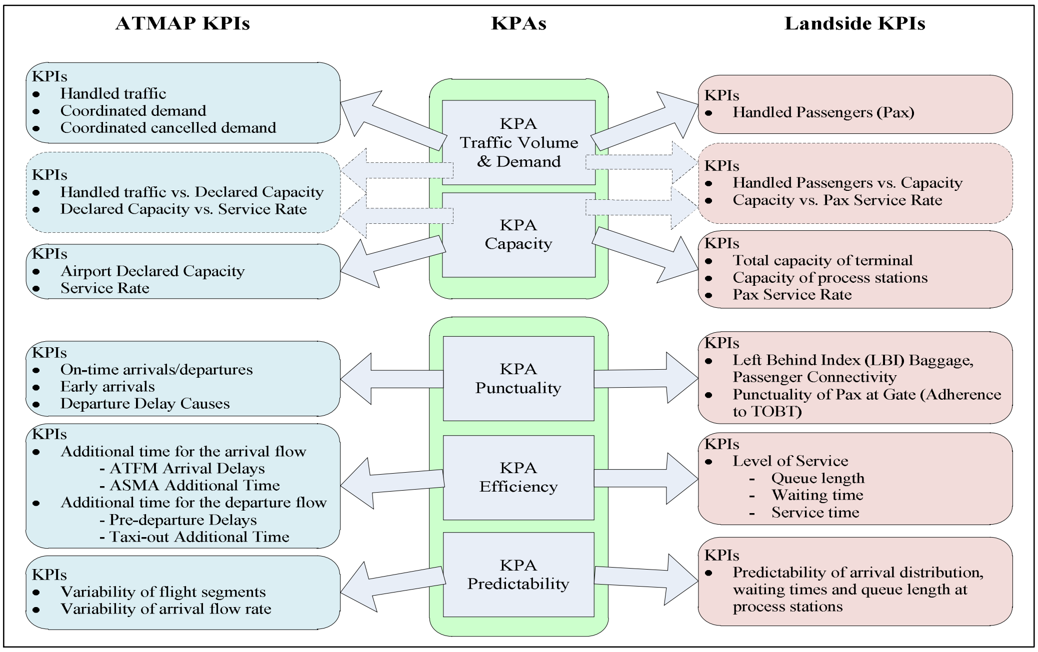
As stated before (section 2.5) in the context of ATM several definitions for helpful key performance indicators have been made. Nevertheless, they are focusing on airside processes and therefore are not transferable one-to-one but provide a good basis for the development of landside performance indicators. ATMAP (Performance Review Commission /EUROCONTROL, 2009) was one of such projects launched by the Performance Review Commission (PRC) developing KPIs for the following five key performance areas (KPA):

- traffic volume and demand,
- capacity,
- punctuality,
- efficiency,
- predictability.

ATMAP developed several KPIs within these areas taking into account the airport system as a whole, regarding several airport stakeholders and without accusing stakeholders contributing to the achieved performance. Therefore first possible landside KPIs are derived from these KPIs (Performance Review Commission/EUROCONTROL, 2009), as shown in Figure 2.

All stakeholders at an airport intending to collaborate have to select or rather agree on indicators suitable for their intention. Hence, indicators can vary between several airports, but the above provided key performance indicators are rather general and should be more detailed in their respective application and exact dimension.

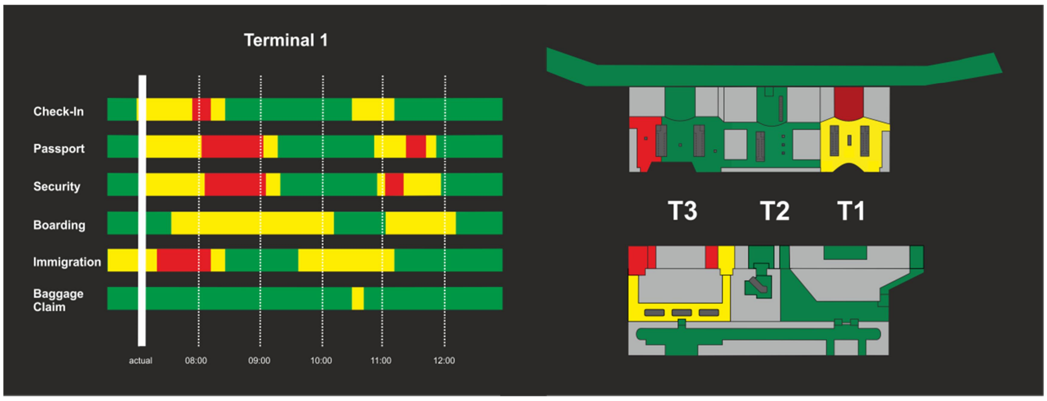
Figure 2: Possible Landside Key Performance Indicators



3.5. Possible Landside Data Presentation on a Joint Video Wall or Agent Working Position

The video wall in the APOC has the task to provide the different agents with a common overview of all information necessary for collaborative and envisaged airport planning especially to generate common situation awareness. In order to guarantee good recognisability and comprehension of information an ergonomic interface design has to be applied for the setup. For further material on this subject, for example refer to (Jipp et al., 2011). With regard to landside aspects it has to be ensured that the status of processes in the terminal is observable, at best on process level but at least combined on terminal level. This information should include the actual as well as the predicted situation for the upcoming hours of operation. Possible implementations of this information in form of a colour coded bar chart or terminal layout are presented in Figure 3. In addition, the video wall should have some reserved space e.g. to accommodate video surveillance images or more detailed information presentation than the aggregated view always visible (Depenbrock et al., 2011).

Figure 3: Possible Landside Elements for a TAM Video Wall Displaying Actual and Predicted Terminal Process Status



Next to the combined video wall all agents have special HMIs at their working positions accommodating specific information needed for their role and responsibility. Those include besides the information overview the installed assistance systems hence allowing access to more detailed information necessary for the decision making process. The working positions also provide for an input facility for the handling of support tools.

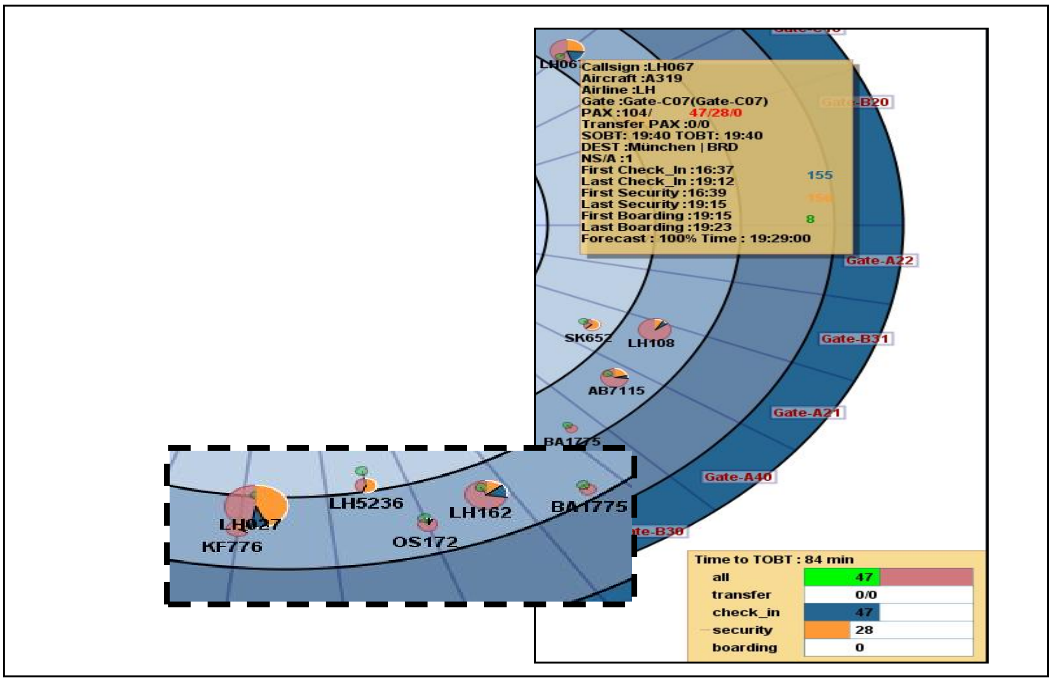
4. PROTOTYPICAL IMPLEMENTATION FOR THE INTEGRATION OF LANDSIDE PROCESSES INTO THE CONCEPT OF TOTAL AIRPORT MANAGEMENT

The support tool developed within the above-mentioned TAMS project for the integration of landside processes into the concept of Total Airport Management is called Passenger Manager (PaxMan). It is a tool suite to assist the management of passenger processes in the airport terminal. It supports terminal management by the airport operator and furthermore is able to provide aircraft operators and ground handlers with helpful information and functionalities for efficient passenger handling. The PaxMan is able to predict the last passenger at the gate for each flight defined as “Estimated Passenger at Gate Time” (EPGT) (Depenbrock et al., 2011) by monitoring all relevant passenger processes based on the actual situation in the terminal. Three modules of the PaxMan suite are exemplarily highlighted in the following sections.

4.1. Passenger Radar

The Passenger Radar (PaxRadar) is a tool to visualize a large amount of information in a compact layout and has the goal to improve overall situation awareness concerning the passenger status throughout the airport. As illustrated in Figure 4, it shows the actual state of all planned flights and their related passengers at an airport within the upcoming day of operation.

Figure 4: HMI of PaxRadar

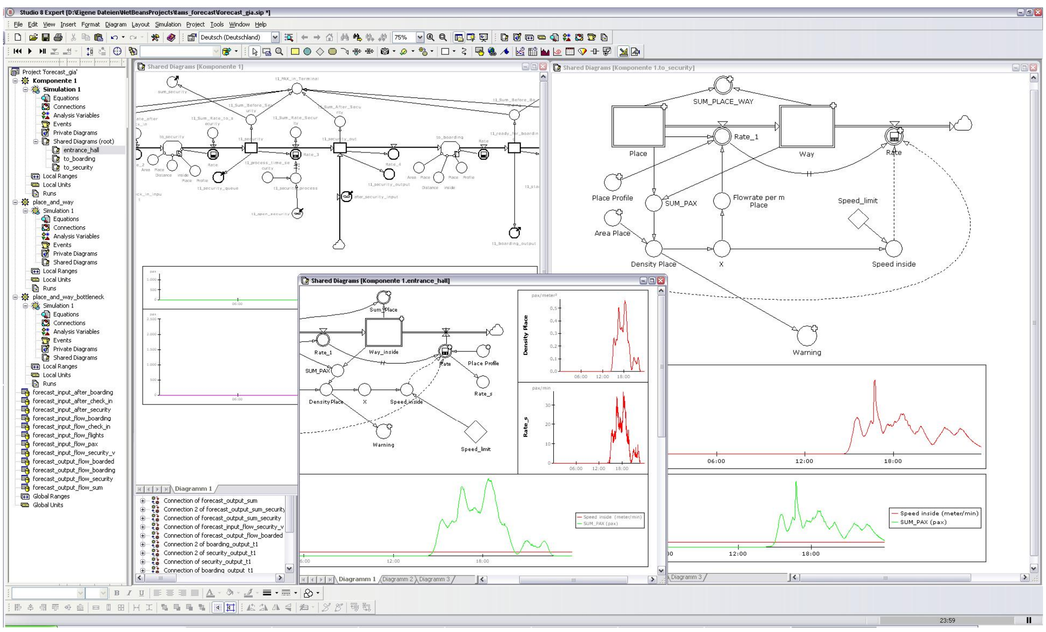


Each circle represents one flight and the size of the circle correlates with the number of passengers booked for this flight. The position, where the flight is placed on this radar display represents a combination of the planned gate, the airline, the aircraft, the destination (city or country) and the difference between the actual time and the Off-Block-Time of this flight. Each circle comprises three circular segments representing the number of passengers checked-in (blue), the number of security checked passengers (orange) and the number of boarded passengers (green). When pointing on a flight represented by a circle, detailed information like destination, airline or for example transfer passengers of the chosen flight is shown (for more details see Figure 4). An overview of the status of this flight's passengers is provided also showing the respective rate of completion at major process points (check-in, security and boarding). This especially supports a judgment whether passengers might reach a flight on time. The information gathered and shown in the PaxRadar is also used for the forecast presentation. The PaxRadar provides an overview of the actual situation in the airport terminal in order to increase the situation awareness. It also shows further information like the EPGT generated by the forecast as a small green circle.

4.2. Forecast Functionality

Another important capability of the PaxMan Suite is the forecast functionality. Visually integrated in the PaxRadar described above a forecast of the expected status of passengers in relation to their flights is provided. The forecast is responsible for computing the EPGT.

Figure 5: Forecast Model



The forecast functionality is specifically designed on principles of a macroscopic system dynamics simulation (see Figure 5). Depending on the actual planned TOBT for each flight (or SOBT if the TOBT is not yet existent) this module allows for a very quick and yet reliable forecast how many passengers will be at the gate on time and when the last passenger can be expected which correlates to the EPGT. The system dynamics simulation is operated as a service and automatically reacts to flight plan updates. As soon as an update is filed to the PaxMan a new forecast run is triggered in order to examine the differences and consequences. The new estimates are also based on actual status of all landside and airside systems, resources and actual passenger status.

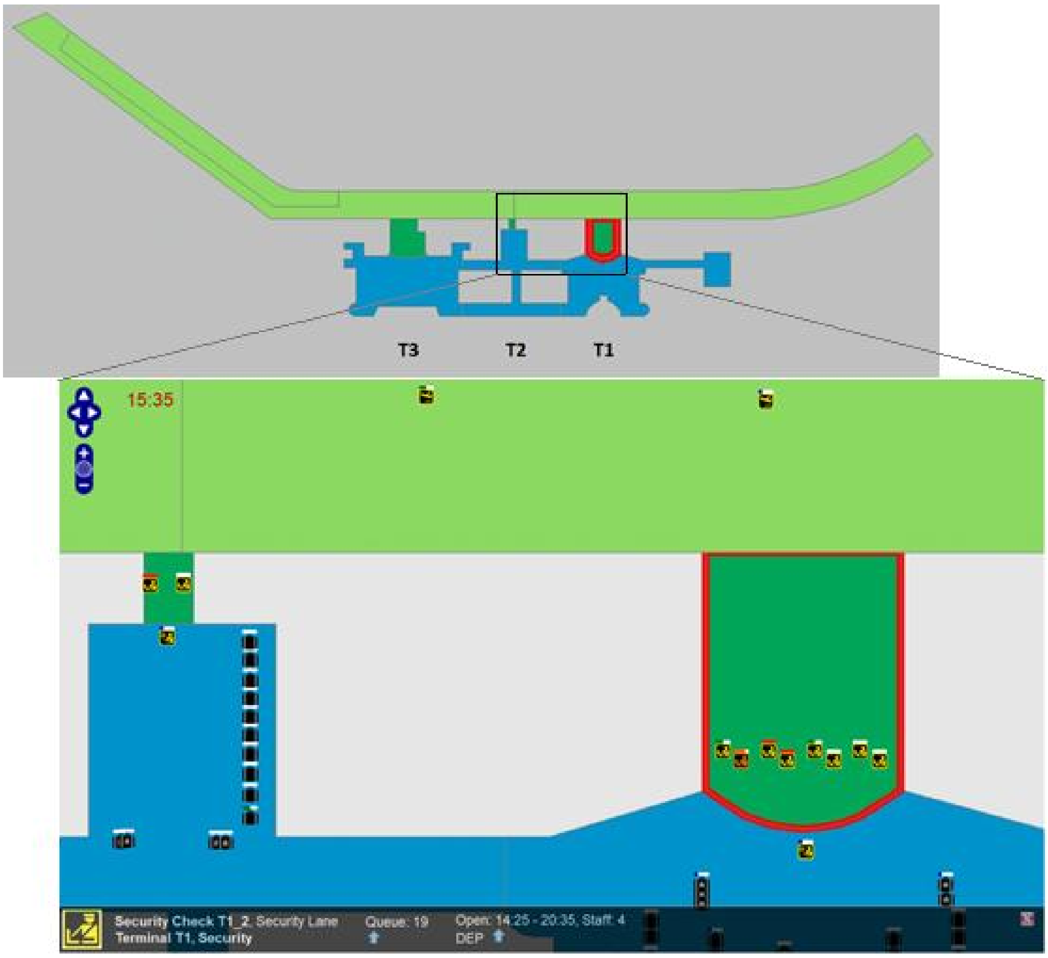
The results of the forecast simulation are displayed in the PaxRadar and can also be used for direct integration with airside management systems in order to establish proper synchronization and fostering a proactive airport management.

4.3. Paxwall

Another part of the graphical user interface (GUI) of the PaxMan is called PaxWall and is illustrated in Figure 6. Aim of the PaxWall is also improvement of the situation awareness in a Total Airport Management environment. Dependent on the application area of a user, the base GUI can be adjusted in the degree of displayed detail of information and possibilities for a user to interact. The GUI can be used on different devices like a standard desktop monitor with a high degree of user interaction or on a video wall with abstract information display without user interaction as well as on mobile devices, such as smartphones or tablets. To easily achieve this universal display a platform independent and web-based visualization has been implemented. The objective was to provide a well-engineered web application for user. The usage of a single web page avoids the feeling of a complex program structure. All necessary information completely fits on one monitor so a user has no need to scroll. Additional or updated data is loaded dynamically from the server and is automatically integrated into this web page without completely reloading it.

The basic GUI of the PaxWall is a smoothed map of the airport terminal of the generic airport model used in the TAMS project. The terminal map is based on OpenLayers. OpenLayers is an open source client side JavaScript library to create interactive web maps, viewable in nearly any web browser (Hazzard, 2011). The user interaction capabilities (e.g. zooming, panning etc.) are similar to the well-known Google Maps, which will increase usability and acceptance of users.

Figure 6: PaxWall – Overview of Airport Status



The colour model separates four airport process types: blue for check-in, green for security, light green for gates and light blue for baggage claim. The colour coding also provides for an optical alerting functionality. The alerting is based on the queues calculated by another module within the PaxMan. For each task station KPI thresholds can be defined according to IATA level of service standards (levels A to E) and local requirements. The alerting mechanism itself is a filter on these thresholds. If the queue at a task station is smaller than level A, the alert-label 'low' is set to this task station. For visualization a dark blue colour represents this status. If the queue is between the thresholds level D and level E, the task station enters a "warning" state (orange colour). Alert label 'fatal', represented by a red colour, is set to the task station if the queue exceeds the threshold of level E. There is also a higher aggregated variant of the alerting mechanism. An airport is separated into terminals (e.g. Terminal 1) and terminal areas (e.g. security checkpoint in Terminal 1). If a defined maximum queue length of the task stations in a certain (terminal) area exceeds a threshold, alert labels as defined above are set to the corresponding terminal area. This basic visualization is used for the video wall in an airport operation control centre (APOC). Figure 6 shows an example with a bottleneck at the security area of Terminal 1. The refresh rate for the alerting layer can be adjusted. Visualization for an agent's working position with a standard desktop monitor is designed with maximal information density and possibility for user interaction. The terminal map can be intuitively zoomed and panned. The zoom levels, however, differ in the level of detail displayed. The first zoom level is reduced to the basic terminal layout. Queue alerting is represented by the maximum queue size for all queues per terminal area and is persistent throughout all zoom levels.

By zooming in more details are provided. As soon as the second zoom level is displayed, all available task stations are displayed as markers in the terminal map. Individual icons have been designed for each task station (check-in, security lane, border control and gate). All markers are clickable to gather further details about the respective task station. A clicked marker is highlighted. A bar above these icons visualizes the queue alerting for each task station. Four alerting states are available: blue for very low usage, green for keeping limits, orange for warning state and red for alerting state.

Figure 6 shows a zoomed map with details about the security lane 2 at Terminal 1 as a black overlay in the lower part of the screen. The task station icon, its name and category, its terminal and terminal area is displayed as static information. The dynamic part of the displayed data contains the actual queue size, the current opening status and time, the staff count operating at this task station and an opening reference.

By clicking on the blue arrows charts can be retrieved showing the queue history and the opening time blocks for the actual day (see Figure 7). The upper chart displays the queue length of a security lane over the past four hours. The lower chart shows the opening times for a gate for specific flights. The x-axis is the time displayed as a float value to get exact chart characteristics. The y-axis is the staff count operating that gate. Each time block represents exactly one flight.

Figure 7: Charts for Task Station Details (On the left: queuing history for a security lane; on the right: opening status for a chosen gate)

5. EXPECTED BENEFITS AND RESULTS

By integrating and synchronizing landside processes with airside processes the focus of airport operations is shifted more towards the passenger. The benefits are on two sides. First of all, it is the passenger who directly benefits from smoother flow of procedures at the airport combined with an improved punctuality, more reliable operations, reduced waiting times at process stations as well as better and earlier information. This results in an improved travel experience for the passenger. On the other hand also airport operators and airlines benefit from a better knowledge of the passenger's status. The PaxMan module described above provides better situation awareness about the passenger flow in the different functional areas of the airport, thus improving transparency. Especially the forecast functionality enables early response and even a KPI-based proactive management of resources. This helps to improve efficiency and optimized utilization of available infrastructure. The cooperative and coordinated planning of all stakeholders facilitates synchronized processes throughout the airport. This synchronization again fosters overall punctuality and also supports the complex airport operations especially in recovery from disturbances. Test runs of the integrated system showed good potentials for improving overall punctuality and passenger connectivity without increasing operational costs. To put it in a nutshell integration of airport airside and landside processes improves the passenger comfort and at the same time supports the airport stakeholders to improve overall operational performance and efficiency.

The integration and synchronization of airport passenger processes with aircraft oriented processes is an important improvement in airport operations. Interdependencies between the landside and airside are clearly targeted with the Total Airport Management concept. This integration could be implemented for the first time in a research prototype for passenger management in the TAMS project. First test results showed good potentials for an improved overall performance – especially in terms of punctuality and passenger comfort.

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