ED Airport

Products and references

INCONTROL

Simulation Solutions

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1. Introduction

Enterprise Dynamics® is a leading simulation platform to design and implement simulation solutions. It allows a problem solver to model virtually any problem and, by experimentation, look for a solution for a given problem or an answer to a specific question.

Most of the problems or questions for which simulation is used are:

- Capacity investigations
- Investment evaluations
- Time-to-Market vs. Costs evaluations

To be able to perform simulation studies, a solid simulation platform is required. A good simulation platform does not only provide easy-to-understand modeling capabilities and advanced visualization features, but it also provides the possibilities for the re-use of previous made models, segments of models, and components used in early stages.

For the simulation of airport processes INCONTROL Simulation Solutions developed ED Airport. ED Airport consists out of specially developed simulation libraries for baggage handling, terminal design & operation, airside and landside traffic and cargo. With ED Airport the modeler can speed up the process of model building and report experimentation results in accepted airport figures.

This document describes an overview of the ED Airport solution. The purpose of this document is to give the reader with little knowledge of simulation and Enterprise Dynamics a good understanding of the capabilities of ED Airport accompanied by relevant references.

2. ED Airport

2.1 ED Airport overview

ED Airport is the integrated simulation solution for the simulation of landside, airside and cargo processes at airports. ED Airport has a modular structure so that one software platform can be used for the simulation of all airport processes. It doesn't matter if you want to simulate baggage handling, passenger flow, cargo or traffic processes, you can all do it with one product.

ED Airport makes it easy to build, change, integrate and extend airport simulation models. ED Airport models can represent current and future processes, comparing differences in infrastructure or business arrangements. Both high and low detail simulation modeling is possible.

Currently, ED Airport contains the following airport simulation libraries:

- BaxSim, the baggage environment
- PaxSim, the passenger terminal environment
- Stand Allocation, the gate planning environment
- TransSim, the road traffic environment
- Logistics, the cargo and general logistics environment

As well as the simulation libraries, ED Airport contains some convenient basic functionality:

- PaxBax Generator, the input module
- Flow Analyzer, the output module

Together it creates a sophisticated simulation environment providing airport managers with a state-of-the-art decision support tool, answering the needs of today and tomorrow.

2.2 ED Airport users

ED Airport is developed for a wide variety of airport related users, a limited overview:

Airport operators

- Overall investigations of all airport related passenger & baggage handling issues
- Airport related scenarios investigation
- Number of employees needed under a variety of circumstances

Typical ED Airport elements required:
BaxSim, PaxSim, Stand Allocation

Terminal operators

- Passenger flows, congestion issues
- Check-in flows and security screening flows
- Customs & immigration flows, number of individual positions to be manned
- Baggage flows

Typical ED Airport elements required:
BaxSim, PaxSim

Customs & immigration, police department, security companies

- Passenger flows, congestion issues

Typical ED Airport elements required:
BaxSim, PaxSim

Cargo handling companies

- Warehouse settings, warehouse environment investigations
- Cargo handling strategies

Typical ED Airport elements required:
TransSim, Logistics

Ground handling companies

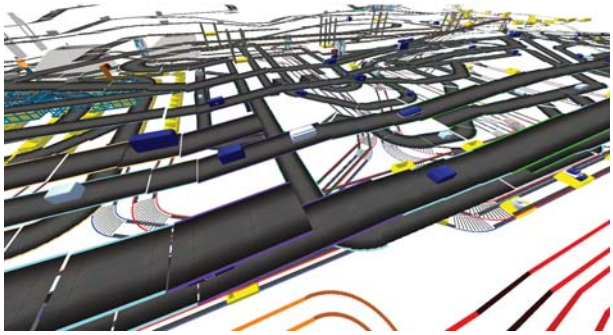
- Baggage flows, number of baggage belts needed
- Passenger flows, number of check-in desks to be manned
- Ground handling operations on airside, ground handling vehicle planning, reduction of turn-around time

Typical ED Airport elements required:
BaxSim, TransSim, Logistics

2.3 ED Airport libraries and modules

BaxSim
A set of simulation objects with which you can model, simulate, and visualize baggage handling systems. The simulation objects that are provided with this library are: Vertical Sorter, Accumulating Conveyer, Buffering Belt Conveyor, Line Sorter, Manual Encoding Station, and many more. This library has been developed in cooperation with INCONTROL, Amsterdam Airport Schiphol and AirFrance/KLM. With this library INCONTROL created an integrated simulation model of the entire baggage handling systems of Amsterdam Airport Schiphol.

PaxSim
This library allows you to simulate people within an airport terminal taking into account: domestic travel, international travel, shopping behavior, greeters, physical boundaries, shortest route based on familiarity with the airport, and many more issues that are important to simulate real-life behavior.



Stand Allocation
A set of simulation objects with which you can model the gates and remote aircraft positions (stands) at an airport. The module uses the flight schedule of a certain day and the available stand capacity. Based on a user defined rule set, the Stand Allocation module assigns the flights to the available stands. Rules have a certain priority, and can reflect a requirement, preference or avoidance.

TransSim
With this library you are able to simulate the road traffic (airside and landside) of an airport. The TransSim library allows detailed modeling of internal and external transport and information flow in logistics nodes of road haulage, e.g. all yard management and internal transport processes of a forwarding agency can be simulated as well as logistics networks consisting of several nodes and hubs.

Logistics
A large set of common use simulation objects with a broad field of applications. There are elements for modeling all kind of general logistical processes and cargo handling in both automated and manually operated environments.

PaxBax Generator
First of all, this is a database that is used by ED Airport to share commonly used data. Second, the PaxBax Generator generates the passenger and baggage flows based on a daily or weekly flight schedule. It contains many rules (tables to define occupation rates, transfer rates, passenger and baggage attributes, etc.). The flight schedule can also be enriched with check-in, reclaim or gate group allocation.
ED Airport simulation models often use the output of the PaxBax Generator as input for simulation runs.

Flow Analyzer
This module allows you to perform a static analysis of the passenger and baggage flows from the PaxBax Generator. This tool is very helpful for short term capacity management and personnel planning. It gives insight whether passenger or baggage flows at critical points exceed the available capacity. Based on these flows personnel can be assigned to meet the capacity demand.

2.4 ED Airport benefits

ED Airport provides quantitative insight of individual airport sections and the relationship between them. Therefore, airport operators can shift their attention from “normal operations” towards “critical operations” and forecasting future “choke points” in terms of passenger waiting times, queues and flow rates.

ED Airport provides insight into future development scenarios for airport expansions and modernizations. Is the chosen layout correct? Are the new terminal plans suited for the requested level of passenger and baggage flows? Are the former problems with known bottlenecks, e.g. number of check-in positions, number of security screening positions and/or number of border control positions solved or do they need a re-design?

ED Airport offers solutions and creates a better understanding of the issues on airport of today, but also for tomorrow’s expansion plans and growing passenger and baggage flows.

The far better insight and understanding of your airport processes combined with investigation of different expansion scenarios will strengthen the decision making process and allow for improved communication with stakeholders.

3. References

3.1 Introduction

ED Airport has been used in many projects at a variety of international airports. The projects are as diverse as a major international airport can be. A selection of these projects is described in the next sections.

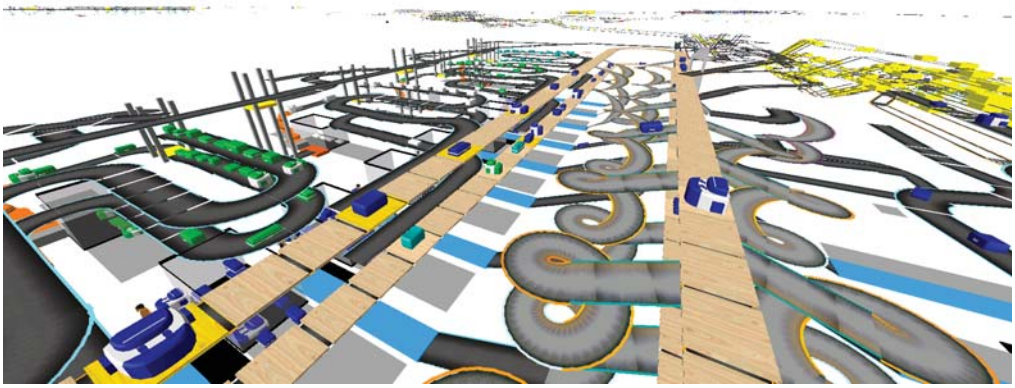
3.2 Baggage handling

SIMBAX – Integral model
Amsterdam Airport Schiphol is one of the largest European airport hubs. Currently, it handles over 48 million passengers annually of which about 40% is transferring. Within the airport infrastructure the baggage handling system is an important part. The system transports, screens and sorts the bags of all passengers. The available time is limited: all bags have to be ready 10-15 minutes before flights are departing. For the next years, the airport foresees a further increase in traffic. To accommodate this traffic, and to deal with new, more strict, EU baggage screening regulation, the baggage handling system needs to be expanded. The goal is to handle 70 million bags per year in 2018.

SIMBAX
A decade ago, simulation projects for baggage handling at Schiphol were initiated to evaluate capacity requirements of a system part. A simulation model was developed for this specific part, and some simulation experiments were performed. After the results were reported, the project ended and the model was not used any more.

A few years later, most of the baggage handling system was available as independent models. The capacity of the systems was reaching its limits due to a large increase in baggage flow. Simulation was used to find short term and long term solutions to increase and optimize the capacity and performance of the systems. Optimizing separate subsystems was not an option, because this could result in bottlenecks in other subsystems. Therefore, the existing models were all connected together. This overall model SIMBAX reflects the current situation of the baggage handling system in detail.

Simulation has proven to be successful. At Schiphol SIMBAX is being used to gain insight in the overall performance of the system and in the flows for the upcoming season. Further, to decrease in system times by reducing bottlenecks, to optimize the available capacity, to improve the redundancy of the system, and



to validate future capacity requirements. This results in a better performing baggage handling system and allows the capacity managers at Schiphol to anticipate on future situations.

Quite recently simulation has also become a design supporting tool. When developing costly and complex systems it is important to validate and improve the design as soon as possible so management can be convinced that the system will meet the requirements. Simulation is also used to test new ideas and to assist in operational management. Simulation has become part of Baggage operation “No structural modifications are done without using simulation.”

FUTURE EXPANSIONS

In order to test the new expansions of the system new models were built and at first tested separately. Next, the new models were connected to the SIMBAX models to investigate the performance of the overall system. Besides the final stage the transition phases between the current and future stages are also of importance. To allow all these different stages within the SIMBAX model and to keep it maintainable the models were split in different sub-models in such way that they are exchangeable. To improve user friendliness a new model builder with a GUI interface was designed, allowing the user to select any predefined stage.

To route the bags correctly through the system in the different stages, both high and low level controls were redesigned. Also sub-system boundaries and handover location between sub-systems were defined. High level controls retrieves information about the statuses of the different sub-systems, and contains the flight plan. Using this information it determines the destination of a bag and sends this information to the low level controls. The destination of the bag can be a final destination within the current sub-system, a temporary destination like a buffer or screening machine, or a handover routing destination to another sub-system. Low level controls then routes a bag to this destination within a sub-system and controls the balancing over different routes. By keeping a strict separation between high and low level controls only small modifications have to be made to the controls to deal with the different stages.

OUTPUT

The output is presented in Excel, making it easily accessible, using the same subdivision as in the model. So, the performance of the overall system and performance of the different sub-systems are presented in different sheets. Within ED bags can be individually approached, which allows to store information about individual bags. This is the bases for the output. Bags are logged when they pass a specified location. Using this information in combination with the bag properties (e.g. outbound / inbound flight number, routing destinations, etc.), most of the desired output can be extracted.
Examples are:

- Flows
- Transportation times on certain routes
- Transportation times on certain routes for specific groups
- Buffer occupancy
- Totals over the day
- Routes of single bags

Additional required output is logged separately. All data is stored in a database and is extracted in Excel by using SQL queries, keeping the excel sheets clean from excessive data. This flexible method gives detailed information about the system and also turned out to be extremely useful when addition output is required when investigating odd behavior without re-running the simulation.

Determination of the Baggage System's Capacity
INCONTROL has conducted a simulation study for a large baggage handler to assess the performance of the baggage handling system for the next three years. By simulation, potential bottlenecks for the near future were assessed. Consequently, INCONTROL Simulation Solutions advised this client several intermediate actions to take until additional capacity is available.

Design validation and optimization for new Baggage Handling System
Terminal Central has the largest and most complex baggage system of Amsterdam Airport Schiphol. The baggage system is greatly expanded in the recent years. By simulation, INCONTROL advised the airport on the large number of design alternatives and their implications on logistics, control and procedures. In addition, INCONTROL used simulation to judge and comment on the proposals of system vendors.

100% Hold Baggage Screening
Conform international agreements; international airports have to perform a complete screening of all Hold Baggage in the near future. INCONTROL Simulation Solutions advised Amsterdam Airport Schiphol on the logistical concept of 100% Hold Baggage Screening and uses simulation to test and improve the designs and concepts of the new systems.

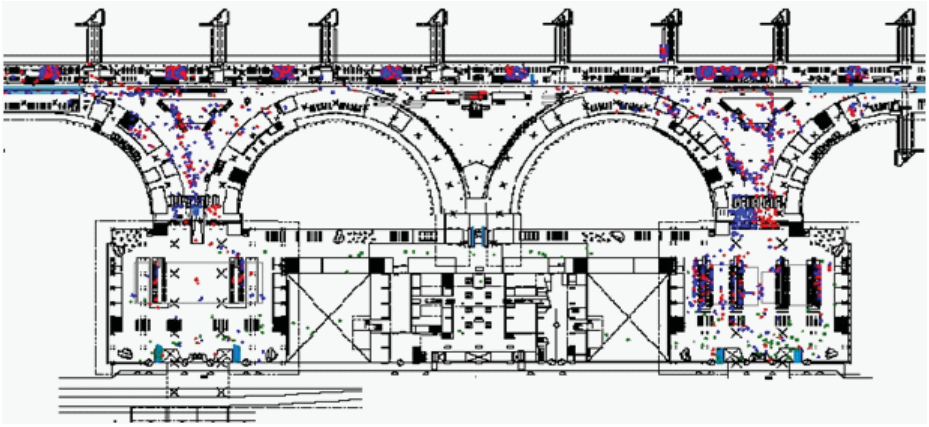
Optimization of the transfer baggage handling process
INCONTROL analyzed the coordination between different baggage handlers at Amsterdam Airport Schiphol. By optimizing the interhandler processes, handling times for transfer baggage (and the number of misconnected bags) could be minimized. Key performance indicators were defined to control the process and to measure and improve the performance.

3.3 Terminal design and operation

Terminal Design
In submission of the Dutch company NACO, Netherlands Airport Consultants B.V, INCONTROLSimulation Solutions has built simulation models for the new terminal of the King Abdulaziz International Airport in Saudi-Arabia.

The large renewal of the King Abdulaziz International Airport consists of the complete renovation of the current terminal to arrival terminal, two new departure terminals for domestic and international traffic, a new concourse with 25 passenger bridges, the design of a master plan of the terminal area, a financial study and sub-studies concerning groundwater and services.

Purpose of the study was to validate the capacity of the new terminal design, identify bottlenecks (if present) for the expected passenger flows in 2020, and visualize the passenger flows in the new terminal.



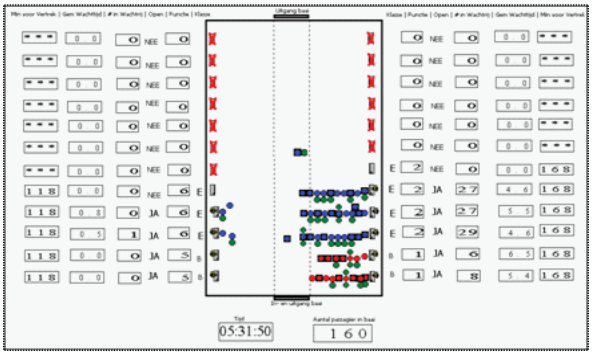
Security and border control
INCONTROL has developed simulation models for both Amsterdam Airport Schiphol and the Dutch Border Control (Koninklijke Marechausee) for the effects of central security and the planning and staffing of security counters.

The models give insight in the passenger flows at the security filters, the waiting times for filters, and the required number of security employees during the day.

Check-in planning

Check-in strategy

INCONTROL has developed simulation models to assess the effects of alternative planning strategies of check-in counter capacity at Amsterdam Airport Schiphol. Using these models, INCONTROL advised the airport on a number of planning strategies that minimize waiting times and use the available check-in counter capacity in an efficient way.



Self Service Check in

INCONTROL was commissioned to simulate a part of the Departures area, in which new self-service check in kiosks were placed, in combination with baggage drop-off points. The model represents the walking routes of passengers with their baggage carts on a detailed level. Using this model, the airport was able to see the effects on the capacity use and maximum passenger flows in that area. Based on the outcome of the model, the airport was advised to take measures to distribute the passenger flows more evenly over the kiosks.

3.4 Stand allocation

Is today's infrastructure sufficient to facilitate tomorrow's flights? Is it possible to use the existing infrastructure in a more efficient way? These and more questions can be answered with ED Airport Stand Allocation module. The module is not a day-to-day gate planning tool, but is used for analysis of current and future gate capacity.

Amsterdam Airport Schiphol started in the summer of 2006 with ED Airport Stand Allocation. The operational Gate Planning system is too complex to quickly evaluate changes in planning rules. The ED Airport Stand Allocation module is an easy to use gate allocation tool that gives insight in the required number of gates and remote positions, now and in the future.

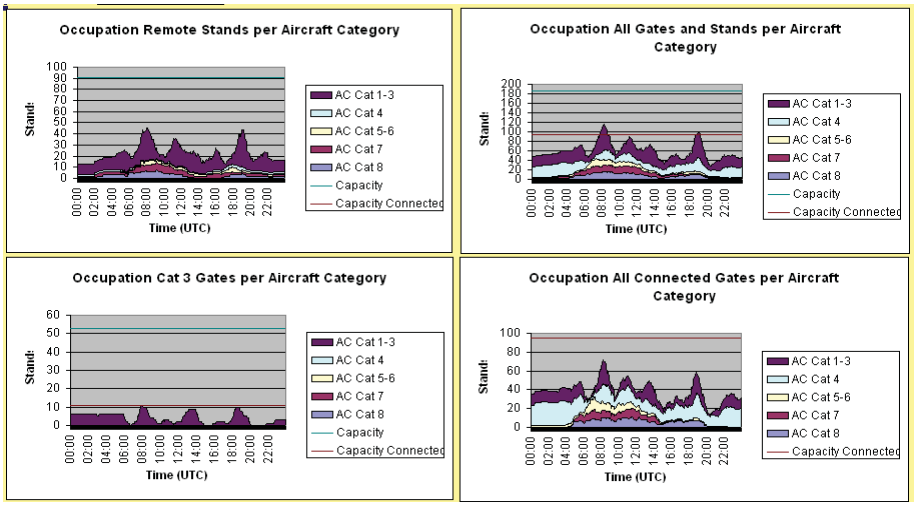
Objective

ED Airport Stand Allocation has been developed in close cooperation with Amsterdam Airport Schiphol. It supports Amsterdam Airport Schiphol in decisions about the capacity of gates and remote aircraft position (stands) and the use in daily operation. Decisions about extensions, adjustments and other use of stands can be supported at different levels:

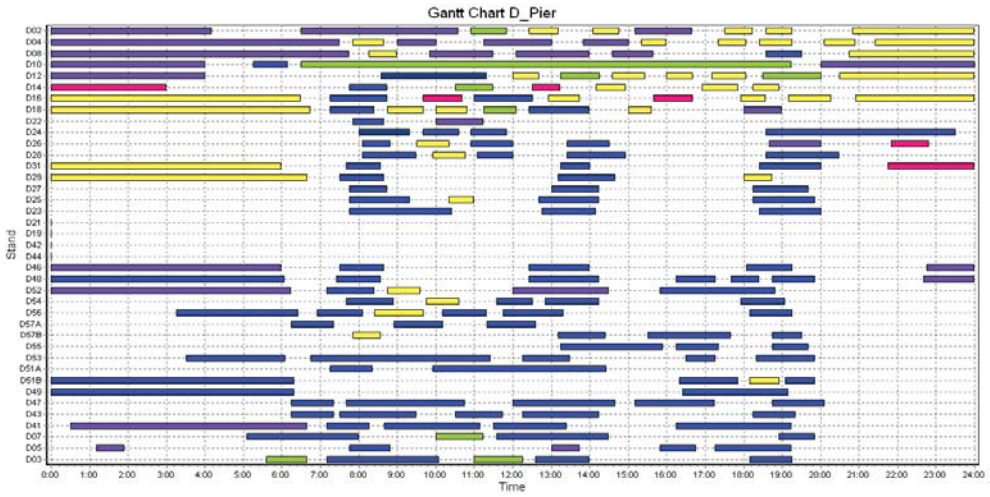
- Strategic decision making on the long term (5-20 years), for example decisions about new piers and platforms, allocation of carrier segments in certain areas.
- Tactical decision making on midterm (1-5 years), for example decisions about investments in extensions or adjustments within the current infrastructure. Or analyzing the impact of changes in allocation rules.
- Operational decision making on the short term (0-1 years), for example a quick analysis of the season forecasts, influence of work on the platforms and of disturbances in the operation.

Benefits for Amsterdam Airport Schiphol

- Optimization of internal processes without expensive investments in capacity extension.
- Possibility to decide about just-in-time investments in capacity. Investments can be done when it is really required; this will keep the visit costs as low as possible.
- Possibility of integral analysis by using ED Airport Stand Allocation in combination with already existing baggage and passenger simulation models.



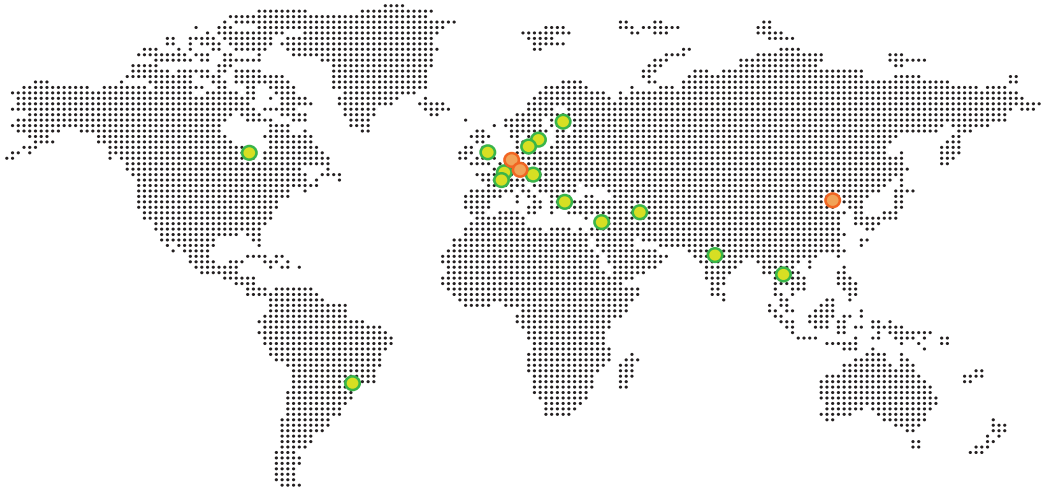
To realize reduction of visit costs, Amsterdam Airport Schiphol wants to accommodate a growing number of aircraft movements while minimizing the investments in gate capacity. This requires an efficient management of airport processes. Design and use of infrastructure is an important issue! ED Airport Stand Allocation makes it possible to analyze these capacity issues in a quick and easy way.



How the ED Airport Stand Allocation works

ED Airport Stand Allocation makes use of a flight schedule for a certain day and the available capacity of stands. Based on a user defined rule set, ED Airport Stand Allocation assigns the flights to the available stands. It evaluates all rules in priority order (requirement, preference, avoidance) and assigns flights to stands with the highest possible score. The resulting gate planning can be represented in a Gantt Chart or in Excel graphs. ED Airport Stand Allocation works together with other ED Airport modules like the PaxBaxGenerator and the passenger simulator PaxSim. This makes it possible to evaluate the influence of a certain gate planning on passenger and baggage flows.

Contact



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