ALOHA

Aircraft Design for Low Cost Ground Handling

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» In the joint research project Aircraft Design for Low Cost Ground Handling (ALOHA), innovative conventional and unconventional aircraft designs are investigated and evaluated with respect to ground handling operations and their associated costs. The duration of the ALOHA project is 3 years and 2 months. It started in November 2007. The project partners in ALOHA are:

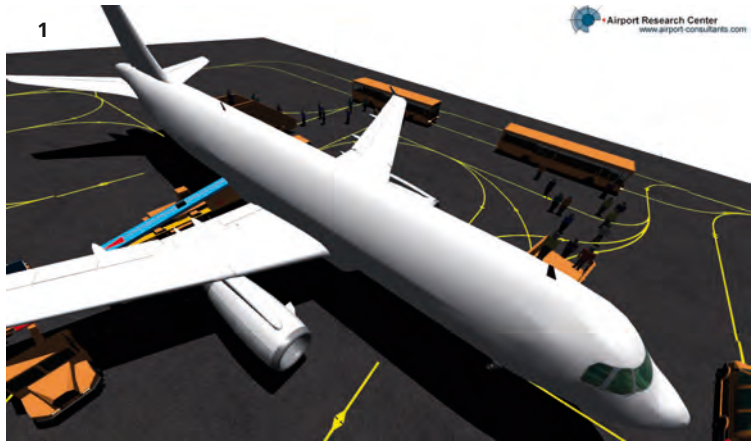
- Hamburg University of Applied Sciences (HAW Hamburg) - acting as project leader
- Airbus Operations GmbH, Hamburg, with its Future Project Office (FPO)
- Airport Research Center GmbH (ARC)
- Hamburg Airport GmbH (Ground Handling Division)

Motivation: Low-Cost Airlines (LCA) have become a major contributor to global aviation in the past decade. It is likely that the low cost airlines segment will continue to grow, claiming an increasing market share of air travel. One of the key enablers of low-cost air transport is an accelerated aircraft turnaround at the airport in combination with reduced ground handling costs. The potential of this LCA approach has has been successfully exploited by well established LCA such as Southwest Airlines and Ryanair. Their success has sprouted a global interest of all airliners in optimizing their turnaround processes to increase their overall efficiency.

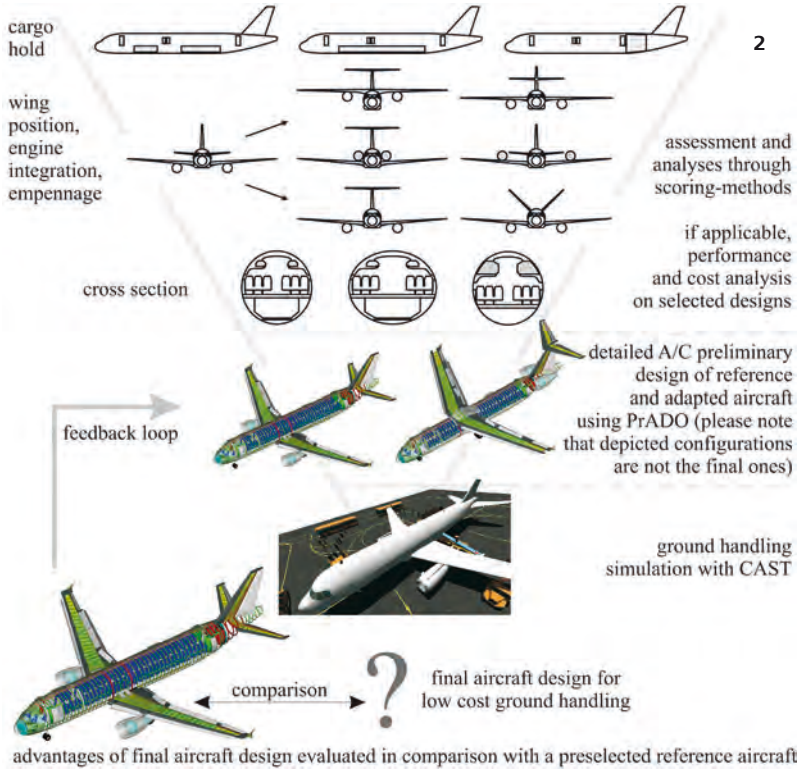
Particularly for short- to medium-range aircraft, turnaround time is an important factor influencing their overall efficieny. The most important types representing this aircraft category are the Boeing B737 and the Airbus A320. Both aircraft families were designed long before the significance of turnaround time was recognized: the B737 was developed in the 1960s, the A320 in the 1980s. This explains why today's airline requirements regarding ground handling operations were not considered in the design of these single-aisle aircraft. Today, LCA are an increasingly interesting market segment for aircraft manufacturers and airports. Airbus with its A320 family and Boeing with its B737 family consider their short- to medium-range aircraft to be the best-selling jet airliner families. Successors of the A320 and the B737 are expected to follow as "cash cows" in the aircraft manufacturers' product portfolios. To ensure their success, it is extremely important to consider and to adapt to potential customer needs already in the conceptual design phase. This automatically implies that existing and evolving turnaround requirements must have a key influence on the overall concept of future single-aisle aircraft.

Possibilities to influence ground handling: Due to a significant number of ground handling processes and various stakeholders involved, the turnaround becomes complex but remains still manageable. One of the overall issues is the high dependency on other processes, resources and/or stakeholders. Thus, by reducing the interfaces between the aircraft and the airport terminal, a reduction in required Ground Support Equipment (GSE) can be accomplished that would further reduce associated costs as well as e. g. the potential of delays. This means that the aircraft has to become more autonomous (i. e. getting independent of external ground support equipment) such as including an autonomous push back system and onboard air stairs. However, technologies for a more autonomous aircraft increase the aircraft weight and have an influence on the overall system (such as drawbacks in cruise performance and direct operating cost). Likewise, the aircraft must be designed to accommodate the new technology.

Not only the interfaces between the aircraft and the airport terminal play an important role in ground handling. Also the ground handling process bears potential for optimization if the aircraft design can meet the needs associated with this process. In this case, the interfaces between the required GSE and the aircraft itself have to be considered. These



1 Ground handling simulation with CAST of the pre-selected ALOHA reference aircraft (Airport Research Center 2010)



2 Approach applied to evaluate an aircraft design for low cost ground handling. Aircraft design selection is still in progress. For this reason, it is not possible to show the final result at this stage (March 2010).

docking points along the fuselage could, with design changes, have a positive effect on respective ground handling processes. Furthermore, external parameters such as sill height and wing position are affecting e.g. the positioning of ground support equipment relative to the aircraft as well as the levitation height of loaders.

Generally speaking, there are two possibilities to influence the daily ground handling of aircraft (by only adapting the aircraft layout and equipment involved):

- getting more independent of external ground support equipment by substituting it with innovative on-board aircraft equipment
- optimizing the aircraft interfaces of respective ground handling processes to reduce time and costs while considering the strong interrelations of the processes involved.

Analyses of ground handling processes: To estimate the potential of possible aircraft design modifications towards a reduction in ground handling costs, ground handling processes have been investigated by analysing real turnarounds (172 turnarounds at four different airports in total). Collected data is currently transferred (by applying general statistical models) into ground handling model scenarios that will be used as a reference in the evaluation of adapted aircraft design turnarounds. Additionally, collected data is currently undergoing a regression analysis to create semi-empirical performance parameters of selected ground handling processes where, finally, a process oriented cost calculation will be added.

In order to obtain a broader perspective of the problems faced in the daily ground handling of aircraft, expert interviews have been conducted with airlines, ground handlers and GSE manufacturers. The collected ideas and issues faced are thus based on hands-on experience and will be fed into the scoring method (e. g. Zangemeister 1973) to evaluate related aircraft concepts and innovative technologies with respect to their potential of improving the ground handling.

The aircraft design process in ALOHA: Selected concepts are currently being implemented into the design of the PrADO aircraft model (Preliminary Aircraft Design and Optimization program (PrADO), Heinze 1994) for performance calculations, whereas the evaluation in terms of ground handling will be done with the help of the Comprehensive Airport Simulation Tool (CAST), an in-house development of the research partner Airport Research Center in Aachen. The ground handling part of it has been designed within ALOHA and allows for simulation of different service arrangements of different aircraft models (Airport Research Center 2010). In order to evaluate aircraft designs out of PrADO, an interface has been programmed to transfer the three-dimensional geometry of the aircraft into CAST Ground Handling. Thus, the selected aircraft configuration will be modelled and analysed by PrADO, evaluated in terms of ground handling by CAST Ground Handling and compared with the preselected reference aircraft (**Figure 2**; depicted configurations are not the final ones). «

References

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