PHD PROFILE, II YEAR STUDENTS, A.A. 2018/2019

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- *Title of the research: Modelling of supply-demand interactions in the optimization of airline integrated fleeting and scheduling decisions*
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OUTLINE OF THE RESEARCH

My research concerns the air transport industry and focuses on the mathematical optimization of multifaceted aspects of air transport networks.

Air transport networks are complex systems involving several interacting players – primarily airlines, airports, regulatory bodies and different type of customers –, as well as the use of up-to-date technology and high-cost assets. Alongside the capital-intensive nature of the business and the large-scale global operations, the fast-changing competitive landscape makes the development of effective planning schemes a key priority for airlines to succeed in the market. In this sense, a mixed set of knowledge and expertise, ranging from an in-depth understanding of the sector dynamics, programming skills and managerial insights is required to develop scientific tools that meet the industry needs.

Within the traditional airline planning process, the optimization of flight scheduling and fleet assignment problems has received ever-expanding attention in the literature due to their great impact on airline profits. Models of increasing complexity have been developed to embrace the peculiarities of airline networks and a variety of solution algorithms have been proposed to accommodate the large scale of real-world airline operations. Starting from basic leg-based fleet assignment models (FAM), enhanced models have achieved a higher degree of realism and wider acceptance among airlines by considering additional features of real-world airline networks, such as itinerary-based demand (IFAM), flexible departure time and re-fleeting mechanisms.

On top of operational considerations, a crucial aspect of airline planning is to ground on accurate forecasts of air travel demand. Starting from the longest-term strategic decisions to daily schedules, relying on proper traffic estimates is key to make optimal decisions at any stage of the planning process, and eventually deliver airlines' success. In addition, demand is inextricably tied to air transport supply and this must be accounted for when aiming at optimizing the fleet assignment and flight scheduling plans over a global network.

The motivation for my research comes from the observation that most of current approaches overlook the potential demand stimulation effects from improved air service provision in O&D markets. They take the overall market demand values as an exogenous input and focus on the distribution of such demand over competing itineraries. As such, the separation between market size estimation and seat capacity allocation fails to fully capture the reciprocal relationship between demand and supply, potentially resulting in sub-optimal decisions. On the contrary, the explicit treatment of demand-supply interactions by letting the model optimize the

operational schedule while concurrently estimate itinerary demands is likely to yield superior decisions and improved schedule plans.

My research aims to contribute to the literature in a twofold way. First, a new parametric demand model capturing how different itineraries in terms of service level may influence air travel demand is introduced. Second, a novel approach is proposed to explicitly enter the estimation of travel demand generation into an integrated flight scheduling and fleet assignment model.

My research fits the PhD program as it concerns the application of strong analytical skills and the adoption of a systematic analysis to the management of airline networks, which can quite rightly be seen as a good example of complex systems. It also contributes to the PhD mission to bridge the gap between research and practice. Indeed, being the final output a viable optimization model, it has the potential to be implemented at major airlines as a practical tool to support their decision-making process. Eventually, the research grounds on strongly quantitative and interdisciplinary techniques, ranging from the use of econometrics, data science techniques and mathematical programming, for which the cross-fertilization promoted by the PhD program through the cooperation between the two universities and the international community is crucial.