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Managing turnaround performance through Collaborative Decision Making

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ABSTRACT

The purpose of this paper is to explore turnaround performance as a resultant from both Collaborative Decision Making (CDM) processes and collaborative measures. This paper presents how CDM operates in the Turnaround Process (TAP) to propose a new method for managing the collaborative turnaround performance of all actors by predicting the most critical indicators. To achieve this, data from a CDM airport is used. Sample data of 6500 observations, taken from turnaround movements handled in 2014 at Madrid-Barajas Airport, were obtained from three separate databases and analyzed separately (in three databases). To predict turnaround performance, this paper also introduces a predictor dependent variable called "*star values*" as a measure of minimal delay conditions in order to predict time performance. The analysis shows that the proposed method unveils a new approach in determining how collaborative performance can be measured in the TAP and the predicted key performance indicators, which shows variations in the predicted CDM indicators. Results challenge managers and policymakers to find which improvements can be enacted for better usage of airport infrastructures and resources for optimum use as well as enhanced TAP. In terms of theory use and extension, the study reveals how CDM is an essential element in the literature on air traffic management.

1. Introduction

Collaborative Decision Making (CDM) is an airport operations' standard that has an impact on the Turnaround Process (TAP) at airports. CDM aims to improve air traffic flow and capacity management by reducing taxi times, turnaround times which translates into, for instance, economic benefits and environmental friendly conditions. However, due to its diverse composition of actors, the assessment of turnaround performance relies on a CDM system that includes, inter alia, ground handlers, airlines, the airport management, and air navigation service providers.

The introduction of CDM at airports relies on the accepted fact that air traffic is rapidly increasing globally, and this trend is predicted to continue. In Europe, for example, the monthly monitoring of the European skies, as shown by Eurocontrol (2015b), indicates continuous growth in traffic from month to month. In other areas, studies in airport business show how the commercialization of the airport sector has facilitated air travel with the rise of low cost carriers (Graham, 2013), and how mergers and acquisitions are facilitating growth in aviation markets (Merkert and Morrell, 2012). As a result, flight demand is anticipated to reach 14.4 million movements in the next two decades (Krstić Simić and Babić, 2015; SESAR, 2014).

This increase in air travel signals positive economic benefits (Profillidis and Botzoris, 2015). However, it also exerts constraints, such as congestion in the skies, delays at airports, and bottlenecks in operations, to the whole network. Moreover, there are negative effects on the environment, notably noise and air pollution (Martini et al., 2013). Increased capacity, safety, efficiency, and the environment are the main goals for the EU. This creates an important supply and demand for runways that is being felt across major airports in Europe.

To address the anticipated needs for future air traffic management and the development of air traffic (Madas and Zografos, 2008;

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Forsyth, 2007; Wu and Caves, 2002), new technologies, concepts, and policies are emerging in order to optimize air traffic management (ATM) infrastructure to facilitate the collaborative management of the ATM network via Next Generation (NextGen) in the USA, and Single European Sky Air Traffic Research (SESAR) in Europe. For example, at the network level, the long-term strategic development of the entire air traffic infrastructure in the EU (SESAR, 2015) involves many programs such as moving from airspace to 4D[1] trajectory management and traffic synchronization. At the airport level, Airport Collaborative Decision Making (ACDM) is one of the optimization standards for airport services under the Single European Sky (SES) initiative, and was introduced in Europe almost a decade ago (Eurocontrol, 2006). Aside from its unique implementation requirements (Corrigan et al., 2015), an implication for CDM post implementation at airports, has been that turnaround performance from all actors can be measured to explicitly show both operational and financial benefits to a diversity of actors, such as ground handlers, airlines, airport management, and air navigation service providers.

In Europe, CDM is a standard for interoperability and a requirement for all airports (ETSI, 2010). At the airport level, CDM is required of all airport actors. However, the completion of CDM implementation does not necessarily mean that the expected outcomes are realized (Eurocontrol, 2006). After CDM implementation at an airport, continuous improvement becomes a daily activity in order to maintain optimal on-time performance. This paper argues that there is a lack of strategic alignment on how actors manage their operations in the TAP by using collaborative measures that are part of CDM. When CDM is viewed as a single-loop performance system, turnaround operations are difficult to manage, not only because of the diversity of airport actors, but also because there is poor alignment of both horizontal and vertical collaborative measures. The CDM performance indicators are not connected to airport actors to support operational improvements. This misalignment highlights the need of appropriate key performance indicators (KPIs) within CDM as a feedback mechanism to push for continuous improvement.

One driving force for CDM implementation has been the anticipation of its benefits to all actors involved at the airport level (Eurocontrol, 2006). However, there is still no recognized cross-organizational approach to how collaborative measures can be used by airport actors as a reference for cost benefit analysis. Because the CDM system is adjustable and there are variations in measures, the relationship between output from CDM operations and actions taken by diverse actors, such as ground handlers, airlines, air traffic controllers, and airport management, need to be examined. This may create a driving element that transforms the CDM system for airports, seen earlier as an ATM system, to a Performance Management System (PMS) (Bititci et al., 2015), defined as "the cultural and behavior routines that determine how measures are used to manage the performance of an organization" (Bititci, 2015a).

Using collaborative measures as a feedback mechanism for all airport actors (Van Bakel et al., 2015) can enables the alignment of the output from different CDM users as well as their push to change the behavior for their input. Moreover, by being able to measure turnaround performance within the CDM framework, this will contribute to the future functioning and continued improvement of ACDM (Eurocontrol, 2015b). In addition, turnaround performance is important because when showing how CDM indicators are critical, the system will be comprehensive of all operations. Ultimately, understanding the measures from local turnaround performance contributes to the airport performance benchmarking system-wide (Oum and Yu, 2004; Lupo, 2015). Overall, understanding the implications of these measures would maintain the credibility of CDM at airports and long-term visions of using the CDM framework.

As such, this paper argues that despite many studies on CDM functioning, there has not been enough research to explore how turnaround performance measures can be managed and aligned between CDM users and their collaborative output. We propose a new method that determines collaborative turnaround performance, in a way that enables tracked measures to be used as a performance management system. The paper does so by answering the following research question: How is TAP performance within CDM managed through collaborative measures? To answer this question, it is important to understand how CDM operates and what operational benefits it brings to the turnaround (see Appendix).

The research adapted insights from Performance Measurement Management (PMM) literature that show how integrated PMM with many actors can be achieved. It also adapted the use of the Classification and Regression Tree (CART) method, using the QUEST algorithm. A classification tree is a non-parametric statistical method that, by using a predictor variable, which is the (*star values*[2] in this case), can classify recursive partitioning to analyze and predict objects. The proposed framework consists of several stages: data mining, data processing, and data analysis and result validation. The results show that this method identifies turnaround performance by predicting the most critical KPIs that affect CDM operations, which then are linked back to the airport actors to manage delay reductions in the turnaround and, hence, both strategically and operationally drive collaborative performance.

The rest of this paper is structured as follows. In Section 2, we present a background on CDM as part of ATM literature as well as insights from PMM literature. In Section 3, we present the overall methodology and predictor *star values*. In Section 4, the analysis of the results is presented, while, in Section 5, the validity of our calculations that warrant consideration from other researchers is examined. Section 6 opens with a discussion of the results and, finally, Section 7 discusses the conclusions and implications for future research.

2. Collaborative Decision Making in air traffic management

Part of the ATM literature deals with airport performance in understanding collaborative approaches to airport operations (Castelli and Pellegrini, 2011; Auerbach and Koch, 2007), including collaborative approaches in airport business (Nucciarelli and Gastaldi, 2009). Collaborative systems in aviation are also evident in other areas such as the collaborative Safety Performance System (Ulfvengren and Corrigan, 2014). This makes ATM an important area of study with an emphasis on terminal airspace and airport operations (de Neufville and Odoni (2013); Koeners and Rademaker, 2012; Krstić Simić and Babić, 2015). However, there is not enough extant literature on how CDM is integrated. To this end, most ATM systems in Europe adopted operating systems to be able to use advanced satellite technologies, and for local airport operations to advance collaborative thinking to reduce congestion and cost.

As indicated, ATM has to increase its role in airport operations, since mastering the ATM fundamentals promises to decrease traffic

[1] 4D is a new concept being investigated by SESAR and Eurocontrol as a way to connect aircraft and ground systems to optimize aircraft trajectory in three dimensions over time.

[2] This term is introduced by the authors in this paper to represent delay conditions, which are the dependent variables used in the calculations in Section 3.