International Journal of Research in Engineering, Science and Management
Volume 5, Issue 9, September 2022
https://www.ijresm.com | ISSN (Online): 2581-5792


# Air Traffic Control and Reducing Congestion by Taking Airport Capacity, Routes of Flights and their Release Time into Account

Hetul Davawala[1], Hitarth Chhajer[2], Jagrati Jalonha[3*], Jinay Mehta[4], Kanak Murarka[5]
[1,2,3,4,5]*SYB.B.A Student, ASMSOC NMIMS University, Mumbai, India*

***Abstract*: In this bibliography, we the writers try to depict through thorough understanding of published research papers in this segment of operations research and its relation with air traffic control. Moreover, we try to go through historical research leading back to the year 1996 all the way to current times and figure out the best discoveries and inventions of methods that have proved exponentially beneficial to both travelers, travel service providers and governing bodies of air transportation. This filtered information would help any reader/researcher to get a centric and specified overview which is detailed in the ways and method through which Air Traffic Control has reached to its heights today and what it can achieve one day. That is what we humans endure, perfection and us writers believe that our efforts would help our fellow researchers to achieve the goal in either learning or in creating better structures that benefit everyone in the air travel industry. This paper conducts a systematic literature review on Air traffic control, reducing congestion and minimizing the cost related to it. It summarizes the developments in the aircraft industry (above mentioned context) over the last 27 years. A total of 200 published journal articles from the literature search were chosen and analyzed. In addition to it, findings of the reviewed articles, number of literature and journal articles available and the leading authors are discussed. By reviewing current research, identifying research gaps, and suggesting new future study opportunities, this review paper adds to the body of literature in reducing congestion and air traffic control.**

***Keywords*: Air traffic control, Airports, Delays, Transportation, Air traffic flow management.**

## 1. Introduction

The world's busiest airport, Hartsfield-Jackson Atlanta international airport has individually handled a total of 96 million passengers including enplaned, deplaned and in-transit passengers in the year of 2012 (Tragale, 2012). In the same year, Hong Kong International airport, recognized as the world's busiest airport in terms of cargo traffic, transported about 4.1 million tons of cargo (Marcell, 2012). Due to its dependability, speed, safety, and convenience, air travel has unquestionably become one of the most widely used modes of transportation. However, as the use of air travel grows, new problems including controlling air pollution and traffic grow. An appropriate aircraft scheduling choice could effectively remove the bottleneck caused by airport operations from the perspective of air traffic. It can also avoid adding extra expenses to the airline companies. Each aircraft that flies faster than its most efficient speed incurs a penalty due to the fuel wasted when it makes an early landing. Additionally, there is a price to pay for the delayed landing. There may be a sizable number of passengers who miss their connecting flights, depending on the length of the delay. The next flight that was originally scheduled may be delayed as a result of this delay. Additional maintenance charges, ground personnel rescheduling fees, passenger loading fees, and other expenses are additional potential costs that delays may result in. (Vadlamani & Hosseini, 2014)

The most pressing problem that European Air Traffic Management (ATM) had to deal with in the past was airspace congestion. A continual increase in air traffic demand significantly exceeds the capacities of the French Air Traffic Control Center (ATCC), which causes flight delays to get longer and longer. The European Commission was forced to issue a special statement [IP/99/924, 1999] acknowledging that current ATFM systems are unable to support high traffic loads and are unscalable for the anticipated growth because these time and management costs were such an annoyance for all airlines and passengers. (Barnier et al., n.d., 2001)

Typically, airlines build their schedules under the assumption "that every flight leg will leave and arrive on time". These strategies are frequently disturbed and airlines frequently suffer significant outlays in addition to those that were initially anticipated because this optimistic scenario doesn't happen very often. Passenger delays and disruptions are also brought on by schedule and flight changes. A stronger strategy can lessen the likelihood and severity of these delays, which will cut costs (Lan et al., 2006).

Making the Air Traffic Management (ATM) system more "efficient and effective" is a major focus for lowering aviation's environmental impact. ATM inefficiencies can occur for a variety of reasons, including airspace structure (e.g., standard routes and flight levels), airspace restrictions (e.g., military training areas), conflict avoidance (e.g., to keep aircraft separated from one another and adverse weather), and airspace congestion (Reynolds, 2008).

*Corresponding author: jagratijalonha04@gmail.com

The foundation for managing air traffic flow at an airport exists, and as the number of daily aircraft departure and arrival operations rises, so does its complexity. The problem of air traffic flow management (ATfM) (Agustin, Alonso-Ayuso, Escudero, & Pizarro, 2012; Lulli & Odoni, 2007) becomes more complex when determinants of air traffic departure and arrival delays are not fully identified and elaborated. (Wesonga, 2015)

In general, air traffic flow management (ATFM) takes into account strategic methods that seek to identify and address demand-capacity mismatches by modifying aggregate traffic flows to correspond with limited capacity resources. ATFM initiatives attempt to mitigate the congestion that may arise from unforeseen disruptions as efficiently as possible. (Andreatta et al., 2011)

Over the past 60 years, there has been consistent evidence of the ability of OR methods to assess performance and pinpoint improvement strategies in aviation settings, though it could be argued that relatively few academic studies have attempted to encompass the full range of complexities that may affect decision-making in practice. There have been multiple methodologies used in recent times to minimize the delay process of flights. "The hotspot problem considers fixed intervals of time and, for each sector and for each interval of time, it compares the aircraft entry counts with the predefined sector capacity" (Mannino et al., 2021).

The papers in this era deal with early computerization of every industry including Air Transportation. They address the problem of determining how to reroute aircraft in the air traffic control system when faced with dynamically changing weather conditions. The overall objective of this problem is the minimization of delay costs (Bertsimas & Patterson, 2000). Ranging from American Air Traffic Control to European Air Traffic Flow Management and the rest of the world's strategy to improve time delays, costs, etc. These papers that we interpret cover methodologies and the theory behind it all.

## 2. Literature Review

This paper makes the accompanying commitments: (a) we incorporate a model that considers the limits of the National Airspace System (NAS) as well as the limits at the air terminals, and we show that the subsequent plan is areas of strength for fairly a portion of the proposed imbalances are feature characterizing for the raised structure of arrangements; (b) we address the intricacy of the issue; (c) we stretch out that model to represent a few varieties of the fundamental issue, most prominently, how to reroute flights and how to deal with banks in the center point and talked framework; (d) we show that by loosening up a portion of our limitations we get a formerly resolved issue and that the LP unwinding bound of our plan is areas of strength for when contrasted with all others proposed in the writing for this issue; and (e) we settle huge scope, reasonable size issues with a few thousand flights (Bertsimas & Patterson, 1998). We address the issue of deciding how to reroute airplanes in the air traffic signal framework when confronted with powerfully changing weather patterns (Bertsimas & Patterson, 2000). This paper is pointed towards the groundwork for the application of operational research to European air traffic flow management (ATFM) (Leal de Matos & Ormerod, 2000). This report presents a basic survey of the chief existing improvement models that have been applied to Air Traffic Flow Management (TFM). Accentuation will be put on two issues, the Generalized Tactical Flow Management Problem (GTFMP) and the Ground Holding Problem (GHP), as well as on a portion of their varieties (Bertsimas & Odoni, 1997). We address the ground-holding issue in aviation authority and propose two procedures that can be utilized to tackle this issue powerfully (Panayiotou & Cassandras, 1999). In this paper, we present a strategy to orchestrate provably safe compromise moves. The strategy models the airplane and the move as a mixture control framework and works out the maximal arrangement of safe starting circumstances for every airplane with the goal that detachment is guaranteed within the sight of vulnerabilities in the activities of the other airplane (Tomlin et al., 1998). A survey of aviation authority is introduced alongside present and future mechanical advances in the field of air route. Air terminal navigational guides are talked about including air terminal surface discovery supplies, robotized surface noticing frameworks, air terminal observation radars, air course reconnaissance radars, and traffic alarm and crash evasion frameworks (Perry, 1997). The potential effect of the simple queuing model and its related schemes that are aimed to control departure traffic and congestion, procedures on direct working expenses, natural expenses and generally speaking deferral is measured and talked about (Pujet et al., 1999). The TMA is a time sensitive key arranging device that gives Traffic Management Coordinators (TMCs) and En Route Air Traffic Regulators the capacity to proficiently improve the limit of an interest influenced air terminal (Swenson et al., 1997). This paper presents the calculated framework design for such a computerization help, the Departure Planner (DP) (Anagnostakis et al., 2000). One approach to diminishing how much clog is to utilize Ground Holding strategies, i.e., to force on chosen airplane a ground holding preceding their takeoff with the goal that blockage during top timeframes might be smoothed away (Andreatta & Brunetta, 1998). The main technique accepts the utilization of crucial time progress as opposed to basic distance progress in overseeing departures and arrivals. The subsequent technique additionally expects similar crucial time progress standards however at that point streamlines the air terminal limit by planning the airplane in view of the accessible time types of progress x (Nutakor, 2016). The advantages of the proposed techniques are then exhibited using recreation models that contrast them and the ongoing strategy (Lucertini et al., 1997). This paper presents progressing research endeavors at the Massachusetts Institute of Technology (MIT) and the German Aerospace Research Establishment (DLR) to foster robotized choice supporting frameworks to help air traffic regulators in taking care of takeoff traffic and relieving the antagonistic impacts of ground clog and deferrals (Anagnostakis, 2001). Dynamic statistical models for the prediction of aircraft take-off times (Shumsky, 1995). These measurements are produced for various flight stages and geographic locales by utilizing functional flight

information to decide the levels and wellsprings of shortcoming (Reynolds, 2008). Robust Aircraft Maintenance Routing, and Flight Schedule Retiming (Lan, 2003). It was estimated that a metric that incorporates terms that catch air traffic intricacy will be a superior proportion of air traffic regulator responsibility than current estimates dependent just upon traffic thickness (Laudeman et al., 1998). We foster a technique to change the unconstrained timetables, representing impacts of clog because of restricted NAS limits (Long et al., 1999). This exploration project recommends new techniques for making more vigorous aircraft plans which can be handily recuperated even with unpredictable tasks (Ageeva, 2000). Privatization v. Corporatization of the Federal Aviation Administration: Patching up Aviation authority (Treanor, 1997). We exploit object innovation to plan a coarse-grained model of an aviation authority framework (Bushey & Malloy, 1997). This study investigation how Air Traffic Regulators pursue choices on directing the airplane arrival interaction and offers a bunch of models to examine air terminal airside limit and the impacts of resequencing arriving on the limit (Kim, 1996). The improvement of a demonstrating climate that envelops this multitude of wellsprings of vulnerability and the technique to be utilized in a probabilistic assessment of mechanical effects are the subject of this paper (Mavris & Garcia, 2000). An examination of the carrier business was performed to determine how much RJs are presently being used and the plans of the aircrafts for extending their deployment later on (Trigeiro, 1999). This report integrates information got from audit and investigation of information bases and writing, conversations /interviews with engineers, air-traffic staff, other FAA specialized faculty, and carrier staff, site visits, and an overview on surface postponements and causes (Chin et al., 1997). The expectation of this exploration was to distinguish the degree of blockage at New Zealand air terminals; to appraise the business cost of clog; to recognize the reasons for blockage; to assess future degrees of blockage; and to give thoughts for arrangement of this issue (MacLeod, 1998). This thesis provides an overall depiction of the model as well as the test system. Toward the end, we show the recreation results got from a bunch of recorded genuine flight plans petitioned for the Chicago O'Hare Global Air terminal (Wong, 1993). Effective limit designation in a cooperative air transportation framework (Hall, 1999). This paper subtleties the cycles and issues related with carrier tasks control and unpredictable tasks, and it distinguishes regions where activities research has made a commitment (Grandeau et al., 1998). The basic rule by which the foundation and institutional plans have been predicated is that there is a man in the know in the air pilots and on the ground air traffic regulators (Clot, 2000). This examination investigates how models can be utilized to help dynamics in European ATFM (Leal De Matos, 1998). In this thesis, whole number programming models are applied to combinatorial prob-lems in air traffic flow management. For the two problems studied, models are developed and examined both hypothetically and computationally (Hoffman, 1997). Therefore, NASA looks to foster the capacity to assess the possible effect of different cutting-edge innovations (Lee et al., 1998). This study endeavors to devise systems that can be utilized for tending to a particular timetable irritation issue (ground defer program) as it happens (Luo & Yu, 1998). The current concentrate first features the errors and shortcomings of the ongoing best flight plan upgrading programming that utilizes the Expense List idea before takeoff. It then, at that point, explores methods to perform upgraded flight-plan advancements on the way, with calculations that are less perplexing than utilizing the Expense Record (le Sellier, 1999). We give a unique programming plan from which lower limits are determined. Two heuristic calculations are proposed (Bianco et al., 1999). A determining model is portrayed that further develops takeoff expectations over those of Collaborative Decision Making (CDM), diminishing blunder by up to 30% for a given day (Vanderson, 2000). The effective execution of a consistent, DGPS-based air terminal route, control and the executive's framework is subject to the fruitful joining of flight and Air Traffic Management (ATM) innovations (Pilley & Pilley, 1995). An endeavor is made to supplement the huge advances in Air Traffic The executives (ATM) by giving a fairly alternate point of view (Zellweger, 1997). In this work, the issues connecting struggle discovery and aversion for blended Airplane RLV tasks were analyzed and contrasted and customary special use airspace (SUA) activities (Khan, 1998).

Our goal is to provide both the operational research community and the ATM practitioners with an up-to-date synthesis on the RSP, with common 3 notions and vocabulary, as well as common test instances and a general view of the literature, providing thereby a common ground with new insights to solve this problem. (Ikli et al., n.d.).

*2001-2005:*

This work introduces a constraint-satisfaction-based mechanism for scheduling aircraft airport departures. The available runway configuration is one of the most limiting elements in airports' increasing congestion. Assisting controllers with the planning and scheduling of planes is one way to reduce this congestion. The prototype described here aims to provide this support for creating the best departure schedule and scheduling the early climb stages for departing aircraft. By briefly outlining present practice and explaining the function of departure planning at airports, the operational problem of departure management is first addressed. The second section describes a translation of the departure management problem to constraint satisfaction. Third, a thorough description of the prototype and an illustration of a solution are provided. Finally, certain inferences are made. (van Leeuwen et al., 2002)

The national airspace system's traffic flow management aims to keep air traffic moving efficiently while minimizing its negative effects on air traffic controllers' workload. This paper demonstrates how the air traffic service provider accomplishes this objective via a three-step method. In the first step, groups of aircraft flying in the same geographic neighborhood are rerouted avoiding flow-constrained locations using traffic flow management techniques like Playbook and tagged departure routes. The process of rerouting traffic accomplishes the goal of keeping traffic away from the flow-restricted locations, but

it occasionally causes congestion and bottlenecks in other portions of the airspace. Temporal traffic decisions, such as miles-in-trail constraints, which regulate the density of the flows along fixed paths, are applied to this traffic flow in the second step to further control this congestion. The aircraft adjusts its speed to stay inside the miles-in-trail limit, or introduces a delay by lengthening the flight route or holding airborne. Thirdly, certain airborne aircraft may be locally diverted to avoid congested locations while other aircraft continue on their predetermined paths. An example of the three-step hierarchical integration method employs the West Watertown Playbook route and an Aberdeen VORTAC miles-in-trail restriction to lessen traffic on Sector 16 in Minneapolis Center. (Sridhar et al., 2002)

Forecasts for unrestricted air traffic development indicate that in Europe and the UK, airport usage might virtually triple by 2030 and more than double over the next 20 years (CEC, 1994; DETR, 2000a; Grayling and Bishop, 2001). Whether to build new airport capacity to accommodate this anticipated growth will be a key issue for the eagerly awaited UK government's policy statement on the future of aviation. Even with a new fifth terminal at London Heathrow, it is predicted that air traffic capacity in the south-east of England could start to run out in about 10 years. Both the UK government and the European Commission's policy discussions reflect concern over the local and global environmental effects of such aviation growth. This research provides an overview of the physical and perceived environmental variables that limit growth at many airports and those that are likely to result in further restrictions. The impact of these issues on airport expansion is explored, together with strategies for controlling environmental capacity, with a focus on contemporary research in the sector. (Upham, Thomas, Gillingwater, & Raper, 2003)

In this publication, an integrated set of models for estimating an airfield's capacity and the related lag times the objective is to provide a decision assistance tool suitable for strategic airport planning. Therefore, the focus is on quickly and accurately getting credible approximations to the quantities of interest with a constrained number of inputs. The models take into account the changing dynamics of airfield capacity and address some unpredictable elements of airfield operations as well as for supply. They are sensitive to the shape of the airfield. The airfield's and the local ATC system's operational features, as well as the local aviation traffic's preferences for airport access and services. (Stamatopoulos, Zografos, & Odoni, 2004).

*2006-2010:*

This project's goal is to develop an initial existence proof for the hypothesis that slot allocation through an auction is a potential remedy for the air traffic congestion issue surrounding airports with high demand to capacity ratios. This project would encourage more extensive research into developing a system design for slot allocation that could be implemented by proving the existence of such a technique for allocating slots at crowded airports (Howe et al., 2003). This paper investigates the use of aircraft capable of vertical or short take-off or landing (V/STOL), specifically the tiltrotor, in the regional air transport market, as well as the impact on airport capacity that this craft would have. With this in mind, the benefits and drawbacks of using this vehicle are identified, as well as the changes that must be made to the air transportation system in order to fully utilize its potential (Deshpande et al., 2006). The authors describe two new techniques for minimizing passenger disruptions and achieving "strong airline scheduling plans." Aircraft must be "routed" in the first case, while flight departure times must be "retimed" in the second. Our strategy can greatly reduce "delay propagation," according to computational results obtained using data from a prominent U.S. airline. It increases punctuality and lowers the number of passengers that are annoyed. In our second area of study, we take into account the issue of passengers missing aircraft portions because of "insufficient connection time." By "retiming departure times" of flight segments within a constrained time frame, we create a new technique to reduce the frequency of passenger missed connections. An algorithmic solution approach is presented (Lan et al., 2006). We suggest a job-shop scheduling model with sequence-dependent set-up times and release dates to schedule all aircraft operations at the runway complex as well as inbound and outbound traffic flows on all prefixed routes in an airport terminal area (Bianco et al., 2006). The Taxi Planning analyses the scheduling and routing of aircraft at the airport. As soon as a new aircraft enters or leaves the system, this dynamic problem must be updated. “A linear multicommodity flow network model with side constraints and binary variables” has been used to model taxi scheduling. When using a specific airport capacity, conflicts and cooperation between aircraft are represented by flow capacity constraints. Methodologies like "Branch and Bound" and "Fix and Relax" have been applied. The computational tests were conducted at the Madrid-Barajas airport using real traffic data (Marín, 2006). The paper provides an illustration of the complexity of EU ATFM solutions, the advantages of assigning some airborne holding delays in addition to ground delays, and the equity problems that develop in the EU ATFM context as a result of interactions between traffic flows (Lulli & Odoni, 2006). This paper aims to capitalize on the research already done in the area of airport slot allocation instruments to define a number of unique and integrated strategies as the candidate strategic options for actual implementation (Madas & Zografos, 2006). The paper estimates the connection among the “quantity of flights wishing to depart and the delays they encounter” using a publicly accessible database. In order to dodge the rush of departures that happen on the hour, airlines are encouraged to move some flights out of the peak period and slightly adjust the planned departure time of other flights. Congestion fees are calculated using this relationship (Johnson & Savage, 2006). This article examines a number of modern weather-air traffic management (ATM) integration applications, including the use of probabilistic visibility forecasts at San Francisco, the Route Availability Planning Tool to ease airport departures during thunderstorms, the estimation of en route capacity in convective weather, and the use of mixed-integer optimization techniques to air traffic management when the en route and terminal capacities are different (Evans et al., 2006). The “National Airspace System (NAS)” performance and throughput are

optimized using genetic algorithms in the method for managing airspace congestion described in this paper. Using a previously created model, stochastic metrics of anticipated congestion are generated. A genetic algorithm is then used to produce preventive resolution options, such as ground delays and alternate routes (Mulgund et al., 2006). This article describes potential analysis methodologies for evaluating the operational performance of AFPs and presents the findings from simulation studies (Doble et al., 2006). At "CAASD's Air Traffic Management Laboratory", operational evaluations of the modifications and improvements were carried out in 2006 and 2007, along with the "objective measurement" of "FAA productivity gains and preliminary estimates" of "NAS customer benefits". The Front-Line Managers who took part in the "Human-In-The-Loop (HITL) evaluation", each of whom is a "seasoned air traffic controller", noted that the "realism" of the evaluation provides new stimulus for the development of "decision support tools" in order to lessen the workload that upcoming controllers will have to carry out in order to handle rising traffic volumes. This paper provides documentation of the evaluations' high-level procedures and outcomes (Rozen, 2007). This study creates a heuristic algorithm for allocating airport runway capacity in order to reduce the expense of aircraft/flight delays upon arrival and departure (Janic, 2007). This chapter examines issues with managing air traffic and airline operations in order to lessen the severity and expense of disruptions (Ball et al., 2007). This study looks at how flight timing and routing affect ground operations at airports during aircraft turnarounds, specifically how de-peaking affects the costs of check-in (by the gate and in the terminal), baggage handling (check-in and claim), catering, load planning control, pushback of aircraft from passenger bridge, and aircraft de-icing (Kemppainen et al., 2007). In this study, we test a multi-agent algorithm for traffic flow management using FACET, a NASA-developed air traffic flow simulator that is widely used by the FAA and industry (Hall et al., 2007). Every schedule adjustment (such as a cancellation, rescheduled flight, or change in the fleet type of aircraft) must be feasible for both crew and aircraft, and it is preferable to minimize the inconvenience to passengers. Disruption Management is the term we use to describe the procedure of tracking and allocating resources close to the day of operations. Operations control is a term that's frequently used to describe this issue. The management of disruptions within the airline sector is the main focus here. Other forms of transportation, like trains and urban transportation, experience comparable issues. Additionally, the issue of being able to recover from schedule disruptions or disturbances must be addressed within production planning settings (Kohl et al., 2007). In this paper, research on air traffic flow management is discussed, with a focus on dynamic capacity allocation and cost reduction (X. Zhang et al., 2007). Our case study shows that the market can find profitable flight schedules at Instrument Meteorological Conditions (IMC) runway rates that substantially "reduce the average flight delay to less than 6 minutes" while simultaneously meeting nearly all of the present demand with "average prices remaining unchanged". This is achieved by significantly up gauging to markets with high demand (Le et al., 2008). For aviation to have a smaller environmental impact, improving the Air Traffic Management (ATM) system would be beneficial. Airspace structure and flight levels are two factors that can contribute to ATM inefficiencies. This study develops efficiency metrics to measure how far off the shortest lateral trajectory airplanes currently fly. These results will assist in informing and prioritizing design elements of ATM evolutions that affect environmental performance (Reynolds, 2008). In this study, we create and apply a model to pinpoint the ideal set of enhancements for airport arrival and departure procedures. We offer a comprehensive method for valuing many options while taking their interactions into account. The model identifies similarities and differences in the stakeholders' perspectives, combines quantitative and qualitative expert assessments of the potential improvements, and ultimately recommends a preferred course of action (Grushka-Cockayne et al., 2008). This study develops analytical models to estimate the maximum capacity of "closely spaced parallel runways for arrival, departure, and mixed operations". The maximum number of corresponding aircraft operations that can be accommodated in each capacity during a specific time frame (typically one or one-quarter of an hour) with constant (i.e., sustained) demand for service (Janic, 2008). We investigate a scheduling problem, inspired by "air traffic control". The objective is to regulate landing times, within these time windows, which capitalize on the minimum time over and done between successive landings. We provide a "general hybrid branch" and cut framework to unravel the problem with random time windows. Experimental results show that our approach outperforms earlier formulation of the problem (Artiouchine et al., 2008). This essay takes the "tactical single runway arrival problem" into consideration. By giving airlines the choice to provide cost functions associated with arrival delays for their flights, the present emphasis on "collaborative decision making" is reflected. Equity is ensured by introducing a scaling method for these costs (Soomer & Franx, 2008). An opportunity to research the impact of an "exogenous shock to product quality on prices in the airline industry" arises from a jurisdictive change in "take-off and landing restrictions" at "LaGuardia Airport". The relationship between price response and market competition has been investigated (Forbes, 2008). We examine the effectiveness of scenario-based models in a practical setting and present methodologies for creating and using scenario trees from empirical data in this paper (Liu et al., 2008). We prove, analytically, that the traditional approach to airport pricing is valid if air carriers have no market power, i.e., airlines are atomistic or they behave as price takers (perfect competition) and have constant marginal operational costs (Basso & Zhang, 2008). The methods used in this paper to control air traffic flow are extended to more realistic domains with coupled flow patterns that require a variety of control mechanisms (Agogino & Tumer, 2008). In this paper, we develop a family of "abstractions for flow restrictions" that can be implemented to address the "coordination of flow management procedures under realistic uncertainties" (e.g., "miles-in-trail restrictions", "ground delay programs", or "slot-based policies"). We can

evaluate the effects of various restrictions on general (uncertain) traffic flows using these abstractions, allowing us to create useful flow management strategies (Wan & Roy, 2008). In this paper, we provide an overview of the flow services, a set of decision support algorithms for cooperative air traffic planning, and the findings of a study to evaluate the potential of this methodology (Jha et al., 2008). In this article, we investigate the potential for real-time inter-modal substitution to lessen flight congestion and delays in scenarios where there is a temporary, serious shortage in airport capacity. The first of two schemes is to cancel short-haul flights and rebook passengers on surface transportation. The second entails picking nearby airports and hubs for surface transportation as well as alternate hubs and spoke airports (Y. Zhang & Hansen, 2008). This paper provides an overview of recent developments in the management of air traffic flow using multiagent coordination algorithms (Tumer & Agogino, 2008). The primary objective of the project being presented is to create a "novel laser tracking technology (SKY-Scanner System)" that can sense and track aircraft "up to at least 6 nautical miles" from the "Aerodrome Traffic Zone (ATZ) barycentre". This system will consist of enabling techniques, protocols, numerical prediction tools, and devices that are specifically made for the analysis of the performance of laser systems in ATC applications, with the ultimate goal of defining a new generation ATM paradigm (Salerno et al., 2008). This article describes how "Genetic Algorithms (GAs)" were used to solve the "ASS problem" in multi-runway structures. "The design of their evolutionary operators, particularly the crossover, presents the majority of existing GAs for ASS with problems related to feasibility and efficiency". The new GA described in this paper builds its chromosomes "based on the relationship between the following two aircraft". As a result, it is now possible to create highly effective operator-uniform crossovers, which are much more applicable than GAs that are designed solely using the order of aircraft in arrival queues (Hu & Di Paolo, 2009). We outline "an integrated decision-making framework and model" that we created to support "EUROCONTROL, the European air traffic management organization", in creating a single, unified European sky, which is a crucial task. We expand on the "broader decision framework and supporting methodologies" in this paper to aid EUROCONTROL in its "facilitation" role. Using our model and decision framework, EUROCONTROL is now choosing a set of improvements to the European aviation system that have been approved by all parties (Grushka-Cockayne & De Reyck, 2009). The distributed agent-based solution presented in this paper involves "agents making recommendations to human controllers". Although conceptually appealing, this strategy raises two significant research concerns. Prior to resulting in a system state, agent actions are first filtered through interactions with "other agents", "human controllers", and "the environment". An intricate learning problem is produced by this "indirect action-to-effect process". Second, not all air traffic controllers will be able or willing to follow the agents' recommendations, even in the best-case scenario (Agogino & Tumer, 2009). In this article, we demonstrate how "Metron Aviation, Inc. and the Volpe Transportation Centre" led operations research team: (i) created and used "system-simulation models" to determine the scope of the traffic flow management issue and to communicate its importance to the "Federal Aviation Administration (FAA) and the aviation sector"; (ii) created the "Airspace Flow Program (AFP)", a novel approach to handling air traffic that could resolve the issue within the constraints of a "condensed development cycle" and a "change-resistant" culture; (iii) created an "interactive simulation system" that could be and was used to develop policies on the use of a "decision support system" in order to hone and perfect this concept before deployment. (iv) used a series of interactive exercises with "FAA and airline traffic management experts" to develop the "final software design, operational procedures, and decision rules" for deployment and use; (v) offered a convincing analysis of the post-deployment benefits for the new traffic management strategy (Sud et al., 2009). In this article, we present a "stochastic integer programming model" for controlling incoming air traffic to an airport under bad weather conditions for both the airport and its approach routes. Decisions regarding the ground delay in the model are static, while those regarding rerouting are dynamic (Mukherjee & Hansen, 2009). The goal of this study is to assess the effects of the Controller Pilot Data-Link Communications (CPDLC) air traffic controller to pilot communication standard on upcoming air traffic operations (Introduction, 2009). This article gives a summary of the CACR ("COLLABORATIVE AIRSPACE CONGESTION RESOLUTION") capability and the analysis done to calculate the capability's benefits (Stalnaker et al., 2009). We discuss how reachability techniques and computer tools based on game theory were applied to a challenge in air traffic control (Margellos & Lygeros, 2009). This paper proposes a "linear integer programming (IP) model" that can predict pre-departure flight rerouting and departure delays in response to "deterministic airspace capacity constraints". It is shown how such a model can be used to lessen the imbalance between demand and capacity at an airport's Terminal Radar Approach Control (TRACON) (Mukherjee et al., 2009). This study shows how intelligent computing models are used in air traffic flow management (ATFM) (Weigang et al., 2010). The purpose of this study is to analyze team cognitive processes and team situation awareness for a team of en route air traffic controllers using the distributed cognition approach in normal (i.e., not accidental) situations in order to better understand current ATC systems (Inoue et al., 2010). This study looks at the interactions between "human performance factors in air traffic control (ATC)" and how they affect one another. In order to better understand how air traffic controllers interact with other human performance factors such as other controllers, software, hardware, environment, and organizations, the paper extends the conceptual SHEL model of ergonomics (Chang & Yeh, 2010). In this paper, the issue of air travel congestion is discussed. The clogged related delays at airports and along the route are the main focus. Long-term solutions include increasing infrastructure spending, but in this article the focus is on short-term operational strategies that can be used to make the best use of already available capacity (Roosens, 2010).

Simply relying on mono-objective programming to address issues like “departure slot”, “flight route”, and “Air Traffic Control (ATC) workload” cannot meet the need of the air traffic flow management due to an increasing number of flight delays brought on by the rising air traffic demands. This study develops a multi-objective, non-linear model that takes into account all of the aforementioned issues as well as the variables that influence airspace congestion and flight delays. To solve this model, a multi-objective genetic algorithm is then developed (Tian & Hu, 2010). In order to support Air Traffic Management (ATM) operations, we investigate the problem of characterizing the complexity of air traffic in this article. In particular, we discuss the pertinent characteristics of a complexity metric in advanced automated ATM systems where trajectory management functions are further automated and distributed and where part of the responsibility for separation maintenance is delegated to the aircrews (Prandini et al., 2010). This essay addresses the air traffic management issue of collision avoidance. The challenge is determining the best approach for new aircraft configurations (velocity and altitude changes) so that all airspace conflicts, or the loss of the minimal safety distance that must be maintained between two aircraft, are avoided (Alonso-Ayuso et al., 2011). We simulate and examine the procedure for boarding an airplane. We demonstrate how the model generates closed-form estimates for the anticipated boarding time in numerous relevant cases (Berend, 2016).

*2011-2015:*

We suggest a mechanism for slot allocation that is based on market principles in the case of a single confined en-route sector or airport since it allows airlines to pay for delay reduction or receive compensation for delay increase. (Castelli et al., 2011). This article tries to prevent the loss of flow capacity caused by merges when rerouting air traffic around locations with bad weather. (Devasia, 2011). The purpose of this paper is to highlight the most pertinent fleet management issues in relation to various modes of transportation, each of which has unique features, and to provide a summary of current advancements in the creation of mathematical models and computer methods. (Bielli et al., 2011). The model solves for an ideal mix of flow management operations, including ground-holding, rerouting, speed control, and airborne holding on a flight-by-flight basis. It includes all phases of each flight, i.e., departure, en route cruising, and landing. The model's ability to make rerouting decisions is one of its distinctive characteristics. This is accomplished by imposing sets of "local" criteria that allow for the compact representation of rerouting choices by simply adding a few more restrictions. (Bertsimas et al., 2011). The proposed concept for automated conflict identification and resolution for the next-generation air transportation system's network structure was examined. This analysis sheds light on the compromises made by various collaborative operating ideas, including compromises made between anticipated conflicts, communication needs, and vulnerability to targeted attack. (Chen et al., 2011). This study offers a comprehensive mathematical model for air traffic flow management (ATFM), a significant issue in both Europe and the US. The model advances prior methods by simultaneously accounting for three significant issues: I it explicitly incorporates uncertainty in airport capacity; (ii) it also takes into account the trade-off between airport arrivals and departures, which is a crucial issue in any hub airport; and (iii) it accounts for interactions between various hubs (Andreatta et al., 2011). In this paper, we attempt to summarize the impact of technologies, particularly intelligent transportation system (ITS) technologies, on transportation research over the course of the last several decades and offer perspectives on how the availability and development of new ITS technologies may affect future transportation research. (Ran et al., 2012). The challenge of controlling takeoff and landing operations in the presence of traffic disturbances at a congested Terminal Control Area is addressed in this work (TCA). Aircraft timing and routing decisions are examples of potential aircraft conflict detection and resolution activities. The reduction of delay propagation, which could shorten flight times and save energy for the aircraft, is a key goal for traffic controllers. We describe an optimization-based decision support system built on a rolling horizon framework to enhance the efficiency of air traffic monitoring and control in a busy TCA. (Samà et al., 2012). With the ultimate goal of better accommodating airlines' preferences at coordinated airports by minimizing the difference between the requested and the allocated slot times to airlines, the purpose of this paper is to develop an optimisation-based model implementing the existing EU/IATA rules, operational constraints, and coordination procedures. (Zografos et al., 2012). This article initially discusses a variety of ways for achieving improvement through small capacity gains and improved demand and capacity management. The following section outlines tactical actions that may be taken every day in response to dynamic, "real-time" situations like bad weather or schedule interruptions as well as long-term strategic projects that airlines and civil aviation authorities may take on. (Barnhart et al., 2012). In this paper, a new TFM method is presented that is motivated by swarm theory and transforms pilots into goal-seeking agents. These agents each seek local solutions to the optimization problem, and collectively, the agents' actions produce emergent behavior that naturally tends to converge to a Pareto-efficient state. (Torres, 2012). We provide a decision-support framework based on ground delay, rerouting, and flight cancellation for air traffic control flight rescheduling. This method is based on modeling air traffic networks with Time Petri Nets (TPN). To depict the state space of Time Petri Nets, we provide a tool based on Binary Decision Diagrams. This technique, known as Time Ordered Binary Decision Diagrams (TOBDDs), allows for the efficient manipulation of this collection by representing a huge state space of a TPN with a compact data structure. (Ali et al., 2012). This essay looks at how academics who publish on aviation have changed their interests over time. The material in the field is field organized and its chronological evolution is studied using the systematic literature review approach. (Ginieis et al., 2012). The report compares traffic with capacity for the largest 1000 airports in the global network to analyze the general capacity limitation issue. We identify airports that currently

have capacity issues and those that will in the near future by extracting peak hour volumes and capacity utilization indices from annual volumes. (Gelhausen et al., 2013). We provide a decision-support framework for air traffic control based on ground delay, altering the initial flight, and canceling flights. This method is based on modeling air traffic networks with Time Petri Nets (TPN). To represent the state space of a class of Time Petri Nets, we provide a tool based on Binary Decision Diagrams. This tool, known as the Time Reduced Ordered Binary Decision Diagram (T-ROBDD), allows for the efficient manipulation of this collection by representing a huge state space of a TPN with a tiny data structure. (Ali et al., 2013). This article examines the several applications, technologies, and sectors of the Intelligent Transport System. This literature review's goal is to integrate and synthesize a few topics, applications, and technology to talk about with all potential customers. (Qureshi & Abdullah, 2013). In this essay, we examine some current strategies for air travel that heavily rely on the theory of complex networks. We talk about potential networks that may be defined for air travel and we concentrate on networks of airports that are connected by flights. (Zanin & Lillo, 2013). The recent advancements in reinforcement learning and its reward system for ATFM decision-making are presented in this work. For the application of agent-based RL in air traffic management, two types of reward functions are proposed: (1) Reward function considering safety separation and the impact of fairness among various commercial entities in Ground Holding Problem (GHP) and (2) Reward function considering safety separation in Air Holding Problem (AHP). (Cruciol et al., 2013). This white paper offers a thorough analysis of what has been accomplished thus far and forecasts what can be accomplished in the future. (Isaacson et al., 2014). An organized summary of the multimodal transportation literature from 2005 and after is provided in this study. We describe the pertinent models and their refined solution methodologies, concentrating on the conventional strategic, tactical, and operational levels of planning. (Steadieseifi et al., 2014). The main objective of the paper, which is to formulate mathematically a general problem of conceptually defining, creating, and using a schedule for PATOs that contains a description of merging sequences and provides aircraft separation continuously in time, determines how the paper will be structured. (Isaacson et al., 2014). This study provides a thorough empirical investigation of the effects of flight delays on costs and frequency of flights in the US air transportation system. We model airfare and flight frequency as factors of origin, destination, and intermediate hub airport cost and demand characteristics, competitive impacts, and flight delays. (Zou & Hansen, 2014). Data envelopment analysis is used to determine cost efficiency in the first stage of the analysis, and regression analysis is used to determine the environmental impact in the second stage, to determine the combined impact of ownership form, economic regulation, and competition on airport performance. (Adler & Liebert, 2014). The Calculated Take-Off Times (CTOTs) are used in this study as a method for minimizing the propagation of perturbations between trajectories that can easily emerge in crowded sectors. This allows for the presentation of various difficult results. (Nosedal et al., 2014). We employ queueing techniques to empirically investigate Japan's flow strategy in an effort to understand how the observed delays are produced. On the basis of this, we derive a rule to more effectively balance ground and en-route congestion delays. (Gwiggner & Nagaoka, 2014). In this research, we solve two sub-problems for the ALP with a single runway and suggest a novel decomposition-based method (Vadlamani & Hosseini, 2014). Multivariate statistical models were created based on airport utility in order to effectively contribute to an accelerated air traffic flow management (ATfM). The daily odds of airport delays and inefficiencies were calculated using parameterized statistical models, and the utility functions were constructed from those results. (Wesonga, 2015). This article proposes an integrated strategy that, while taking scheduling, capacity, and delay-reduction limitations into consideration, simultaneously optimizes the airport's flight schedule at the strategic level and the tactical level of airport capacity utilization. In order to reduce congestion costs, the runway configuration and the balance of arrival and departure service rates must be controlled. (Jacquillat & Odoni, 2015). Various air traffic control (ATC) strategies applied to the current or proposed airport layout are discussed in this study in relation to airport traffic complexity, time efficiency, and environmental efficiency. Evaluation of airport traffic complexity, aircraft fuel use, gas emissions, and time efficiency for various ATC strategies and/or airport airfield layouts are prioritized. (Krstić Simić & Babić, 2015). In this research, the two types of congestion are jointly modeled and connected. This is accomplished by using a simpler static congestion model for the runway and a deterministic bottleneck model to characterize passenger behaviour at the terminal. (Wan et al., 2015). The newly developed Active Routing idea is included into a multi-objective integrated optimization problem in this research. This new model, which was created using methodical perspectives, integrates a number of components, including 4-Dimensional aircraft scheduling and routing. (Weiszer et al., 2015). We present an optimization model to help aviation authorities make strategic decisions about the long-term growth of an airport network. The goal is to maximize total system throughput within a specific budget while taking into account demand, airport capacity, and the influence of travel costs. (Santos & Antunes, 2015). A deregulated aviation industry adds a further layer of complexity to potential demand swings. A deterministic total cost reduction model is put forth to address this issue, and it is subsequently expanded into stochastic programmes by taking traffic forecast uncertainty into account. (Sun & Schonfeld, 2015). In this study, an optimization method for dynamic aircraft scheduling is presented. The method aids air traffic controllers in choosing and executing landing and takeoff schedules at airports that are both practical and practicable from an operational standpoint. It displays appropriate computation timeframes for reaching the ideal outcome. (Murça & Müller, 2015). This essay reviews the literature on fuel consumption optimization (FCO) in the field of aviation and discusses classification schemes, criticism, a straightforward meta-analysis, and implications for future

study. (Singh & Sharma, 2015). With examples of its relevant metrics on various scales, examples of complex network theory are shown. Selected, applied air traffic management case studies are examined to demonstrate how complexity science is beginning to make significant contributions to performance assessment and system design. (Cook et al., 2015). The authors suggest a flight flow dynamic adjustment and distribution model based on predatory thought and build an en-route traffic load balance model in order to improve the flow distribution restrictions brought on by the static air traffic flow distribution mode and alleviate conflicts between the current flight traffic demand and the resource constraints of airspace. (Zhang et al., 2015). In this study, a sequential capacity allocation mechanism in a congested transportation system is modeled using game theory. In this specific application, we examine the guiding principles at play in how airlines will time their requests for en route resources under capacity shortages and uncertain circumstances, when flights are unable to take their preferred route at their preferred departure time slot because of the shortages. (Kim & Hansen, 2015).

*2016-2022:*

The addition of avoidance of conflict in the creation of a strategy for taxi operations with a goal to reduce fuel use as much as possible while maximizing the desired level of service. (Soltani et al., 2020)

The topic of coordinating aircraft ground and air operations in an airport region in real time is discussed in the study. Airborne decisions at a crowded airport involve take-off and landing procedures, whereas ground (taxiway) decisions involve planning aircraft movements between the gates and the runways. (Samà et al., 2017) The synchronization between aerial scheduling and taxiway scheduling is examined in this work along with models, methodologies, and policies for improvement. The delay and travel time associated with an aircraft's energy consumption are used to gauge a solution's performance. It is decided to use a tiny mathematical formulation to arrive at trustworthy answers. Based on practical-size, the various policies have been analyzed in conjunction with exact and heuristic techniques. Examples from the Netherlands' Amsterdam Schiphol airport. Experience with computation demonstrates that there are viable answers within compatible with real-time operations; limited time. (Samà et al., 2017).

A suitable demand-capacity balancing on both the local and global levels is the primary tenet of corresponding flow management. In the Asia-Pacific area, they offer an operational model that is centered on long-range air traffic flow management. The coordination of long-haul international flights necessitates coordination between several flight information areas and local laws. (Schultz et al., n.d.)

“To demonstrate our approach, we choose Singapore Changi International Airport and use aircraft-transmitted positional data and flight plan information.” (Schultz et al., n.d.)

“The research describes an efficient and expandable model for allocating Standard Terminal Arrival Route during Continuous Descent Approach (CDA) that effectively uses performance-based Navigation (PBN) requirements.” (Enayatollahi et al., 2021)

Atlantis International Airport has been used as an example to demonstrate the same. (Enayatollahi et al., 2021)

The Multi-layer Air Traffic Network Delay (MATND) model is being introduced by the authors. This model is created using both a data-driven strategy that uses flight schedules and aircraft tracking data as inputs to characterize a national air traffic network and a system-level model approach that bases the delay process on queueing theory. (Lin et al., 2021)

Through the integrated control of arrivals and departures, the paper addresses the issues of terminal airspace management and airport congestion management at the macroscopic level. A predetermined terminal route structure is used in conjunction with conflict detection and resolution techniques. The modeling of various airside components makes use of network abstraction. Utilizing an optimization strategy, speed, arrival and departure timings, and runway assignment are managed. To address the issue, a time decomposition method and an adjusted simulated annealing heuristic are suggested. (Ma et al., n.d.)

The Paris Charles De-Gaulle airport has been used as a case study. (Ma et al., n.d.)

This paper introduces the concept of Line Maintenance Scheduling Problem (LMSP)(Shaukat et al., 2020)

The LMSP determines the commencement time for each job and distributes jobs to available maintenance opportunities that are determined by aircraft routes. Its goal is to keep this timetable as close to the deadlines for each task as possible while never going over the airports' resource capabilities. (Shaukat et al., 2020)

By taking operational efficiency and airline interests into account, the paper suggests a data-driven method to reduce operational delays at a strategic level. (Zeng et al., 2021)

The proposed model is applied to Hangzhou Xiaoshan International Airport in China. (Zeng et al., 2021)

The paper critically reviews the field to determine which Air Traffic Flow Management (ATFM) research and development efforts hold the best promise for practical technological implementations, offering clear benefits both in terms of enhanced safety and efficiency in times of growing air traffic. (Kistan et al., 2017)

The ideal Required Time for Arrivals (RTAs) for electric Vertical Take-Off and Landing eVTOLs are computed in this work using a mixed-integer linear programme, which is the first to do so to minimum delay determined by the battery's remaining state of charge, vertiport capacity, etc. A vertiport operational idea of creating the terminal area airspace design by utilizing the current technology for energy-efficient trajectory optimization. (Kleinbekman et al., 2018)

NASA is evaluating an integrated arrival, departure, and surface (IADS) traffic management system as part of the Airspace Technology Demonstration-2.traffic scheduling throughout a flight's whole life cycle from one gate to the next inside a multi-airport metroplex environment.(Coupe et al., n.d.)

The paper examines the project's technical innovation, background in construction, construction content, and current issues from the standpoint of process management system

construction. (Zhuang et al., 2021)

In the paper, the authors present a two-stage network ATFM approach that takes into account fairness and airline cooperation. (Bertsimas & Gupta, 2016)

The purpose of this study is to add to ongoing research on slot allocation process enhancements that may be logically applied in practice to increase efficiency, fairness, and transparency. The authors give a critical analysis of the existing quo and literature for that aim, based on these slot allocation methodologies and recent studies with demand and congestion management viewpoints by taking into account general socioeconomic, examine hypothetical, computational, and real-world scenarios related to passenger welfare, airline, and airport surplus, and difficulties brought on by cross-disciplinary approaches. (Cavusoglu & Macário, 2021)

This work identifies the key methods by which each constraint to control the scale of the service (i.e., the number of Urban Air Mobility (UAM) operations in a region) emerges. Each of the mechanisms' influencing technical, ecological, or operational aspects is also noted. The relationships between the limitations are displayed. (Vascik & Hansman, 2018)

Paper offers potential methods for reducing constraint severity by modifying the processes. The severity of each operational limitation is then attempted to be described as a function of the density of UAM activities in the region of interest. (Vascik & Hansman, 2018)

The study examines high-dimensional data from Beijing International Airport and offers a useful model for forecasting aircraft delays. A novel deep belief network method is used to mine the internal patterns of flight delays after taking a multifactor approach. (Yu et al., 2019)

In an airport with a mixed operation runway, under wake vortex separation and constrained position shifting restrictions, the major goal of the research is to design an algorithm with very low processing times capable of minimizing delays in the scheduled times of arrival and departure flights. (Rodríguez-Díaz et al., n.d.)

The proposed Collaborative Air Traffic Flow Management framework for synchronized demand-capacity balancing is presented in this study. The strategy aims to achieve more synchronized scheduling of airspace layout and traffic flow optimization. (Xu et al., n.d.)

The literature on the hotspot problem is small, with only a few papers dealing with somewhat related problems (of which an over [1] view can be found in Zhong (2018)). None of these papers matches exactly with the Hotspot Problem. (Mannino et al., 2021)

During the last decades, intensive researches have been carried out on the ATNFO problem (Cai et al., 2017).

## 3. Research Methodology and Analysis

We have carried out extensive research on Air Traffic Control and Reducing Congestion by taking airport capacity, routes of flights and their release time into account. We have used 'EBSCO host', 'Science Direct', 'Google Scholar', 'ResearchGate' and other websites to collect approximately 200 Research Papers for our analysis. To find these papers, we used some key words such as 'Air Traffic Control', 'Congestion', 'Operations' and 'Research'.

This Bibliometric Paper is done for the years starting from 1996 till 2022, which helps us to cover a wide range of information over a period of time, so that we can do our analysis in a much better way. The charts and Graph were obtained from a software called VOS Viewer, which were then analyzed by us.

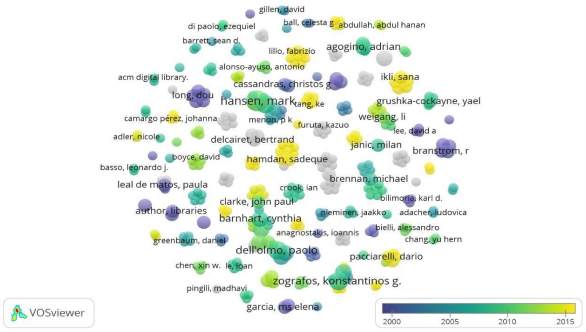


Fig. 1. Authors whose papers we referred (Year-wise)

Figure 1 represents the year wise citation network of contributed articles on the basis of authors. Following table shows the leading authors for the respective years.

Table 1

| | |
|---|---|
| 2000 | Long dou |
| 2005 | Dell'olmo, paolo |
| 2010 | Hasnen, mark |
| 2015 | Hamdan, sadeque |

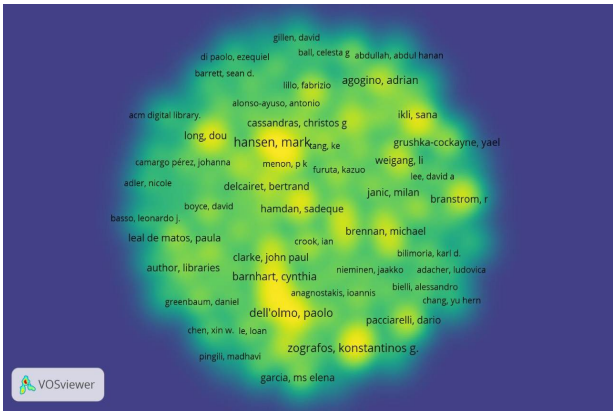


Fig. 2. No. of research papers used by the authors

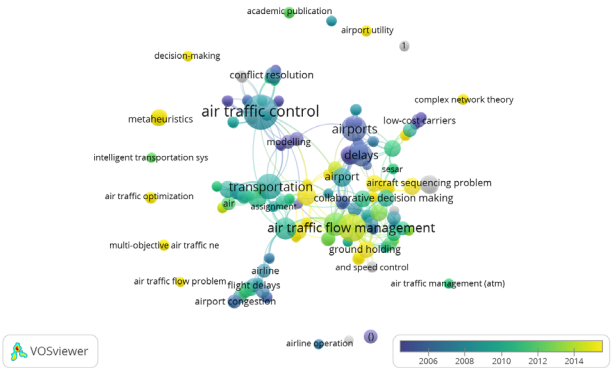


Fig. 3. Keywords used in the analysis and their repetition in different years

Figure 3 represents the year wise citation network of keywords used in contributed articles. Following table shows top keywords used for the respective years.

Table 2

| | |
|---|---|
| 2006 | airports |
| 2008 | Air traffic control |
| 2010 | transportation |
| 2012 | assignment |
| 2014 | Air traffic flow management |

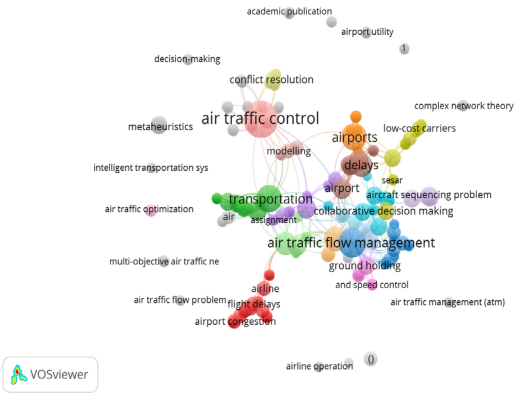


Fig. 4. Different Keywords used in the Analysis

Figure 4 presents the keyword network obtained from the keywords used in each of the contributing articles. This represents that Air traffic control, airports, delays, transportation, Air traffic flow management are the top keywords used in contributed articles.

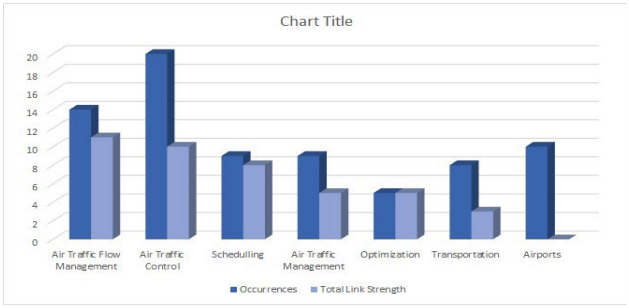


Fig. 5. Occurrence of keywords and their total link strength

We can see in Figure 5 that keywords such as “Air Traffic Flow Management”, “Scheduling”, “Air Traffic Management”, “Optimization”, “Transportation” and “Airports” are used the most in our paper, where “Air Traffic Control” is used the most and the “Total Link Strength” of “Air Traffic Flow Management” is the highest, followed by “Air Traffic Control”, meaning these words are strongly related to the analysis work.

## 4. Conclusion and Future Work

This research reviewed the literature on air traffic control and how to lessen traffic by accounting for airport capacity, airline routes, and departure times. There are extremely few review articles published, despite the fact that there have been many publications published in the field of air traffic management. There was a lack of a thorough literature assessment and analysis of the changes in air traffic control over the years. This is the first attempt to assess the techniques used to manage air traffic and lessen congestion utilizing transportation issues and operation research, adding to the academic conversation on the subject. We would like to highlight certain study limitations and suggest some potential future research areas before we conclude. Currently, just three databases—EBSCO Host, science direct, and Google Scholar—have been used for the study. As a result, potential supplementary sources of knowledge and information like conference proceedings or books that are not indexed in the three databases have been left out. Additionally, the research was restricted to those publications that were published in English, potentially omitting local contributions that were translated into other languages.

We the authors have tried to throw light on the problem of Air traffic control and thus to reduce its congestion by taking airport capacity, routes of flights and their release time into account. Throughout the years there have been various methods introduced to tackle this globally faced issue, but there has not been full-fledged implementation to get the optimum results in real life.

## References

[1] Ageeva, Y. (2000). *Approaches to incorporating robustness into airline scheduling*. https://dspace.mit.edu/handle/1721.1/8930

[2] Anagnostakis, I. (2001). Runway Operations Planning and Control Sequencing and Scheduling.

[3] Anagnostakis, I., Idris, H. R., Clarke, J.-P., Feron, E., Hansman, R. J., Odoni, A. R., & Hall, W. D. (2000). A Conceptual Design of A Departure Planner Decision Aid. *Europe Air Traffic Management R&D Seminar Napoli*, 13–16. https://dspace.mit.edu/handle/1721.1/37321

[4] Andreatta, G., & Brunetta, L. (1998). Multiairport Ground Holding Problem: A Computational Evaluation of Exact Algorithms. *46*(1), 57–64. https://doi.org/10.1287/opre.46.1.57

[5] Bertsimas, D., & Odoni, A. (1997). a critical survey of optimization models for tactical and strategic aspects of air traffic flow management - NASA Technical Reports Server (NTRS). https://ntrs.nasa.gov/api/citations/19980004146/downloads/19980004146.pdf.

[6] Bertsimas, D., & Patterson, S. S. (1998). The Air Traffic Flow Management Problem with Enroute Capacities. *46*(3), 406–422. https://doi.org/10.1287/opre.46.3.406

[7] Bertsimas, D., & Patterson, S. S. (2000). The Traffic Flow Management Rerouting Problem in Air Traffic Control: A Dynamic Network Flow Approach., *34*(3), 239–255. https://doi.org/10.1287/TRSC.34.3.239.12300

[8] Bianco, L., Dell’Olmo, P., & Giordani, S. (1999). Minimizing total completion time subject to release dates and sequence-dependent processing times. *Annals of Operations Research 1999 86:0*, *86*(0), 393–415. https://doi.org/10.1023/A:1018975323093

[9] Bushey, D. E., & Malloy, B. A. (1997). Study of dynamic traffic re-routing in the National Airspace System. *Proceedings of the IEEE Annual Simulation Symposium*, 104–113. https://doi.org/10.1109/SIMSYM.1997.586499

[10] Chin, D. K., Goldberg, J., & Tang, T. (1997). airport surface delays and causes: a preliminary analysis - NASA Technical Reports Server (NTRS). https://ntrs.nasa.gov/citations/19970041407

[11] Clot, A. J. (2000). *Airspace Policy and Air Traffic Management*. https://apps.dtic.mil/sti/citations/ADP010753

[12] Grandeau, S. C., Clarke, M. D., & Mathaisel, D. F. X. (1998). *The Processes of Airline System Operations Control*. 312–369. https://doi.org/10.1007/978-1-4615-5501-8_11

[13] Hall, W. D. (William D. 1968-. (1999). *Efficient capacity allocation in a collaborative air transportation system*. https://dspace.mit.edu/handle/1721.1/8786

[14] Hoffman, R. L. (1997). *Integer programming models for ground-holding in air traffic flow management - ProQuest*. https://www.proquest.com/openview/558c3c072e6433b467a896d3d91b21f0/1?pq-origsite=gscholar&cbl=18750&diss=y

[15] Khan, K. A. (1998). Air traffic management and conflict analysis for reusable launch vehicles. https://dspace.mit.edu/handle/1721.1/50473

[16] Kim, I. D. (1996). *Airport airside capacity analysis: Fuzzy inference system for air traffic controllers' decision process - ProQuest*. https://www.proquest.com/openview/4219a08ff43e119fccbc2789563031a6/1?pq-origsite=gscholar&cbl=18750&diss=y

[17] Lan, S. 1970-. (2003). Planning for robust airline operations: Optimizing aircraft routings and flight departure times to achieve minimum passenger disruptions. https://dspace.mit.edu/handle/1721.1/17568

[18] Laudeman, I. v., Shelden, S. G., Branstrom, R., & Brasil, C. L. (1998). *dynamic density: an air traffic management metric - NASA Technical Reports Server (NTRS)*. https://ntrs.nasa.gov/citations/19980210764

[19] le Sellier, F. 1974-. (1999). *Discrete real-time flight plan optimization*. https://dspace.mit.edu/handle/1721.1/50629

[20] Leal De Matos, P. A. (1998). *The Development of Decision Support Models for European Air Traffic Flow Management*. http://go.warwick.ac.uk/wraphttp://go.warwick.ac.uk/wrap/2547

[21] Leal de Matos, P., & Ormerod, R. (2000). The application of operational research to European air traffic flow management – understanding the context. *European Journal of Operational Research*, *123*(1), 125–144. https://doi.org/10.1016/S0377-2217(99)00084-3

[22] Lee, D. A., Nelson, C., Shapiro, G., Nelson, C., & Shapiro, G. (1998). the aviation system analysis capability airport capacity and delay models.

[23] Long, D., Lee, D., Gaier, E., Johnson, J., & Kostiuk, P. (1999). a method for forecasting the commercial air traffic schedule in the future - NASA Technical Reports Server (NTRS). https://ntrs.nasa.gov/citations/19990032102

[24] Lucertini, M., Smriglio, S., & Telmon, D. (1997). *Network Optimization in Air Traffic Management*. 91–112. https://doi.org/10.1007/978-3-642-60836-0_5

[25] Luo, S., & Yu, G. (1998). Airline Schedule Perturbation Problem: Landing and Takeoff with Nonsplitable Resource for the Ground Delay Program. 404–432. https://doi.org/10.1007/978-1-4615-5501-8_14

[26] MacLeod, G. M. (1998). *Airport congestion in New Zealand*. https://researcharchive.lincoln.ac.nz/handle/10182/3163

[27] Mavris, D., & Garcia, E. (2000). *Framework for the assessment of capacity and throughput technologies*. https://doi.org/10.2514/6.2000-5612

[28] Nutakor, C. (2016). Proposed Air Traffic Control Strategies to Reduce Airport Delay and Improve Capacity: *5*(2), 126–134. https://doi.org/10.1177/1087724X0052006

[29] Panayiotou, C. G., & Cassandras, C. G. (1999). Sample path approach for solving the ground-holding policy problem in air traffic control. *Proceedings of the IEEE Conference on Decision and Control*, *3*, 2450–2455. https://doi.org/10.1109/CDC.1999.831293

[30] Perry, T. S. (1997). In search of the future of air traffic control. *IEEE Spectrum*, *34*(8), 18–35. https://doi.org/10.1109/6.609472

[31] Barnier, N., Brisset, P., & Rivière, T. (2001). Slot Allocation with Constraint Programming: Models and Results. *ATM Seminar*.

[32] Sridhar, B., Chatterji, G. B., Grabbe, S., & Sheth, K. (2002). Integration of traffic flow management decisions. *AIAA Guidance, Navigation, and Control Conference and Exhibit*, *August*, 1–9. https://doi.org/10.2514/6.2002-5014

[33] Stamatopoulos, M. A., Zografos, K. G., & Odoni, A. R. (2004). A decision support system for airport strategic planning. *Transportation Research Part C: Emerging Technologies*, *12*(2), 91–117. https://doi.org/10.1016/j.trc.2002.10.001

[34] Upham, P., Thomas, C., Gillingwater, D., & Raper, D. (2003). Environmental capacity and airport operations: Current issues and future prospects. *Journal of Air Transport Management*, *9*(3), 145–151. https://doi.org/10.1016/S0969-6997(02)00078-9

[35] Van Leeuwen, P., Hesselink, H., & Rohling, J. (2002). Scheduling aircraft using constraint satisfaction. *Electronic Notes in Theoretical Computer Science*, *76*, 252–268. https://doi.org/10.1016/S1571-0661(04)80797-7

[36] Agogino, A., & Tumer, K. (2008). Regulating air traffic flow with coupled agents. *Proceedings of the International Joint Conference on Autonomous Agents and Multiagent Systems, AAMAS*, *1*(Aamas), 526–533.

[37] Agogino, A., & Tumer, K. (2009). Learning indirect actions in complex domains: Action suggestions for air traffic control. *Advances in Complex Systems*, *12*(4–5), 493–512. https://doi.org/10.1142/s0219525909002283.

[38] Alonso-Ayuso, A., Escudero, L. F., & Martín-Campo, F. J. (2011). Collision avoidance in air traffic management: A mixed-integer linear optimization approach. *IEEE Transactions on Intelligent Transportation Systems*, *12*(1), 47–57. https://doi.org/10.1109/TITS.2010.2061971

[39] Artiouchine, K., Baptiste, P., & Dürr, C. (2008). Runway sequencing with holding patterns. *European Journal of Operational Research*, *189*(3), 1254–1266. https://doi.org/10.1016/j.ejor.2006.06.076

[40] Ball, M., Barnhart, C., Nemhauser, G., & Odoni, A. (2007). Chapter 1 Air Transportation: Irregular Operations and Control. *Handbooks in Operations Research and Management Science*, *14*(C), 1–67. https://doi.org/10.1016/S0927-0507(06)14001-3

[41] Basso, L. J., & Zhang, A. (2008). On the relationship between airport pricing models. *Transportation Research Part B: Methodological*, *42*(9), 725–735. https://doi.org/10.1016/j.trb.2008.01.005

[42] Berend, D. (2016). *of Airplane*. *57*(2), 499–513. https://doi.org/10.1287/opre.

[43] Bianco, L., Dell'Olmo, P., & Giordani, S. (2006). Scheduling models for air traffic control in terminal areas. *Journal of Scheduling*, *9*(3), 223–253. https://doi.org/10.1007/s10951-006-6779-7

[44] Chang, Y. H., & Yeh, C. H. (2010). Human performance interfaces in air traffic control. *Applied Ergonomics*, *41*(1), 123–129. https://doi.org/10.1016/j.apergo.2009.06.002

[45] Deshpande, M., Greiner, K. B., & Gilbert, J. R. (2006). a Nalysis of M Ulticomponent S Ample T Ransport in E Lectrokinetic. 11(617).

[46] Doble, N. A., Brennan, M., Arora, N., Ermatinger, C., & Clover, S. (2006). Simulation and operational analysis of airspace flow programs for traffic flow management. *Collection of Technical Papers - 6th AIAA Aviation Technology, Integration, and Operations Conference*, *2*(September), 1199–1208. https://doi.org/10.2514/6.2006-7828

[47] Evans, J. E., Weber, M. E., & Moser, W. R. (2006). Integrating Advanced Weather Forecast into Air Traffic Management Decision Support. *Lincoln Laboratory Journal*, *16*(1), 81–96.

[48] Forbes, S. J. (2008). The effect of air traffic delays on airline prices. *International Journal of Industrial Organization*, *26*(5), 1218–1232. https://doi.org/10.1016/j.ijindorg.2007.12.004

[49] Grushka-Cockayne, Y., & De Reyck, B. (2009). Towards a single european sky. *Interfaces*, *39*(5), 400–414. https://doi.org/10.1287/inte.1090.0436

[50] Grushka-Cockayne, Y., Reyck, B. De, & Degraeve, Z. (2008). An integrated decision-making approach for improving European air traffic management. *Management Science*, *54*(8), 1395–1409. https://doi.org/10.1287/mnsc.1080.0878

[51] Hall, R., Tumer, K., & Field, M. (2007). Distributed Agent-Based Air Traffic Flow Management Categories and Subject Descriptors. *Optimization*, *5*, 342–349.

[52] Howe, B., Richardson, C., Rigdon, M., Russell, S., Sprague, S., Donohue, G., & Wieland, F. (2003). Potential air traffic congestion solution: Slot allocation by auction method. *Proceedings of the 2003 IEEE Systems and Information Engineering Design Symposium, SIEDS 2003*, 67–75. https://doi.org/10.1109/SIEDS.2003.158006

[53] Hu, X. B., & Di Paolo, E. (2009). An efficient genetic algorithm with uniform crossover for air traffic control. *Computers and Operations Research*, *36*(1), 245–259. https://doi.org/10.1016/j.cor.2007.09.005

[54] Inoue, S., Furuta, K., Kanno, T., Aoyama, H., & Nakata, K. (2010). Cognitive process modelling of team cooperative work in en route air traffic control. In *IFAC Proceedings Volumes (IFAC-PapersOnline)* (Vol. 11, Issue PART 1). IFAC. https://doi.org/10.3182/20100831-4-fr-2021.00005

[55] Introduction, I. (2009). Benefits in Congested Airport Terminal Area. August, 1–20.

[56] Janic, M. (2007). A heuristic algorithm for the allocation of airport runway system capacity. *Transportation Planning and Technology*, *30*(5), 501–520. https://doi.org/10.1080/03081060701599995

[57] Janic, M. (2008). Modelling the capacity of closely-spaced parallel runways using innovative approach procedures. *Transportation Research Part C: Emerging Technologies*, *16*(6), 704–730. https://doi.org/10.1016/j.trc.2008.01.003

[58] Jha, P. D., Suchkov, A., Crook, I., Tibichte, Z., Lizzi, J., & Subbu, R. (2008). NextGen collaborative air traffic management solutions. *AIAA Guidance, Navigation and Control Conference and Exhibit*, *August*, 1–12. https://doi.org/10.2514/6.2008-6329

[59] Johnson, T., & Savage, I. (2006). Departure delays, the pricing of congestion, and expansion proposals at Chicago O'Hare Airport. *Journal of Air Transport Management*, *12*(4), 182–190. https://doi.org/10.1016/j.jairtraman.2006.01.006

[60] Kemppainen, K., Nieminen, J., & Vepsäläinen, A. P. J. (2007). Estimating the costs of airport congestion due to fast connections. *Journal of Air Transport Management*, *13*(4), 169–174. https://doi.org/10.1016/j.jairtraman.2007.02.002

[61] Kohl, N., Larsen, A., Larsen, J., Ross, A., & Tiourine, S. (2007). Airline disruption management-Perspectives, experiences and outlook. *Journal of Air Transport Management*, *13*(3), 149–162. https://doi.org/10.1016/j.jairtraman.2007.01.001

[62] Lan, S., Clarke, J. P., & Barnhart, C. (2006). Planning for robust airline operations: Optimizing aircraft routings and flight departure times to minimize passenger disruptions. *Transportation Science*, *40*(1), 15–28. https://doi.org/10.1287/trsc.1050.0134

[63] Le, L., Donohue, G., Hoffman, K., & Chen, C. H. (2008). Optimum airport capacity utilization under congestion management: A case study of New York LaGuardia airport. *Transportation Planning and Technology*, *31*(1), 93–112. https://doi.org/10.1080/03081060701835779

[64] Liu, P. chen B., Hansen, M., & Mukherjee, A. (2008). Scenario-based air traffic flow management: From theory to practice. *Transportation Research Part B: Methodological*, *42*(7–8), 685–702. https://doi.org/10.1016/j.trb.2008.01.002

[65] Lulli, G., & Odoni, A. (2006). The European air traffic flow management problem. *IFAC Proceedings Volumes (IFAC-PapersOnline)*, *11*(PART 1), 96–100. https://doi.org/10.3182/20060829-3-nl-2908.00017

[66] Madas, M. A., & Zografos, K. G. (2006). Airport slot allocation: From instruments to strategies. *Journal of Air Transport Management*, *12*(2), 53–62. https://doi.org/10.1016/j.jairtraman.2005.08.001

[67] Margellos, K., & Lygeros, J. (2009). Air traffic management with target windows: An approach using reachability. *Proceedings of the IEEE Conference on Decision and Control*, 145–150. https://doi.org/10.1109/CDC.2009.5400119

[68] Marín, Á. G. (2006). Airport management: Taxi planning. *Annals of Operations Research*, *143*(1), 191–202. https://doi.org/10.1007/s10479-006-7381-2

[69] Mukherjee, A., Grabbe, S., & Sridhar, B. (2009). Arrival Flight Scheduling through Departure Delays and Reroutes. *Air Traffic Control Quarterly*, *17*(3), 223–244. https://doi.org/10.2514/atcq.17.3.223

[70] Mukherjee, A., & Hansen, M. (2009). A dynamic rerouting model for air traffic flow management. *Transportation Research Part B: Methodological*, *43*(1), 159–171. https://doi.org/10.1016/j.trb.2008.05.011

[71] Mulgund, S., Wanke, C., Greenbaum, D., & Sood, N. (2006). A genetic algorithm approach to probabilistic airspace congestion management. *Collection of Technical Papers - AIAA Guidance, Navigation, and Control Conference 2006*, *3*(August), 1663–1679. https://doi.org/10.2514/6.2006-6226

[72] Prandini, M., Putta, V., & Hu, J. (2010). Air traffic complexity in advanced automated Air Traffic Management systems. *Proceedings of the 9th Innovative Research Workshop and Exhibition, INO 2010*, 3–10.

[73] Reynolds, T. G. (2008). Analysis of lateral flight inefficiency in global air traffic management. *8th AIAA Aviation Technology, Integration and Operations (ATIO) Conference*, *September*, 14–19. https://doi.org/10.2514/6.2008-8865

[74] Roosens, P. (2010). Congestion and air transport: A challenging phenomenon. *Critical Issues in Air Transport Economics and Business*, 222–233. https://doi.org/10.4324/9780203845332

[75] Rozen, N. E. (2007). Performance-based Air Traffic Management: Evaluation of. September, 1–18.

[76] Salerno, M., Rondinella, D., Crispino, M. V, Costantini, G., Carota, M., & Casali, D. (2008). *Sky-Scanner: A New Paradigm for Air Traffic Management*. *2*(2).

[77] Soomer, M. J., & Franx, G. J. (2008). Scheduling aircraft landings using airlines' preferences. *European Journal of Operational Research*, *190*(1), 277–291. https://doi.org/10.1016/j.ejor.2007.06.017

[78] Stalnaker, S. E., Dearmon, J. S., & Katkin, R. D. (2009). Collaborative airspace congestion resolution (CACR) benefits analysis. *AIAA/IEEE Digital Avionics Systems Conference - Proceedings*, 1–7. https://doi.org/10.1109/DASC.2009.5347520

[79] Sud, V. P., Tanino, M., Wetherly, J., Brennan, M., Lehky, M., Howard, K., & Oiesen, R. (2009). Reducing flight delays through better traffic management. *Interfaces*, *39*(1), 35–45. https://doi.org/10.1287/inte.1080.0417

[80] Tian, W., & Hu, M. (2010). Study of air traffic flow management optimization model and algorithm based on multi-objective programming. *ICCMS 2010 - 2010 International Conference on Computer Modeling and Simulation*, *2*, 210–214. https://doi.org/10.1109/ICCMS.2010.20

[81] Tumer, K., & Agogino, A. (2008). Adaptive management of air traffic flow: A multiagent coordination approach. *Proceedings of the National Conference on Artificial Intelligence*, *3*, 1581–1584.

[82] Wan, Y., & Roy, S. (2008). A scalable methodology for evaluating and designing coordinated air-traffic flow management strategies under uncertainty. *IEEE Transactions on Intelligent Transportation Systems*, *9*(4), 644–654. https://doi.org/10.1109/TITS.2008.2006813

[83] Weigang, L., Dib, M. V. P., Alves, D. P., & Crespo, A. M. F. (2010). Intelligent computing methods in Air Traffic Flow Management. *Transportation Research Part C: Emerging Technologies*, *18*(5), 781–793. https://doi.org/10.1016/j.trc.2009.06.004

[84] Zhang, X., Zhou, Y., Liu, B., & Wang, Z. (2007). The air traffic flow management with dynamic capacity and Co-evolutionary genetic algorithm. *IEEE Conference on Intelligent Transportation Systems, Proceedings, ITSC*, 580–585. https://doi.org/10.1109/ITSC.2007.4357707

[85] Zhang, Y., & Hansen, M. (2008). Real-time intermodal substitution: Strategy for airline recovery from schedule perturbation and for mitigation of airport congestion. *Transportation Research Record*, *2052*, 90–99. https://doi.org/10.3141/2052-11

[86] Adler, N., & Liebert, V. (2014). Joint impact of competition, ownership form and economic regulation on airport performance and pricing. Transportation Research Part A: Policy and Practice, 64, 92–109. https://doi.org/10.1016/j.tra.2014.03.008

[87] Ali, K. M., Alexandre, S., & Nidhal, R. (2012). A flight plan rescheduling in air traffic management problem: A time discret event system approach. IFAC Proceedings Volumes (IFAC-PapersOnline), 14(PART 1), 285–290. https://doi.org/10.3182/20120523-3-RO-2023.00077

[88] Ali, K. M., Alexandre, S., & Nidhal, R. (2013). Flight rescheduling problem induced by air traffic network capacity constraints based on the binary decision diagram approach. IFAC Proceedings Volumes (IFAC-Papers Online), 46(9), 281–288. https://doi.org/10.3182/20130619-3-RU-3018.00213

[89] Andreatta, G., Dell'Olmo, P., & Lulli, G. (2011). An aggregate stochastic programming model for air traffic flow management. European Journal of Operational Research, 215(3), 697–704. https://doi.org/10.1016/j.ejor.2011.06.028

[90] Barnhart, C., Fearing, D., Odoni, A., & Vaze, V. (2012). Demand and capacity management in air transportation. EURO Journal on Transportation and Logistics, 1(1–2), 135–155. https://doi.org/10.1007/s13676-012-0006-9

[91] Bertsimas, D., Lulli, G., & Odoni, A. (2011). An integer optimization approach to large-scale air traffic flow management. Operations Research, 59(1), 211–227. https://doi.org/10.1287/opre.1100.0899

[92] Bielli, M., Bielli, A., & Rossi, R. (2011). Trends in models and algorithms for fleet management. Procedia - Social and Behavioral Sciences, 20, 4–18. https://doi.org/10.1016/j.sbspro.2011.08.004

[93] Castelli, L., Pesenti, R., & Ranieri, A. (2011). The design of a market mechanism to allocate Air Traffic Flow Management slots. Transportation Research Part C: Emerging Technologies, 19(5), 931–943. https://doi.org/10.1016/j.trc.2010.06.003

[94] Chen, X. W., Landry, S. J., & Nof, S. Y. (2011). A framework of enroute air traffic conflict detection and resolution through complex network analysis. Computers in Industry, 62(8–9), 787–794. https://doi.org/10.1016/j.compind.2011.05.006

[95] Cook, A., Blom, H. A. P., Lillo, F., Mantegna, R. N., Miccichè, S., Rivas, D., Vázquez, R., & Zanin, M. (2015). Applying complexity science to air traffic management. Journal of Air Transport Management, 42, 149–158. https://doi.org/10.1016/j.jairtraman.2014.09.011

[96] Cruciol, L. L. B. V., de Arruda, A. C., Weigang, L., Li, L., & Crespo, A. M. F. (2013). Reward functions for learning to control in air traffic flow management. Transportation Research Part C: Emerging Technologies, 35, 141–155. https://doi.org/10.1016/j.trc.2013.06.010

[97] Devasia, S. (2011). Capacity-maintaining conflict resolution for adverse-weather air-traffic rerouting. IFAC Proceedings Volumes (IFAC-PapersOnline), 44(1 PART 1), 13034–13039. https://doi.org/10.3182/20110828-6-IT-1002.00713

[98] Gelhausen, M. C., Berster, P., & Wilken, D. (2013). Do airport capacity constraints have a serious impact on the future development of air traffic? Journal of Air Transport Management, 28, 3–13. https://doi.org/10.1016/j.jairtraman.2012.12.004

[99] Ginieis, M., Sánchez-Rebull, M. V., & Campa-Planas, F. (2012). The academic journal literature on air transport: Analysis using systematic

literature review methodology. Journal of Air Transport Management, 19(1), 31–35. https://doi.org/10.1016/j.jairtraman.2011.12.005

[100] Gwiggner, C., & Nagaoka, S. (2014). Data and queueing analysis of a Japanese air-traffic flow. European Journal of Operational Research, 235(1), 265–275. https://doi.org/10.1016/j.ejor.2013.10.056

[101] Isaacson, D. R., Sadovsky, A. v., & Davis, D. (2014). Tactical scheduling for precision air traffic operations: Past research and current problems. Journal of Aerospace Information Systems, 11(4), 234–256. https://doi.org/10.2514/1.I010119

[102] Jacquillat, A., & Odoni, A. R. (2015). An integrated scheduling and operations approach to airport congestion mitigation. Operations Research, 63(6), 1390–1410. https://doi.org/10.1287/opre.2015.1428

[103] Kim, A., & Hansen, M. (2015). Some insights into a sequential resource allocation mechanism for en route air traffic management. Transportation Research Part B: Methodological, 79, 1–15. https://doi.org/10.1016/j.trb.2015.05.016

[104] Krstić Simić, T., & Babić, O. (2015). Airport traffic complexity and environment efficiency metrics for evaluation of ATM measures. Journal of Air Transport Management, 42, 260–271. https://doi.org/10.1016/j.jairtraman.2014.11.008

[105] Murça, M. C. R., & Müller, C. (2015). Control-based optimization approach for aircraft scheduling in a terminal area with alternative arrival routes. Transportation Research Part E: Logistics and Transportation Review, 73, 96–113. https://doi.org/10.1016/j.tre.2014.11.004

[106] Nosedal, J., Piera, M. A., Ruiz, S., & Nosedal, A. (2014). An efficient algorithm for smoothing airspace congestion by fine-tuning take-off times. Transportation Research Part C: Emerging Technologies, 44, 171–184. https://doi.org/10.1016/j.trc.2014.03.017

[107] Qureshi, K. N., & Abdullah, A. H. (2013). A survey on intelligent transportation systems. Middle East Journal of Scientific Research, 15(5), 629–642. https://doi.org/10.5829/idosi.mejsr.2013.15.5.11215

[108] Ran, B., Jin, P. J., Boyce, D., Qiu, T. Z., & Cheng, Y. (2012). Perspectives on future transportation research: Impact of intelligent transportation system technologies on next-generation transportation modeling. In Journal of Intelligent Transportation Systems: Technology, Planning, and Operations (Vol. 16, Issue 4, pp. 226–242). https://doi.org/10.1080/15472450.2012.710158

[109] Samà, M., D'Ariano, A., & Pacciarelli, D. (2012). Optimal Aircraft Traffic Flow Management at a Terminal Control Area during Disturbances. Procedia - Social and Behavioral Sciences, 54, 460–469. https://doi.org/10.1016/j.sbspro.2012.09.764

[110] Santos, M. G., & Antunes, A. P. (2015). Long-term evolution of airport networks: Optimization model and its application to the United States. Transportation Research Part E: Logistics and Transportation Review, 73, 17–46. https://doi.org/10.1016/j.tre.2014.10.016

[111] Singh, V., & Sharma, S. K. (2015). Fuel consumption optimization in air transport: a review, classification, critique, simple meta-analysis, and future research implications. European Transport Research Review, 7(2). https://doi.org/10.1007/s12544-015-0160-x

[112] Steadieseifi, M., Dellaert, N. P., Nuijten, W., van Woensel, T., & Raoufi, R. (2014). Multimodal freight transportation planning: A literature review. European Journal of Operational Research, 233(1), 1–15. https://doi.org/10.1016/j.ejor.2013.06.055

[113] Sun, Y., & Schonfeld, P. (2015). Stochastic capacity expansion models for airport facilities. Transportation Research Part B: Methodological, 80, 1–18. https://doi.org/10.1016/j.trb.2015.06.009

[114] Torres, S. (2012). Swarm theory applied to air traffic flow management. Procedia Computer Science, 12, 463–470. https://doi.org/10.1016/j.procs.2012.09.105

[115] Vadlamani, S., & Hosseini, S. (2014). A novel heuristic approach for solving aircraft landing problem with single runway. Journal of Air Transport Management, 40, 144–148. https://doi.org/10.1016/j.jairtraman.2014.06.009

[116] Wan, Y., Jiang, C., & Zhang, A. (2015). Airport congestion pricing and terminal investment: Effects of terminal congestion, passenger types, and concessions. Transportation Research Part B: Methodological, 82, 91–113. https://doi.org/10.1016/j.trb.2015.10.006

[117] Weiszer, M., Chen, J., & Locatelli, G. (2015). An integrated optimisation approach to airport ground operations to foster sustainability in the aviation sector. Applied Energy, 157, 567–582. https://doi.org/10.1016/j.apenergy.2015.04.039

[118] Wesonga, R. (2015). Airport utility stochastic optimization models for air traffic flow management. European Journal of Operational Research, 242(3), 999–1007. https://doi.org/10.1016/j.ejor.2014.10.042

[119] Zanin, M., & Lillo, F. (2013). Modelling the air transport with complex networks: A short review. In European Physical Journal: Special Topics (Vol. 215, Issue 1, pp. 5–21). https://doi.org/10.1140/epjst/e2013-01711-9

[120] Zhang, Z., Hao, Z., & Gao, Z. (2015). A dynamic adjustment and distribution method of air traffic flow en-route. Journal of Air Transport Management, 42, 15–20. https://doi.org/10.1016/j.jairtraman.2014.07.007

[121] Zografos, K. G., Salouras, Y., & Madas, M. A. (2012). Dealing with the efficient allocation of scarce resources at congested airports. Transportation Research Part C: Emerging Technologies, 21(1), 244–256. https://doi.org/10.1016/j.trc.2011.10.008

[122] Zou, B., & Hansen, M. (2014). Flight delay impact on airfare and flight frequency: A comprehensive assessment. Transportation Research Part E: Logistics and Transportation Review, 69, 54–74. https://doi.org/10.1016/j.tre.2014.05.016

[123] Boujarif, A., Hamdan, S., & Jouini, O. (n.d.). Impact of Aircraft Model and Delay Duration on the Air Traffic Flow Management.

[124] Mannino, C., Nakkerud, A., & Sartor, G. (2021). Air traffic flow management with layered workload constraints. *Computers and Operations Research*, *127*. https://doi.org/10.1016/j.cor.2020.105159

[125] Shone, R., Glazebrook, K., & Zografos, K. G. (2021). Applications of stochastic modeling in air traffic management: Methods, challenges and opportunities for solving air traffic problems under uncertainty. In *European Journal of Operational Research* (Vol. 292, Issue 1, pp. 1–26). Elsevier B.V. https://doi.org/10.1016/j.ejor.2020.10.039

[126] Bertsimas, D., & Gupta, S. (2016). Fairness and collaboration in network air traffic flow management: An optimization approach. *Transportation Science*, *50*(1), 57–76. https://doi.org/10.1287/trsc.2014.0567

[127] Cavusoglu, S. S., & Macário, R. (2021). Minimum delay or maximum efficiency? Rising productivity of available capacity at airports: Review of current practice and future needs. *Journal of Air Transport Management*, *90*. https://doi.org/10.1016/j.jairtraman.2020.101947

[128] Coupe, W. J., Lee, H., Jung, Y., Chen, L., & Robeson, I. (n.d.). Scheduling Improvements Following the Phase 1 Field Evaluation of the ATD-2 Integrated Arrival, Departure, and Surface Concept.

[129] Enayatollahi, F., Atashgah, M. A. A., Malaek, S. M. B., & Thulasiraman, P. (2021). PBN-Based Time-Optimal Terminal Air Traffic Control Using Cellular Automata. *IEEE Transactions on Aerospace and Electronic Systems*, *57*(3), 1513–1523. https://doi.org/10.1109/TAES.2020.3048787

[130] Kistan, T., Gardi, A., Sabatini, R., Ramasamy, S., & Batuwangala, E. (2017). An evolutionary outlook of air traffic flow management techniques. In *Progress in Aerospace Sciences* (Vol. 88, pp. 15–42). Elsevier Ltd. https://doi.org/10.1016/j.paerosci.2016.10.001

[131] Kleinbekman, I. C., Mitici, M. A., & Wei, P. (2018). eVTOL arrival sequencing and scheduling for on-demand urban air mobility. *AIAA/IEEE Digital Avionics Systems Conference - Proceedings*, *2018-September*. https://doi.org/10.1109/DASC.2018.8569645

[132] Lin, Y., Li, L., Ren, P., Wang, Y., & Szeto, W. Y. (2021). From aircraft tracking data to network delay model: A data-driven approach considering en-route congestion. *Transportation Research Part C: Emerging Technologies*, *131*. https://doi.org/10.1016/j.trc.2021.103329

[133] Ma, J., Delahaye, D., Sbihi, M., Scala, P. M., Antonio, M., Mota, M., & Scala, P. (n.d.). *Integrated optimization of terminal maneuvering area and airport at the macroscopic level*. https://doi.org/10.1016/j.trc.2018.12.006ï

[134] Rodríguez-Díaz, A., Adenso-Díaz, B., & González-Torre, P. L. (n.d.). Minimizing Deviation from Scheduled Times in a Single Mixed-Operation Runway.

[135] Samà, M., D'Ariano, A., Corman, F., & Pacciarelli, D. (2017). Coordination of scheduling decisions in the management of airport airspace and taxiway operations. *Transportation Research Procedia*, *23*, 246–262. https://doi.org/10.1016/j.trpro.2017.05.015

[136] Schultz, M., Lubig, D., Rosenow, J., Itoh, E., Athota, S., & Duong, V. N. (n.d.). *Concept of a Long-Range Air Traffic Flow Management*.

[137] Shaukat, S., Katscher, M., Wu, C. L., Delgado, F., & Larrain, H. (2020). Aircraft line maintenance scheduling and optimisation. *Journal of Air Transport Management*, *89*. https://doi.org/10.1016/j.jairtraman.2020.101914

[138] Soltani, M., Ahmadi, S., Akgunduz, A., & Bhuiyan, N. (2020). An eco-friendly aircraft taxiing approach with collision and conflict avoidance. *Transportation Research Part C: Emerging Technologies*, *121*. https://doi.org/10.1016/j.trc.2020.102872

[139] Vascik, P. D., & Hansman, R. J. (2018). Scaling constraints for urban air mobility operations: Air traffic control, ground infrastructure, and noise.

*2018 Aviation Technology, Integration, and Operations Conference*. https://doi.org/10.2514/6.2018-3849

[140] Xu, Y., Prats, X., & Delahaye, D. (n.d.). Synchronised Demand-Capacity Balancing in Collaborative Air Traffic Flow Management.

[141] Yu, B., Guo, Z., Asian, S., Wang, H., & Chen, G. (2019). Flight delay prediction for commercial air transport: A deep learning approach. *Transportation Research Part E: Logistics and Transportation Review*, *125*, 203–221. https://doi.org/10.1016/j.tre.2019.03.013

[142] Zeng, W., Ren, Y., Wei, W., & Yang, Z. (2021). A data-driven flight schedule optimization model considering the uncertainty of operational displacement. *Computers and Operations Research*, *133*. https://doi.org/10.1016/j.cor.2021.105328

[143] Zhuang, Q., Deng, K., & Ye, X. (2021). Research on Integrated Scheduling Algorithm of Inbound and Depart Flights in Airport Based on Integrated Operation. *ACM International Conference Proceeding Series*, *PartF168982*. https://doi.org/10.1145/3448734.3450827