

IBN HALDUN UNIVERSITY
SCHOOL OF GRADUATE STUDIES
DEPARTMENT OF AIR TRANSPORT MANAGEMENT

MASTER THESIS

**THE ANALYSIS OF THE FLIGHT DISPATCHER'S
WORKLOAD IN THE TURKISH AVIATION INDUSTRY**

BURAK GÜNER

THESIS SUPERVISOR
PROF. MUSTAFA KEMAL YILMAZ

ISTANBUL, 2024

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by

BURAK GÜNER

**A thesis submitted to the School of Graduate Studies in partial
fulfillment of the requirements for the degree of Master of Science in
Air Transport Management**

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ISTANBUL, 2024

APPROVAL PAGE

This is to certify that we have read this thesis and that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of Master of Science in Air Transport Management.

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ACADEMIC HONESTY ATTESTATION

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Name Surname:

Signature:



ÖZ

TÜRK HAVACILIK SEKTÖRÜNDE DİSPEÇERLERİN İŞ YÜKÜNÜN ANALİZİ

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Ocak 2024, 40 Sayfa

Bu çalışmanın amacı, havacılık sektöründe dispeçerlerin artan iş yüküne ve Hava Trafik Akış Yönetimi (HTAY) gecikmelerine bağlı olarak maliyetlerin nasıl düşürülebileceği ve operasyonel etkinliğin nasıl artırılabiliridir. Çalışmada, Temporal Bin Packing Problem'in kavramsal çerçevesinden faydalanılarak, Batı Avrupa, Orta Avrupa ve İngiltere gibi yüksek HTAY gecikmeleri yaşanan güzergâhlar Haziran-Ağustos 2022 dönemine ait bir Türk havayolu şirketinin uçuş verileri kullanılarak analiz edilmiştir. Pandemi sonrası toparlanmanın yaşandığı ve Ukrayna hava sahasının kapanması gibi önemli olayların uçuş trafiğini etkilediği bu dönem sektörde yeni fırsatlar yaratmıştır. Çalışma sonuçları, yoğun sezonda dispeçerlerin iş yükünün yoğun olmayan dönemdekine benzer şekilde yönetilebileceği ve havayolu şirketlerinin operasyonel etkinliklerinin artarak maliyetlerinde önemli azalma olabileceğini göstermiştir. Havayolu şirketleri bu sonuçları, daha verimli stratejiler geliştirmek, operasyonel etkinliği artırmak ve maliyeti düşürmek için kullanabilirler.

Anahtar Kelimeler: Dispeçer İş Yükü, Hava Trafik Akış Yönetimi, Havacılık Sektörü.

ABSTRACT

THE ANALYSIS OF THE FLIGHT DISPATCHERS WORKLOAD IN THE TURKISH AVIATION INDUSTRY

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This study aims to focus on the increased costs related to the workload of flight dispatchers in the aviation industry, and on the air traffic flow management (ATFM) delays that constitute a significant part of the operational costs in the airlines. Inspired by the conceptual framework of De Cauwer's Temporal Bin Packing Problem, we use flight data of an anonymous Turkish airline company from June to August 2022 on flights to West Europe, Central Europe, and Great Britain, as these regions experience high rates of ATFM delays. The year 2022, considered a part of the post-pandemic period, witnessed significant international events, like the closure of Ukraine's airspace, that have affected air traffic between Turkey and Europe, creating new challenges and opportunities for flight dispatchers and airlines. The findings show that applying the workload metrics of the off-season to the high season generates net savings of €940,800 in the ATFM delay costs. The results provide valuable insights for the airlines to enhance operational efficiency, reduce costs, and develop efficient strategies.

Keywords: Air Traffic Flow Management, Flight Dispatcher, Turkish Aviation.

DEDICATION

This work is dedicated to my wife, Gülfidan Güner, and my brothers, Taha and İsmail Güner. Their constant support and motivation were crucial in pursuing a Master's degree. Their faith in me has been the driving force behind my journey.

I would also like to express my deep appreciation to my colleagues working in shifts in the aviation industry. Your commitment and dedication, even under the most challenging conditions, are invaluable not only to our daily work but also to the safety and efficiency of our industry. Your professionalism and team spirit gave me valuable insights and inspiration for this work. You are a shining example of what can be achieved through dedication and teamwork.

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Burak Güner
ISTANBUL, 2024

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LIST OF SYMBOLS AND ABBREVIATIONS

ADF	Airline Dispatchers Federation
AOC	Airline Operation Centers
AOCC	Airline Operation Control Centers
ATC	Air Traffic Controller
ATFM	Air Traffic Flow Management
BPP	Bin Packing Problem
COVID-19	Coronavirus Disease 2019
DHMI	Devlet Hava Meydanları İşletmesi
EASA	European Union Aviation Safety Agency
EASA AIR OPS	EASA Implementing Rules for Air Operations
ED DECISION	EASA Decision
FAA	Federal Aviation Administration
ICAO	International Civil Aviation Organization
IOCC	Integreted Operation Control Centers
IROPS	In-flight Irregular Operations
IT	Information Technology
MOCC	Maintenance Operation Control Centers
NBAA	National Business Aviation Association
NOTAMs	Notices to Airmen
NOS	Nominal Operational Schedule
OCC	Operation Control Centers
PANSA	Polish Air Navigation Services Agency
ROS	Resource Operational Schedule
SHGM	Sivil Havacılık Genel Müdürlüğü
SOCC	Station Operation Control Centers
TAF	Terminal Aerodrome Forecast
TBP	Temporal Bin Packing Model
TRENDS	Landing Forecasts
US	United States

CHAPTER I

INTRODUCTION

1.1. Background of the Study

The aviation industry has shown remarkable growth over the last decades with a significant increase in airline operations. Within this dynamic environment, airlines increasingly focus on providing timely and safe services to their customers. In this respect, flight dispatchers play a critical role in ensuring the smoothness and safety of the operations of commercial flights. They are responsible for managing the intricate logistical aspects of flight operations, including route planning, weather analysis, fuel management, and regulatory compliance. In this scheme, Eurocontrol plays a vital role in giving a clear overview to flight dispatchers, pilots, and air traffic controllers (ATC) on the processes they should follow to ensure efficient operations.

Eurocontrol acts as an intergovernmental organization committed to achieving safe, efficient, and sustainable European air traffic flow management (ATFM). It aims to optimize air traffic flow by balancing the demand and capacity of the European flight regions. ATFM delays occur when flights are held on the ground or rerouted due to congestion, weather conditions, and other operational constraints. These delays, specifically within European air traffic flow management (ATFM), have a significant economic impact on airlines. The estimated cost associated with each delay is Euro 103, as detailed in the analysis by Cook and Tanner (2015). There were over 15 million ATFM delays from 2019 to 2022, indicating the importance of air traffic management (Eurocontrol, 2022). In this context, flight dispatchers act as the liaison between airline operators and authorities, executing operational control, flight planning, and in-flight assistance.

The Turkish aviation industry provides an excellent case study examining the interplay between flight dispatcher workload and cost efficiency. As a significant regional player in a rapidly growing market, the Turkish aviation industry has shown an

overwhelming growth over the last decade. Between 2010 and 2019, the total volume of flight traffic, encompassing overflights, experienced an increase of 168 percent, while passenger numbers surged by 202 percent (DHMI, 2019). The study period deliberately omits the year marked by the Covid-19 pandemic, which exerted a profound influence on the global aviation sector. The number of flight points has also grown in this period. In 2012, there were 49 domestic and 250 international flight points, while in 2022, these figures were 57 domestic and 342 global flight points, representing a growth rate of 16% and 37%, respectively (Sivil Havacılık Genel Müdürlüğü, 2022). This increase in air traffic and flight routes has consequently resulted in an increased workload for flight dispatchers. In this context, it is crucial to understand that an excessive workload may lead to inefficiencies and increased costs for airlines, as flight dispatchers may struggle to manage the multitude of complex and time-sensitive tasks associated with flight operations. Therefore, striking a balance between workload and cost efficiency becomes vital for airlines to ensure the safety and reliability of their operations.

A significant challenge within the Turkish aviation sector is the rigorous work schedule imposed on flight dispatchers. Their routine encompasses working in shifts: two consecutive days in an early shift, followed by two days in a midday shift, and concluding with two days in a night shift, after which they are allocated two days off. Yet, these off days are not entirely free from work. The dispatchers often find themselves working an additional six hours on average, particularly those who are wrapping up their night shifts that typically run from around 10:00 pm to 6:00 am. This extended work period shows the demanding nature of the dispatcher role and the intense workload these individuals often face.

This thesis explores the relationship between flight dispatcher workload and cost efficiency in the Turkish aviation industry, focusing on Eurocontrol and ATFM delays. It delves into how optimizing the workload of flight dispatchers may contribute to reducing Air Traffic Flow Management (ATFM) delays and the costs associated with these delays. Therefore, it contributes to the understanding of this critical task, helping airlines optimize their operations for the benefit of all stakeholders.

1.2. Motivation of the Study

This study seeks to introduce a cost-efficient strategy designed to enhance operational efficiency for airlines and improve the working conditions for flight dispatchers within the aviation sector. It focuses on identifying measures that can mitigate operational costs while simultaneously maximizing the productivity and job satisfaction of dispatchers. By optimizing flight dispatcher workload, airlines may improve their operational performance and ensure the well-being of their workforce. Moreover, a cost-efficient solution often corresponds with environmentally friendly practices. Reducing ATFM delays and enhancing the efficiency of flight operations may lead to a decrease in fuel consumption and carbon emissions, contributing to a green and more sustainable aviation industry.

Second, the current staffing level of flight dispatchers is often designed to operate effectively outside of the high-traffic seasons. This approach can result in increased costs and operational challenges during peak times, i.e. the summer season. Exploring strategies to optimize dispatcher workload during high-traffic seasons may help minimize the challenges and improve cost efficiency. Third, the competitive nature of the aviation industry demands constant efficiency improvement to maintain with a competitive edge. Efficient shift management strategies can provide airlines a competitive advantage by reducing costs and improving operational performance. Optimizing workload and increasing off time for flight dispatchers ensures the well-being of employees and motivates them to perform their tasks better.

Finally, Turkey has a unique location as a crossroad between Europe and Asia, along with its growing aviation market. This makes the Turkish aviation industry an ideal case study for optimizing flight dispatcher workload and cost efficiency. The recent political atmosphere has also highlighted the need for effective strategies in managing the workload of flight dispatchers, as Turkish airlines continues to operate flights to Russia despite the military invasion of Ukraine and the closure of Ukrainian airspace. This study provides valuable insights for airlines in optimizing their operations, enhancing employee well-being, and promoting environmentally friendly practices.

1.3. Research Objectives and Scope of the Study

In this study, we use flight data of a Turkish airline company, referred to as "Airline X", to conduct an in-depth analysis of the relationship between flight dispatcher workload and cost efficiency. Our central hypothesis is that by equipping flight dispatchers to be productive during peak seasons, airlines can decrease operational expenses due to ATFM delays. We use daily flight data of the Airline X from June to August 2022, focusing mainly on flights to Western Europe, Central Europe, and Great Britain, as these regions experience higher rates of ATFM delays compared to other destinations. This strategic focus allows us to concentrate our research on areas with the most significant potential for cost savings through improved flight dispatcher productivity. In our analysis, we assume that each ATFM delay incurs operational costs of Euro 100, as indicated by previous studies (Cook & Tanner, 2015; Institut du Transport Aérien, 2000).

In this study, we employed the methodology proposed by De Cauwer et al. (2016), tailored specifically to analyze the dispatcher workload at Airline X. This method involves a three-step process that begins by comparing seasonal flight numbers and ATFM delays to understand the variations in dispatcher workload. We then conducted a detailed workload analysis across different seasons, informed by concepts similar to the Temporal Bin Packing (TBP) approach. The final step assesses the financial impact of the workload, focusing on the potential cost savings and operational efficiency for Airline X. This approach enables us to examine and address the challenges of dispatcher workload management at Airline X, providing valuable insights for airlines about the operational and financial implications.

The study covers the period after Covid-19 pandemic, particularly 2022, as the aviation industry has significantly recovered from the pandemic, making it a more relevant reference point than the years of the pandemic, i.e. 2020-2021. This period is exciting due to the unique challenges in the aviation industry, i.e. the Russian military invasion of Ukraine that has led to the closure of Ukrainian airspace and increased demand for Polish and Lithuanian airspace. These developments have affected all airlines in Turkey, as they are among the few Eurocontrol partners that have continued to serve the Russian market, and they play a vital role in maintaining operations between

Turkish and Russian airports via the Polish-Lithuanian corridor. Before the Ukraine crisis, the Polish Air Navigation Services Agency (PANSNA) reported only 0.20 minutes of ATFM delays per flight, totaling 175,266 flights. However, following the crisis, this figure increased dramatically to 1.42 minutes per flight, with a total of 808,341 flights. This five-fold increase had a significant impact on the Polish aviation industry and affected air travel between Turkey and Russia.

This situation mentioned above situation created unusual interactions between flight dispatcher, and ATC, highlighting the need for effective strategies to optimize efficiency in the aviation industry. By examining the challenges faced by the Turkish aviation industry during this period, this study will provide valuable insights into the cost-saving potential of flight dispatchers in flight operations.

1.4. The Structure of the Study

This thesis consists of five chapters.

Chapter 1 provides the motivation and scope of the study and research questions.

Chapter 2 gives a conceptual background on the role of flight dispatcher's in the aviation industry and reviews the relevant literature. It also focuses on the factors that affect the dispatcher workload.

Chapter 3 presents the data and the methodology, focusing on the operational and cost efficiency in the aviation industry.

Chapter 4 presents the empirical findings. It examines the factors that affect flight dispatcher workload and identifies potential areas for improvement.

Chapter 5 concludes and discusses study's implications for the relevant parties, i.e., airlines and policymakers. It also addresses the limitations of the study and proposes future research directions.

CHAPTER II

LITERATURE REVIEW

Turkish aviation industry has substantial operations, and one of these areas is flight dispatching. Although there are numerous studies on the Turkish aviation industry, there are few works on flight dispatching. In this chapter, we examine the flight dispatcher workload within the realm of airline operations planning, shedding light on issues associated with scheduling. Subsequently, we provide an overview of the role of flight dispatcher, and the current situation in Turkey, drawing attention to the problems of flight dispatching in the Turkish aviation industry.

2.1. Conceptual Framework and the Role of Flight Dispatchers

To provide a comprehensive overview of the role of flight dispatchers in the aviation industry, it is essential to mention the annexes and regulatory frameworks such as the European Union Aviation Safety Agency Air Operations (EASA Air OPS). These sources serve to assign responsibilities to flight dispatchers, as they establish the guidelines and regulations governing flight operations. They are developed to ensure safety, efficiency, and compliance in the aviation industry. By adhering to these guidelines, flight dispatchers play a vital role in flight planning and execution, ensuring compliance with regulatory requirements and best practices. Annex 1 of the Convention on International Civil Aviation (ICAO) establishes standards and recommended practices for the licensing of the aviation staff, including flight dispatchers. It also emphasizes the importance of competent and well-trained personnel in the aviation industry, ensuring that individuals working in this industry acquire adequate training and possess valid licenses to run the operations. EASA, on the other hand, plays a significant role in regulating and overseeing flight dispatch operations in Europe through its air operations (Air OPS) regulation. Air OPS defines the requirements and procedures for safe and efficient flight operations. It includes provisions for flight planning, operational control, and dispatcher training.

Compliance with these regulations ensures a high level of safety and adherence to international and regional requirements for flight dispatchers operating in Europe.

2.1.1. Workload and Challenges of Flight Dispatchers

Flight dispatchers face several challenges in executing their duties, ranging from managing operational disruptions, such as changes in weather and aircraft malfunctions, to coordinating in real-time with different departments to ensure safe flight operations. Factors that contribute to the workload of flight dispatchers include timely decision-making, constant communication, and stress associated with ensuring the safety of passengers. The working environment is dynamic and demands a high degree of concentration. The workload increases during operational disruptions such as severe weather conditions, equipment malfunctions, or air traffic congestion. In these cases, flight dispatchers must quickly assess the situation, make sound decisions, and communicate it to the relevant parties. These circumstances may require rapid changes in flight plans, affecting the workload. Tools such as automated flight planning systems and advanced weather forecasting models can help reduce the workload and enhance decision-making. However, these tools require continuous learning and adaptation, adding a layer of complexity to the role of flight dispatchers. Despite these challenges, their knowledge and decision-making skills make them invaluable assets in ensuring the smooth functioning of operations in the aviation industry.

2.1.2. Route Planning and Fuel Calculations

The role of flight dispatchers encompasses critical tasks such as route planning and fuel calculations as they operate in a highly dynamic aviation landscape. Their responsibilities are multifaceted, extending beyond routine flight coordination. They manage the complexities associated with operational and geopolitical factors. Flight dispatchers must consider several elements in planning flight routes and calculating required fuel. Geopolitical environment, notably conflicts, can significantly affect the planning and execution of flight routes. For instance, the recent conflict in Ukraine necessitated changes in the flight paths, particularly affecting routes between Istanbul and Moscow. Figure 2.1. shows the adaptation required in the flight

routes due to the geopolitical unrest in Ukraine. The original path (left) and the modified path (right) show the necessary deviations to avoid Ukrainian airspace.

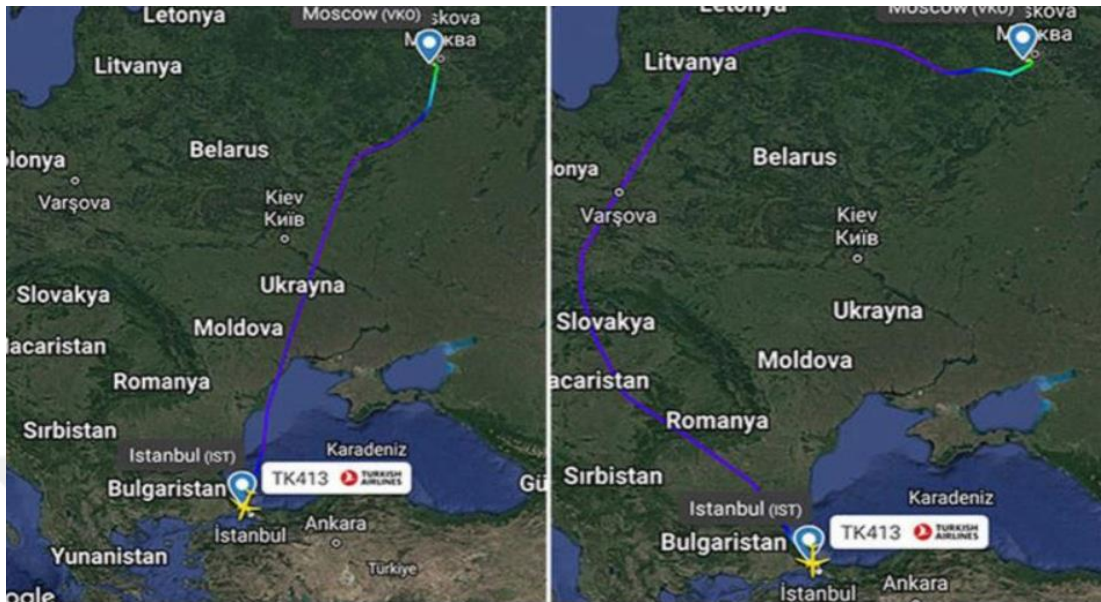


Figure 2.1. Comparative Flight Paths between Istanbul and Moscow due to Conflict in Ukraine

Source: Flightradar24

This adjustment underlines the agility and strategic planning required from flight dispatchers. They must swiftly respond to unforeseen geopolitical events by revising flight routes and recalculating fuel requirements to maintain the high standards of safety and efficiency (Yılmaz & Bayar, 2022). Flight dispatchers are equipped with various tools that aid them in route planning and fuel calculation, such as automated flight planning systems and advanced weather forecasting models. These tools are instrumental in enhancing operational efficiency but necessitate continuous learning for flight dispatchers.

2.1.3. Responsibilities of Flight Dispatchers

Flight dispatchers play a vital role in flight safety and efficiency. Their responsibilities encompass flight scheduling and operations, sharing operational control with pilots, and monitoring flights from departure to landing. They are involved in decision-making on aircraft operations in the airline operation centers

(AOC), collecting available information to make decisions for the operational control of the aircraft (Boo, 2016).

The responsibilities of flight dispatchers in terms of workload include managing 30–45 domestic flights during a 9-hour shift or 4-20 international flights. These tasks are influenced by factors such as traffic levels, weather conditions, trip duration, and the number of flights within a small time window. They must coordinate services and preparations to ensure that the aircraft departs and arrives safely on time, interacting with multiple teams (Huan, Nneji & Cummings, 2019). Flight dispatchers also communicate with numerous internal and external departments, i.e., maintenance teams, pilots, meteorology teams, and air traffic controllers, to handle operational issues and flight contingencies. In-flight irregular operations (IROPS) significantly affect the workload of flight dispatchers, with the priority of tasks being adjusted based on the criticality of the issues at hand.

The task analysis for flight dispatching can be broken down into taking over a shift, planning a flight, following a flight, and handing over the shift. This process includes evaluating weather conditions, assessing fuel requirements, choosing flight paths, and re-evaluating flight plans during the flight. For international flights, flight dispatchers must consider alternative landing airports and re-dispatch planning to maximize fuel efficiency.

2.1.3.1. Flight Planning and Decision Making

Flight dispatchers collaborate with the captain to authorize and oversee airline operations, adhering to government and company regulations. One of the essential responsibilities of flight dispatchers is the application of aerodrome forecasts (TAF & trend) to pre-flight planning (ICAO ANNEX 3, 2010). TAF provides detailed weather forecasts for specific airports, including information on visibility, cloud cover, wind speed and direction, and significant weather phenomena. By using these forecasts, flight dispatchers can assess potential weather-related risks and make informed decisions about flight operations, enhancing the safety of the flight.

Flight dispatchers also consider airport minima as a part of their pre-flight tasks. Airport minima provide weather conditions and visibility requirements that must be met for safe aircraft operations at a particular airport. These requirements are set up by regulatory authorities and consider various factors, including runway length, approach and landing aids, and aircraft performance capabilities. By consulting with airport minima, flight dispatchers ensure that the weather conditions at the departure and destination airports meet the required criteria. Flight dispatchers also incorporate Notices to Airmen (NOTAMs) into the planning process. NOTAMs provide critical information about temporary changes or hazards at the airports or in the airspace. These changes may include runway closures, navigational aids being out of service, or airspace restrictions. By incorporating NOTAMs, flight dispatchers ensure that the flight crew is aware of any operational changes or potential risks that may affect the planned flight. Table 2.1 shows TAFs and landing forecasts (TRENDS) to be used for pre-flight planning (EASA Annex IV to ED Decision, 2022).

Table 2.1. Aerodrome Forecasts and Landing Forecasts for Pre-Flight Planning

APPLICATION OF AERODROME FORECASTS (TAF & TREND) TO PRE-FLIGHT PLANNING							
1. APPLICATION OF INITIAL PART OF TAF							
<p>a) Application the time period: From the start of the TAF validity period up to the time of applicability of the first subsequent 'FM...' or 'BECMG', or if no 'FM' or 'BCMG' is given, up to the end of the validity period of the TAF.</p> <p>b) Application of forecast: The prevailing weather conditions forecast in the initial part of the TAF shall be fully applied with the exception of the mean wind and gusts (and crosswind) which shall be applied in accordance with the policy in the column 'BECMG AT and FM' in the table below.</p>							
2. APPLICATION OF FORECAST FOLLOWING CHANGE INDICATION IN TAF AND TREND							
TAF or TREND for AERODROME PLANNED AS:	FM (alone) and <u>BECMG AT</u> : Deterioration and Improvement	BECMG (alone) ,BECMG FM, BECMG TL, BECMG FM... TL, in case of:		TEMPO (alone), TEMPO FM, TEMPO FM...TL, PROB30/40 (alone)		PROB 30/40 TEMPO	
				Deterioration		Improvement	
		Deterioration	Improvement	Transient/ Shower Conditions in connection with short-lived weather phenomena, e.g. thunderstorms, showers	Persistent Conditions in connection with e.g. haze, mist, fog, dust/sandstorm, continuous precipitations	In any Case	
DESTINATION at ETA± 1HR TAKE-OFF ALTERNATE at ETA± 1HR DEST. ALTERNATE at ETA± 1HR ENROUTE ALTERNATE at ETA± 1HR	Applicable from the start of change ; Mean wind: Shall be within required limits; Gusts: May be disregarded.	Applicable from the time of the start of change ; Mean wind: Shall be within required limits; Gusts: May be disregarded.	Applicable from the time of the end of change ; Mean wind: Shall be within required limits; Gusts: May be disregarded.	Not applicable Mean wind and gusts exceeding required limits may be disregarded.	Applicable Mean wind: Shall be within required limits; Gusts: May be disregarded;	Deterioration may be disregarded; on Commander's discretion Improvement shall be disregarded including mean wind and gusts.	
ETOPS ENRT ALTN at earliest/latest ETA± 1 HR	Applicable from the time of start of change ; Mean wind: Shall be within required limits; Gusts exceeding crosswind limits shall be fully applied	Applicable from the time of start of change ; Mean wind: Shall be within required limits; Gusts exceeding crosswind limits shall be fully applied	Applicable from the time of end of change ; Mean wind: Shall be within required limits; Gusts exceeding crosswind limits shall be fully applied	Applicable if below applicable landing minima ; Mean wind: Shall be within required limits; Gusts exceeding crosswind limits shall be fully applied	Applicable if below applicable landing minima ; Mean wind: Shall be within required limits; Gusts exceeding crosswind limits shall be fully applied		
<p>Note: 'Required Limits' are those contended in this Manual.</p> <p>*The space following 'FM' should always include a time group e.g. 'FM1030'.</p>							

Source: EASA

Furthermore, flight dispatchers exercise operational control over day-to-day flight operations and make critical decisions. They consider several factors such as economics, passenger service, and, most importantly, safety. If unsafe conditions threaten the aircraft or passengers, flight dispatchers have the authority to delay or cancel flights. Throughout the flight, they continuously monitor weather conditions, aircraft position reports, and aeronautical navigation charts to evaluate the progress of the flight. They communicate significant changes in weather or flight plans to the pilot-in-command and may recommend alternative flight plans, such as altering the course or altitude, or making enroute landings, to ensure the safety of the flight.

2.1.3.2. Communication and Collaboration

Effective communication is essential for the smooth operations in aviation. Flight dispatchers are vital in facilitating communication between ground personnel, pilots, and the Operations Control Center (OCC). They maintain regular communication with pilots during their shifts and rely on navigation information, flight plan guidelines, and any updates from the OCC, which serves as the operational control center, to ensure safe travel. They closely work with the OCC, which serves as the central hub for operational decision-making and resource coordination (Kohl, 2007). The OCC monitors and manages crew scheduling, aircraft assignment, and resource allocation. Flight dispatchers collaborate with the OCC to address operational disruptions such as flight delays, cancellations, or aircraft changes to ensure that alternative plans are efficiently communicated to pilots. This collaborative approach helps optimize resources, minimize passenger inconvenience, and maintain operational efficiency (Clarke, 1998).

2.1.3.3. Training and Certification

Becoming an aircraft dispatcher requires extensive training and certification. Flight dispatchers undergo serious training programs to get the coveted Aircraft Dispatcher Certificate. This certification involves rigorous examinations, including an oral examination administered by the regulatory authority, such as the Federal Aviation Administration (FAA) in the US (Airline Dispatchers Federation, 2023). The training

and certification requirements are guided by global standards and recommended practices outlined in Annex 1- Personnel Licensing, published by the ICAO.

In addition to the FAA, each civil aviation authority set up its regulations and certification processes for aircraft dispatchers. These regulations ensure that flight dispatchers are trained and qualified to perform their duties safely and effectively. For example, the Directorate General of Civil Aviation (SHGM) in Turkey sets up the training and certification requirements for flight dispatchers. To maintain the certification, flight dispatchers must participate in recurrent training courses to stay updated on aircraft systems, operations policy, meteorology, and air regulations. This ongoing training ensures that they remain proficient in executing their roles.

2.2. The Role and Challenges of Flight Dispatchers in Turkey

In Turkey, the Directorate General of Civil Aviation is responsible for overseeing airline operations and establishing regulations. It adheres to the regulations set by the ICAO but tailors them to accommodate the unique characteristics of the Turkish aviation industry. The role of flight dispatchers in Turkey aligns with international standards, but there are unique aspects. Similar to their global counterparts, they are responsible for pre-flight planning, monitoring weather conditions, calculating fuel requirements, and maintaining communication with pilots and the OCC. However, the geographical location of Turkey, being at the crossroads of Europe and Asia, adds layer of complexity to their duties. The busy airspace over Turkey, coupled with diverse weather conditions, may pose different challenges for flight dispatchers.

The workload of Turkish flight dispatchers is affected by several factors. First, the geographic location of the country makes it a strategic hub for international flights. This factor results in a high volume of air traffic that flight dispatchers must manage. Second, Turkish flight dispatchers must manage operational disruptions caused by diverse weather conditions. The geographic landscape of Turkey stretches across multiple climatic zones. The eastern part of the country often experiences severe winter conditions, while the western regions may face intensive heat during the summer. These weather conditions require flight dispatchers to exercise a high level of vigilance and adaptability in the decision-making process. Severe winter conditions

may lead to frequent cancellations or diversions of flights due to poor visibility, icy runways, or hazardous flying conditions. Flight dispatchers must make quick decisions about re-routing or canceling flights to ensure passenger safety. The hot and dry summer weather, on the other hand, can affect the performance of the aircraft. High ambient temperatures can decrease air density, which has a negative effect on an aircraft's engine efficiency. This situation requires flight dispatchers to make crucial decisions, such as leaving a part of the payload behind to maintain the aircraft's safe operational limits. Finally, flight dispatchers must be proficient in Turkish and English, as they must communicate with domestic crews and international air traffic control. This requirement adds to their cognitive workload.

2.3. The Role of Flight Dispatchers in Different Airline Operations Models

2.3.1. Integrated Operations Control Center Model

In the Integrated Operations Control Center (IOCC) model, flight dispatchers are members of the operation team, directly contributing to decision-making processes. In this model, flight dispatchers work alongside Maintenance Operations Control Centers (MOCC) and Station Operations Control Centers (SOCC), collaborating with a broad spectrum of stakeholders. This holistic approach to flight operations management incorporates diverse teams that manage maintenance and station resources. The MOCC team primarily focuses on aircraft maintenance activities, ensuring that aircraft downtime due to technical issues is minimized and that aircraft are safe and ready for operation. In contrast, the SOCC team manages resources at each station, including gates, refueling operations, catering, ramp handling, and passenger facilities.

Lufthansa Systems represents an excellent implementation of the IOCC model. The IOCC is a fully integrated IT platform designed to facilitate the daily tasks of flight dispatchers and other members of the OCC. By linking various airline business units, it delivers timely information and robust functionality adaptable to changing operational conditions. The IOCC platform encompasses several components that are integral to the efficient functioning of airline operations, as given below (Lufthansa IOCC Platform, 2023):

Short-term schedule management: The IOCC platform includes short-term schedule management that monitors schedule planning during the final weeks before the flight event. Schedules must already be set for crew and maintenance reasons. However, schedules are prone to disruption and should be modified to address changes in market conditions.

Operations control: The operations control component of the IOCC platform is responsible for controlling daily flight operations. An extremely complex process is required to ensure that passengers arrive at the destination safely and punctually. The OCC is the traffic center of an airline. This is where all the data relevant to conducting a flight converges.

Hub and turnaround management: Lufthansa Systems includes hub or station control management that monitors aircraft, crew, and passenger connection, and aircraft turnaround at its hub(s). Active management of the interplay between airports, airlines, and service providers can reduce the propagation of delays caused by disruptions.

Maintenance control: The IOCC platform includes maintenance control that monitors the allocation and observance of maintenance intervals and the execution of upcoming maintenance events. For efficiency, operation controllers and maintenance technicians should be kept informed about all changes in operational activities in real-time.

Passenger and cargo management: Unavoidable disruptions in flight operations may occasionally result in the inability to transport passengers or cargo as planned. The role of passenger and cargo management requires that the delayed passengers and cargo are transported to the destination as quickly as possible with minimum inconvenience.

Crew management: The crew management process covers the handling of planned duty rosters issued to flight crews. It must ensure that the right crew is always on duty at the right time and the right place for every flight. As in the initial planning

phase, particular attention must be paid to the requisite qualifications and legality of the crew in question.

Flight planning: The flight planning process provides airlines with high-quality briefing packages and optimized trajectories from take-off to landing. It covers all aspects of flight planning as well as flight following procedures. It calculates the optimal route between two airports while taking flight-related and all aeronautical information into account.

Weight and balance: Weight and balance revolve around coordinating the planned weight and center of gravity of a flight. The weight for take-off, cruise, and landing must be strictly controlled within the structural limits of the airframe. Moreover, the trim must be controlled to stay within the established parameters for a safe flight.

The commitment of the airline systems to integrating these essential components into the IOCC platform underlines their dedication to ensuring efficient and safe airline operations in the industry. Flight dispatchers take part in the flight planning process in the IOCC model.

2.3.2. Airline Operations Control Center (AOCC) Model in Low-Cost Carriers

Operational planning is handled in two phases: strategic and tactical (Clarke, 1998). Strategic planning involves creating a flight schedule of services. The operations group then generates a Nominal Operational Schedule (NOS) for the generic resources of airlines, including aircraft and crew rotations. Drawing on this fact, it schedules specific airline resources by assigning tail numbers and individual crew members to flights, resulting in a Resource Operational Schedule (ROS). The tactical side of the operations group is responsible for the execution scheduling. This encompasses executing pre-planned schedules, updating the schedules for minor operational deviations, and re-routing for irregular operations.

The central organization overseeing the 24/7 control of tactical operations is the Airline Operational Control Center (AOCC). The AOCC is supported by the MOCC, responsible for controlling airline maintenance activities, and by the SOCC, which

monitors station resources. The AOCC is organized into three functional groups with distinct responsibilities: airline controllers, on-line support, and off-line support. Airline operation controllers maintain the current operational version of the system resource schedules and manage irregular operations. Online support staff, i.e., flight dispatch group and crew dispatch group, assist controllers. The flight dispatch group is responsible for the flight planning, flight dispatching, and en-route flight following, while the crew operations group tracks individual crew members, maintains up-to-date status for all crew members, and calls in reserve crews as required.

2.3.3. The Role of Flight Dispatchers in the General Aviation Operations

In the context of general aviation, specifically for business jet airliners, flight dispatchers play a multi-faceted role that extends beyond the responsibilities of commercial aviation. As shared by the National Business Aviation Association (NBAA, 2023), they are akin to an OCC, undertaking numerous operational and logistical duties. The goal is to provide efficient flight operations for customers who charter flights for business travel. Unlike the OCC of large airlines, flight dispatchers in general aviation manage several vital tasks. These tasks include handling agreements with different entities, providing maintenance agreements, coordinating station services, and even taking care of ancillary services such as hotel and transfer bookings. The role of flight dispatchers also comprises obtaining overflight and movement permissions for departure and arrival airports and sending movement messages. Thus, they use their profound knowledge of aircraft performance, travel logistics, and company policies to orchestrate travel arrangements. Their duties extend to maintaining and updating aircraft and flight crew schedules, liaising with pilots and flight attendants to inform them of any passenger needs, and coordinating aircraft servicing with the maintenance department.

Moreover, flight dispatchers must build and maintain close relationships with a network of aircraft support service companies that include fixed-base operators, ground transportation providers, hotels, inflight catering companies, and international aircraft handlers. This interaction enables them to manage the details involved in business jet operations, ensuring that everything from flight plans and weather information to necessary permits for international travel is accurately coordinated and

communicated. Once an aircraft departs, flight dispatchers use flight following systems to ensure the safety and timely progress of the trip. Upon mission completion, they handle administrative tasks such as processing service provider invoices and company chargebacks and maintaining other flight department records.

To execute these responsibilities efficiently, flight dispatchers should have a strong knowledge of aviation practices, excellent analytical and computer skills, and the ability to coordinate with departments, particularly upper management. Having a high level of attention to detail and strong organizational ability is of paramount importance for producing efficient flight schedules.

2.4. Optimization in the Airline Operations Planning

Airline operations planning includes four major airline problems that are solved sequentially: schedule generation, fleet assignment, maintenance routing, and crew scheduling (Lan, Clarke & Barnhart, 2006). Schedule generation determines which flights are flown and at what times. These schedules allow for the formation of networks to solve the remaining problems. Fleet assignment allocates the type of aircraft that will fly at each of the scheduled flights. A network structure is used for fleet assignment. Flight legs are represented by nodes for departure/arrival times and locations with flight arcs, considering maintenance time and ground arcs depicting idle aircraft (Belobaba et al., 2009). Maintenance routing assigns a specific aircraft to a sequence of flights while ensuring compliance with maintenance requirements. For maintenance routing, separate networks are formed by decomposing the flight network by the type of aircraft required, and they are solved by using a network circulation model. Finally, crew scheduling assigns crews to a sequence of flights with restrictions from governing agencies, labor organizations, and airlines. Crew scheduling is broken into the crew pairing problem, where crews are assigned to flights, and the crew assignment problem, where individual members are assigned to crews. Duty periods are a grouping of flights (within one day), and a sequence of duties and layovers comprises a pairing. In the crew scheduling problem, a network structure is used for generating pairings, either in the form of a flight network- where there are nodes representing the departure and arrival of a flight and arcs represent possible connections between flights- or a duty period network- where nodes represent the start

or end of duty and arcs represent possible overnight connections between duties (Lan et al., 2006).

The crew scheduling problem breakdown is similar to how the dispatching problem is broken down with flights assigned to desks and then desks split into worker shifts. Airlines aim to create a balanced workload between crews through this scheduling. The assignment of flights to desks can be structured as a network where nodes represent flights, arcs represent flights that can depart sequentially on the same desk, and a path represents flights on a single desk, similar to flight network structure in crew scheduling and fleet assignment.

Like airline operations planning, the flight dispatching problem is an airline problem. A key difference is the importance of location. In the planning problem, location is an essential factor that defines what is possible. Crews must serve flights in a sequence where each flight departs from the exact location that the previous flight arrives. In dispatching, location may be used to decompose the problem. However, since flight dispatchers work centrally, there is no limitation on sequencing flights for a desk-based on location. They monitor multiple flights at once, whereas a crew is only assigned to one flight at a time. As a result, a network structure may not be the best way to model the dispatching problem. This is because overlapping flights can be assigned to the same desk, and there are few limitations on which flights can be given consecutively to the same desk. This would create a dense network, and due to the structure of the maximum workload objective, it is not easy to dominate paths. In planning problems, the location and timing constraints restrict the number of arcs in a network. Balance is measured differently; for crew pairing, it is based on the number of hours per worker, whereas for dispatching, it is based on the maximum workload for each desk.

2.4.1. Temporal Bin Packing Problem

The concept of Bin Packing Problems (BPP) has been extensively explored in various contexts, from physical dimensions in packaging to complex scheduling issues. In the standard formulation of BPP, all bins typically have the same capacity, although variants exist that consider bins with varying capacities (Correia et al., 2006). The fundamental challenge lies in efficiently utilizing space or resources,

whether in one-dimensional settings or more complex scenarios like three-dimensional pallet packing (Elhedhli et al., 2019).

In the aviation industry, managing resources includes both space and time. De Cauwer et al. (2016) adapted the ideas from Bin Packing Problems (BPP) to create a new model called Temporal Bin Packing Problem (TBP). This model applies the BPP approach to the specific needs of aviation, focusing on dispatcher workload and how it affects efficiency. This adaptation mirrors the objectives similar to BPP, such as minimizing the net cost associated with resource allocation (Baldi et al., 2012; Witteman et al., 2021). In the TBP model, the “bins” are analogous to the capacity of dispatchers in managing flight schedules, and the “items” represent the flights requiring allocation.

While De Cauwer's TBP model provides a framework for optimizing the allocation of flights to dispatchers to ensure efficiency, this study draws on the conceptual underpinnings of TBP to analyze dispatcher workload at Airline X. Rather than directly applying the TBP model, we use it as a guide to examine the relationship between dispatcher workload, ATFM delays, and their impact on operational efficiency, aiming to highlight potential areas for improvement and offer insights into how workload management may benefit operational and financial performance.

De Cauwer's work in 2016 marks a significant shift from the traditional BPP applications, introducing a temporal dimension that is vital for operational considerations in the aviation industry. It exemplifies how BPP evolves to incorporate time-based considerations, an essential factor in effectively allocating resources in airline operations.

2.5. Gap in the Literature

The existing literature provides insights about the role and responsibilities of flight dispatchers. At the same time few studies are held on how flight dispatchers in specific regions, such as Turkey, handle the workload and manage unique challenges they encounter. The Turkish aviation industry has 434 licensed active flight dispatchers, and they play an essential role in maintaining the safety of flight operations. Despite

this considerable workforce, limited research has been conducted to analyze the challenges they face and the methods they employ to maintain a high level of safety and efficiency. This study aims to fill this gap by examining the workload and challenges of flight dispatchers in the Turkish aviation industry.



CHAPTER III

DATA AND METHODOLOGY

3.1. Data

We obtained daily flight data from a Turkish airline company called “Airline X”. The dataset covers the period from June 2022 to August 2022. This timeframe is significant, as it allows us to analyze the post-Covid-19 pandemic phase, during which the aviation industry has experienced unique challenges, such as the Russian military invasion of Ukraine leading to the closure of Ukrainian airspace.

The data includes flight schedules, delays, and flight routes. We mainly focused on flights to West Europe, Central Europe, and Great Britain, as these regions have high rates of ATFM delays compared to the other destinations. By concentrating on these areas, we aim to identify regions with the most significant potential for cost savings through improved flight dispatcher productivity.

3.2. Variables

In this study, we utilized flight data, including flight departure and arrival times, flight routes, aircraft type, and passenger load. These variables, along with ATFM delays and dispatcher workload, were identified as key factors for analysis. The following part defines each variable:

Flight departure and arrival times refer to the specific times a flight is scheduled to leave the airport and when it is expected to land at its destination, respectively.

Flight routes are the specific paths an aircraft follows from its origin to its destination, often encompassing several airspaces and possibly different countries.

Aircraft type denotes the specific model of the airplane, such as a Boeing 737. Each type has unique features like size, range, and capacity. Only aircraft types with strong flight-level capacity are used.

ATFM delay: This data includes the duration of delays caused by Air Traffic Flow Management (ATFM). This process manages the flow of aircraft through airspace to ensure safety and efficiency. We also recorded the cost of these delays, estimated at Euro 100 per minute based on the benchmarks set in the prior studies.

Dispatcher workload: We collected data about flight dispatcher schedules. The data includes the start and end times of their shifts, categorized as early, midday, or night shifts, and any additional hours worked beyond these regular shifts.

3.3. Methodology

3.3.1. An Overview of the Methodology

The methodology applied in this study can be broken down into several steps, each serving a specific purpose in our analysis. Figure 3.1 shows the flowchart of the dispatcher workload analysis and decision-making process.

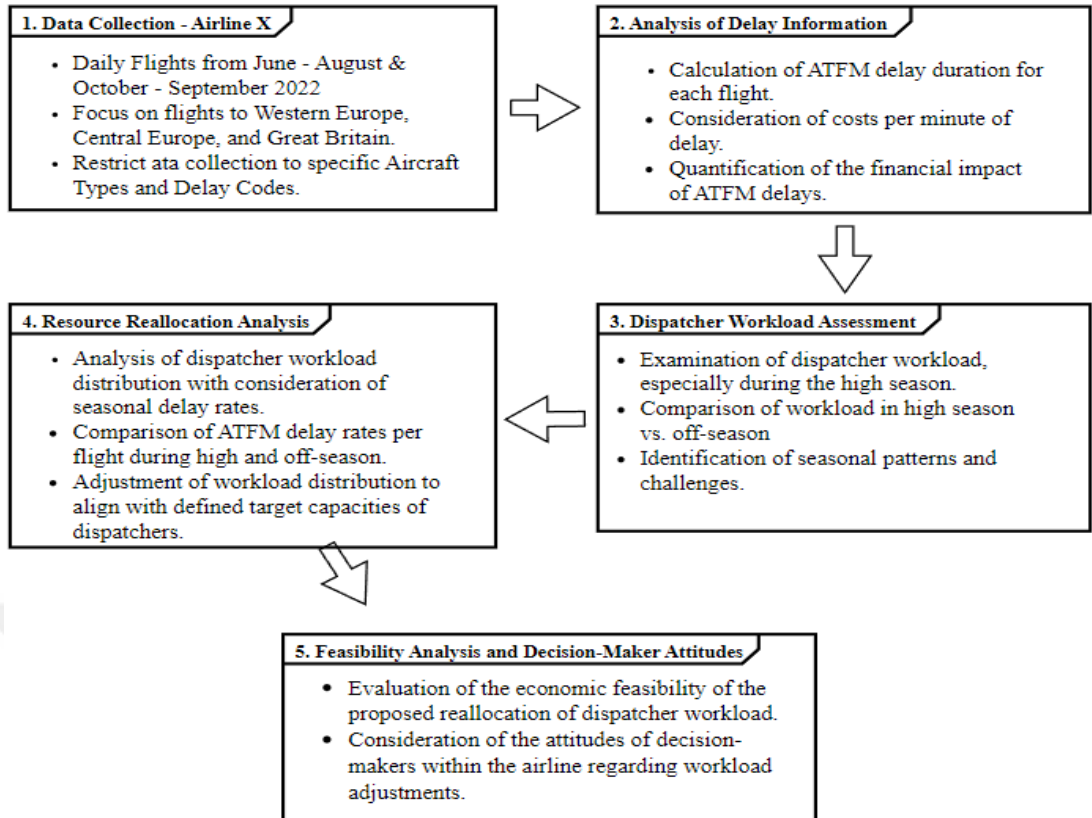


Figure 3.1. Flowchart of Dispatcher Workload Analysis and Decision-Making Process

Step 1: Data collection and preprocessing- The first step involves collecting data from Airline X. This data includes flight schedules, delays, and other relevant variables. The collected data, which includes flight schedules, delays, and other relevant variables, is then cleaned and processed to ensure accuracy for the analysis.

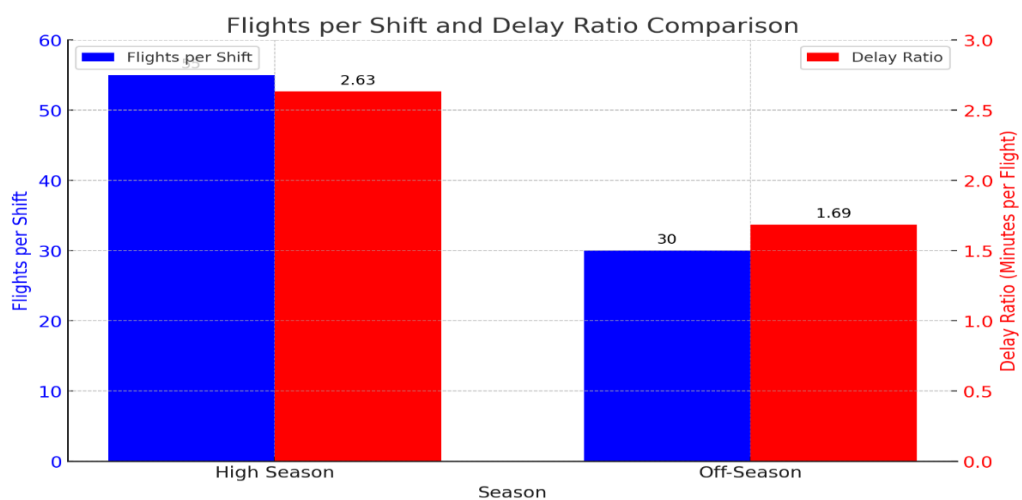


Figure 3.2. Flights per Shift and Delay Ratio Comparison

Step 2: Analyzing delay information- Once the data is in a usable format, we initiate our analysis by delving into the delay information. This step involves calculating the duration of ATFM delays for each flight, which is a critical metric for understanding the impact of these delays on airline operations. We also factor in the cost per minute of the delay, estimated at Euro 100 based on the prior studies. This cost estimation helps us quantify the financial impact of the ATFM delays.

Step 3: Dispatcher workload assessment- In this step, our focus shifts to analyzing the workload of the flight dispatchers with a particular emphasis on the differences between high and off-season periods, specifically June-August 2022 versus October-December 2022. This approach allows us to understand how the responsibilities of flight dispatchers fluctuate with seasonal changes in flight schedules. By comparing these distinct periods, we identify patterns and challenges unique to each season. This comparative analysis provides valuable insights into the operational demands placed on dispatchers during different times of the year, which is pivotal for optimizing workload and enhancing operational efficiency.

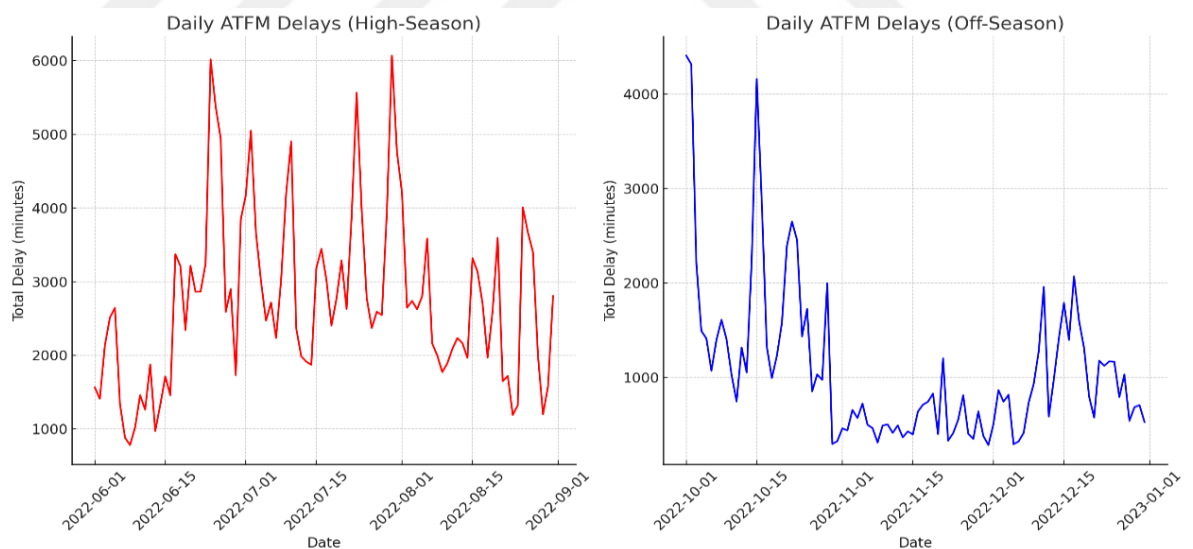


Figure 3.3. Daily ATFM Delays (High-Season Versus Off-Season)

Step 4: Resource reallocation analysis- Building on the delay analysis, we focus on assessing the potential for resource reallocation, mainly through optimizing flight dispatcher workload to mitigate ATFM delays and their associated costs. To achieve this, we employ a goal programming method, a mathematical modeling technique used in operational research. This step involves calculating and comparing the ratios

of ATFM delays per flight in both high (June-August) and off-season (October-December). By doing so, we aim to understand the disparity in workload and operational challenges faced during these periods. The goal programming method is then used to determine how flight dispatcher workload can be adjusted to find the optimal configuration, factoring in these seasonal delay ratios. This allows us to optimize the resource allocation in a way that aligns with the seasonal variability in flight schedules and ATFM delays, thereby enhancing overall operational efficiency and reducing costs.

(i) *Constraint prioritization:* In goal programming, we prioritize specific constraints. In our case, the primary constraints are related to the ATFM delays and their associated costs. By prioritizing to these constraints, we aim to minimize their impact on airline operations.

(ii) *Analysis goal:* Our study is guided by the objective of analyzing the impact of dispatcher's workload on ATFM delays and associated costs. The goal is to understand how different workload levels are related to operational efficiency and expenses, providing insights that may shape strategic decision-making to enhance efficiency.

(iii) *Decision variables:* The decision variables represent various aspects of the dispatcher workload, such as the number of dispatchers, their working hours, and shift allocation. These variables are adjusted to find optimal workload configuration.

Step 5: Feasibility analysis and decision-maker attitudes- The final step involves evaluating the economic feasibility of the proposed reallocation of the flight dispatcher workload and considering the attitudes of decision-makers in the airline. We assess whether the changes in the flight dispatcher workload are cost-effective and align with the operational objectives. This methodology allows us to address the critical research questions in this study: How do variations in the flight dispatcher workload affect the ATFM delays and the associated costs? Can optimizing the flight dispatcher workload lead to cost savings for airlines in the Turkish aviation industry? What are the implications of these findings for airlines and policymakers in improving cost efficiency and operational performance?

In adapting the methodology to the aviation industry, we focus on the context of the ATFM delays and the role of flight dispatchers. We assess how adjusting the flight dispatcher workload, shift scheduling, and additional work hours can lead to a reduction in ATFM delays and their associated costs.

3.3.2. Benefits of the Methodology

The methodology employed in this study offers several benefits, making it suitable for addressing the research questions and shedding light on the relationship between the flight dispatcher workload and cost efficiency in the Turkish aviation industry:

(i) Quantitative rigor: Using a goal programming approach, we introduce quantitative rigor into the analysis. This allows us to formulate an objective function to minimize the ATFM delays and the associated costs. It provides a solid foundation for making data-driven decisions.

(ii) Real-world applicability: The methodology is designed to apply to real-world scenarios in the aviation industry. By using actual flight data and considering the economic feasibility of the proposed changes, we bridge the gap between academic research and practical implementation.

(iii) Strategic decision support: By focusing on the attitudes of decision-makers within the airline, this methodology offers valuable insights for strategic decision-making. Airlines and policymakers can use these insights to make informed decisions on managing the flight dispatcher workload.

CHAPTER IV

EMPIRICAL FINDINGS

This Chapter provides the empirical findings for analyzing the flight dispatcher workload by employing the temporal bin packing problem. Before discussing the application of the Temporal Bin Packing Model, it is crucial to clarify the timeframe we focus on. In our analysis, the “high season” refers to the busy months of June, July, and August, while the “off-season” includes the less active months of October, November, and December. This distinction is vital for understanding the workload management and efficiency of flight dispatchers in different seasons. We analyze the workload of the flight dispatchers, particularly during the peak season. The TBP framework adapted by De Cauwer et al. (2016) focuses on two objectives: aligning the flight dispatcher workload between high and off-seasons, and identifying operational and financial benefits. The data is structured in the following context:

- (i) High season Flights (J_{High}): 11,033
- (ii) Off-season flights (J_{off}): 4,121
- (iii) High season ATFM delay (D_{high}): 29,044 minutes
- (iv) Off-season ATFM delay (D_{off}): 6,948 minutes
- (v) Target dispatcher capacity (Q): 30 flights per shift

We aim to align the workload of the high season with the proven efficiency of the off-season. The costs, in terms of ATFM delays (€100 per minute) and the annual cost per new dispatcher (€13,000), are also crucial factors to consider when assessing financial viability.

4.1. Analysis of Flight Dispatcher Workload

In this section, we explore the ideal number of flights a flight dispatcher should handle per shift. The results show that during the less busy months, managing

around 30 flights per shift is efficient, as it results in fewer delays. We apply this standard during the active months to maintain operational smoothness.

Efficiency benchmark from off-season: The analysis of the less busy months shows that flight dispatchers handling around 30 flights per shift achieve a lower ATFM delay ratio, indicating better operational efficiency. This means they could manage flights effectively without causing many delays.

ATFM delay ratio as a standard: The ATFM delay ratio in the off-season is a benchmark. To ensure things run smoothly during busy months, we plan to have flight dispatchers handle a similar number of flights as they do in the less active months. We hope to keep delays low, even when the flight numbers are much higher.

Operational feasibility: Assigning each flight dispatcher to manage 30 flights in one shift is a good balance. If they have a lot of work, they might make more mistakes, leading to flight delays.

Therefore, in analyzing the flight dispatcher workload, a desired benchmark of 30 flights per dispatcher per shift is established as a reference point for high-season operations. This benchmark is informed by the efficiency observed during the off-season with the hypothesis that achieving similar workload levels may contribute to operational efficiency, potentially reducing ATFM delays and costs. We now turn to the steps for examining this hypothesis in practice. The following steps outline the methodology that we use to analyze the flight dispatcher workload and its potential effects on operational performance.

Step 1: Establish the desired workload based on the off-season analysis.

- I. Off-season flight and delay data
 - Total off-season flights (J-off). 4121
 - Total off-season ATFM delay (D_off): 6,948 minutes.
 - Duration of off-season: 123 days.

- II. Calculating off-season average workload per dispatcher per shift:
- Average daily flights: $\frac{4121}{123} \approx 33.5$ flights/day
 - Assuming three shifts per day, the workload per shift (if evenly distributed):
 $\frac{33,50}{3} \approx 11.17$ flights per shift
 - Estimating number of dispatchers for 30 flights per shift: $\frac{33,50}{30} \approx$
1.12 Dispatchers/day
- III. Off-season ATFM delay ratio per flight:
- Delay ratio: $\frac{6948}{4121} \approx 1.686$ mins/flights
- IV. Justification for the desired workload of the 30 flights per shift:
- The off-season analysis suggests that around 30 flights per dispatcher per shift is associated with efficient operations and a lower ATFM delay ratio.

Table 4.1. Seasonal Comparison of the Flight Numbers and ATFM Delays

Parameter	High Season	Off-Season	Notes
Total Flights	11,033	4,121	-
Total ATFM Delay (mins)	29,044	6,948	-
Delay Ratio (mins/flight)	2.63	1.686	Total Delay / Total Flights

In the second step, we focus applying of the TBP model to the high season, targeting the established optimal workload of 30 flights per dispatcher per shift. This step provides the process of restructuring high-season scheduling to mirror the efficiency of the off-season.

Step 2: Applying the desired workload to high-season.

- I. High-season flight data:
- Total high season flights (J_High): 11,033
 - Duration of high season: 122 days

II. Daily high-season flights:

- $Daily\ Flights_{high} = \frac{11033}{122} \approx 90.43\ flights/day$

III. Calculating the dispatcher requirements for high-season

- Dispatchers required for the optimum workload:

$$M_{optimal} = \frac{90.43}{30} = 4\ dispatchers/day$$

- Total dispatcher pool for four crews (accounting for rotating shifts):

$$M_{total} = 4 \times 4 = 16\ dispatchers$$

IV. Additional dispatchers needed:

- Current dispatchers (assuming 55 flights/shift):

$$M_{current} = \frac{90.43}{55} \approx 2\ dispatchers/day$$

- Total current dispatchers for four crews: $2 \times 4 = 8$ dispatchers
- Additional dispatchers required $16 - 8 = 8$ dispatchers.

Table 4.2. High Season vs. Off-Season: Flight Dispatcher Workload Analysis

Parameter	High Season	Off-Season	Notes
Average daily flights	90.43	33.50	Total flights / Duration
Flights per dispatcher per shift	55 (actual)	30 (target)	Off-season optimal workload as a benchmark
Required dispatchers per day	1.64	1.12	Daily flights / Flights per dispatcher

4.2. Financial Impact Analysis

We assess the financial impact of applying the TBP approach with the desired workload in the high season. We analyze the cost savings by reducing ATFM delays through optimized flight dispatcher scheduling. We cover the following key aspects:

- (i) Comparison of the current ATFM delay costs in the high season against the projected costs after implementing the optimized workload.
- (ii) Calculation of the potential savings from the reduced delays.

- (iii) Assessment of the costs of hiring additional flight dispatchers, if necessary.
- (iv) Net financial impact highlighting the overall savings and the cost of the TBP approach.

Step 3: Financial impact analysis

- I. Current high season delay cost:

$$Cost_{current} = 29,044 \text{ mins} \times \text{€}100 = \text{€}2,904,400.$$

- II. Projected high season delay cost with the desired workload:

$$\text{Applying the off-season delay ratio: } Cost_{projected} = 1.686 \times 11,033 \times \text{€}100 = \text{€}1,859,600.$$

- III. Savings from the reduced delays:

$$\text{Savings} = \text{€}2,904,400 - \text{€}1,859,600 = \text{€}1,044,800.$$

- IV. Net savings, including the cost of additional dispatchers:

$$\text{- Cost of the additional dispatchers: } 8 \times \text{€}13,000 = \text{€}104,000.$$

$$\text{- Net savings: } \text{€}1,044,800 - \text{€}104,000 = \text{€}940,800$$

Table 4.3. The Financial Impact of the Optimized Flight Dispatcher Workload Analysis

Parameter	High-Season	Off-Season	Notes
Current ATFM delay cost	€2,904,400	-	Total delay (mins) x €100
Projected delay cost (Optimized workload)	€1,859,600	-	Using off-season delay ratio for high season projection
Savings from reduced delays	€1,044,800	-	Difference between current and projected costs
Cost of additional dispatchers	€ 104.000	-	Based on a yearly salary
Net savings	€ 940,800	-	Savings minus the cost of additional flight dispatchers

Table 4.3 shows the financial impact of the optimized dispatcher workload during the high season. By applying the off-season workload metrics to the high season, we project net savings of €940,800 in ATFM delay costs for Airline X. This finding clearly illustrates the cost reduction potential from the reduced delays and the financial impact of hiring additional dispatchers, highlighting the importance of aligning high season operations with the proven efficiency of the off-season.

4.3. Implications for Airline X

In Chapter 4, we present a comprehensive analysis of the flight dispatcher workload at Airline X, aligning it with the operational and financial metrics in the aviation industry. This analysis is essential for understanding the implications of operational efficiency, particularly in the context of substantial navigational costs incurred by airlines in the region.

Regarding human resources, with the necessity for an additional eight dispatchers, a financial commitment of €104,000 is warranted. This investment is significant in maintaining operational efficiency. Moreover, optimizing the crew tolerance times and reducing reliance on ATFM slots can lead to further labor costs.

In financial terms, the forecast indicates substantial savings for Airline X, amounting to €940,800. This is a direct consequence of the proposed staff optimization and a strategic response to the considerable navigational costs in the region. The airline should integrate these findings to enhance its financial strategy. In-flight planning, efficient dispatcher workload management will improve flight planning processes and minimize operational delays. This is crucial in maintaining a competitive edge, particularly alongside the navigational cost strategies of significant airlines in Turkey.

Finally, the strategic implications for Airline X are profound, especially in light of the fact that the two major airlines in Turkey, i.e., Turkish Airlines and Pegasus, had a combined navigational cost of €1,377,486,000 in 2022 (Pegasus and Turkish Airlines Annual Report, 2022). This significant expense underlines the need for

Airline X to closely monitor the navigational costs and operational efficiencies of regional competitors in its strategic planning to enhance its market position.



CHAPTER V

CONCLUSIONS AND DISCUSSIONS

The aviation industry has shown increasing growth over the last decades with a significant increase in airline operations. This dynamic environment pushes airlines to focus more on providing timely and safe services to customers. In this context, flight dispatchers play a critical role in ensuring the smoothness, efficiency, and safety of flight operations. This study examines the relationship between flight dispatcher workload and cost efficiency for a single airline, specifically Airline X, in Turkish aviation, focusing mainly on Air Traffic Flow Management (ATFM) delays. We use daily flight data of Airline X from June to August 2022 on flights to West Europe, Central Europe, and Great Britain, as these regions experience high rates of ATFM delays compared to other destinations and allow us to concentrate our efforts on areas with the most tremendous potential for cost savings by the improved flight dispatcher performance. We analyze the potential benefits of optimizing flight dispatcher workload in reducing ATFM delays and their associated costs. We employ De Cauwer's Temporal Bin Packing Problem methodology to examine the multifaceted nature of the dispatcher workload, covering critical issues such as seasonal workload fluctuations and their associated operational and financial effects

The results show the impact of the optimized dispatcher workload during the high season. By applying the workload metrics of the off-season to the high season, we forecasted net savings of €940,800 in the ATFM delay costs for Airline X. This saving comes from the cost reduction potential resulting from the reduced delays and the financial impact of hiring an additional eight dispatchers, totaling €104,000. This finding highlights the importance of aligning high-season operations with the proven efficiency of the off-season and underscores the financial benefits of strategic workload management. Moreover, optimizing crew tolerance times and reducing reliance on ATFM slots may lead to further labor cost reduction.

The findings indicate that Airline X may adopt a dynamic and flexible staffing policy to respond to seasonal demand fluctuations during peak times rather than staffing based on lower-demand periods. This would necessitate maintaining a reserve pool of flight dispatchers for unexpected situations to balance the workload during the high season and prevent burnout while enhancing efficiency. Aligning dispatcher schedules with seasonal fluctuations will minimize ATFM delays and reduce operational costs. Continuous evaluation of this methodology is vital to ensure the effectiveness of the operations. Moreover, Airline X may employ advanced automated flight planning systems, particularly domestic flights, with consistent routes and schedules to streamline operations, reduce manual workload, and minimize human errors. Airline X should also integrate these findings into its financial strategy to leverage the forecasted substantial net savings from the management of dispatcher workload. Finally, Airline X should invest in continuous training to ensure that flight dispatchers are well-equipped with the latest tools, become more proficient in flight planning, workload management, and informed decision-making.

5.1. Implications of the Study

The study provides valuable insights for the airlines across operational, financial, and strategic dimensions. The findings indicate the need for a systematic approach to optimize flight dispatcher workload, creating a balance between active demand and resource allocation. Aligning dispatcher schedules with seasonal fluctuations can curtail ATFM delays, leading to significant enhancement in financial and operational efficiency; this, in turn, steers airlines towards developing more sustainable strategies. Airlines may generate substantial savings by managing the workload of flight dispatchers and reducing ATFM delay costs, strategically using these resources to foster their financial stability further and enhance their competitive position and market performance in the aviation industry.

The findings also underscore the pivotal role of flight dispatcher workload on efficiency and safety, offering valuable insights for airline management in handling the dynamic nature of operational demand and in adapting a roadmap to ensure uninterrupted operations by following an active approach to scheduling and resource allocation. This would increase service quality and customer satisfaction, enhancing

the performance of airlines. By building on these insights, airlines can refine their operations and successfully position themselves.

5.2. Limitations of the Study and Future Research

We acknowledge that this study has some limitations. First, it covers only a six-month period, i.e., summer and winter seasons, that may not fully capture the variations in the flight dispatcher workload throughout the entire year. This limitation may result in a partial view of the seasonal impact on dispatcher operations. Future studies may address this limitation by incorporating a full-year analysis to capture a more holistic view of the flight dispatcher workload. Second, this study focuses only on a single airline company that has experienced high ATFM delays and examines flights to the selected regions, i.e., West Europe, Central Europe, and Great Britain. This prevents the generalization of the findings. Future research may extend the coverage and analyze more airlines and regions to produce more refined results. Third, the cost of the ATFM delays is estimated to be between Euro 59 to Euro 85 per minute for direct expenses. Still, it did not cover the full spectrum of indirect costs associated with these delays, such as maintenance, handling and airport charges, passenger-related costs, and operational disruptions. The complexity in calculating these costs adds another challenge to thoroughly to examine the financial effect of the ATFM delays fully. Gaining access to the detailed fleet and cost data for the airlines would significantly enhance the ability to accurately quantify direct and indirect costs and benefits of the flight dispatcher workload optimization.

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