



**INFLUENCE OF JOB DEMANDS, JOB RESOURCES, AND PERSONAL
RESOURCES ON AIR TRAFFIC CONTROLLERS' JOB STRESS AND JOB
PERFORMANCE IN SAUDI ARABIA**

By

ALAYDI BADER IBRAHIM S

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia,
in Fulfilment of the Requirements for the Degree of Doctor of Philosophy**

June 2022

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy

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Air Traffic Control (ATC) is a major component of the aviation industry as it plays a substantial role in ensuring flight safety. If ATC performance is compromised, tragedies may happen. As a result, ATC is recognized universally as a highly stressful occupation. Based on the job demands-resources theory (JDR), a framework was developed to investigate the impacts of job complexity, mental workload, mindfulness, and training on job stress and job performance, via the moderating role of intra-functional flexibility and social work support. Although many studies have investigated the relationships between job complexity, mental workload, training, mindfulness, stress and job performance, there remain several unaddressed gaps related to conflicting findings on the mental workload–job performance, job complexity–job performance, mindfulness–job stress, and mindfulness–job performance relationships. Also, the literature calls for more investigations on the moderating roles of intra-functional flexibility and social work support, given the importance of understanding the conditions that influence the job stress–performance relationship in Saudi Arabian ATC. The study was conducted on air traffic controllers across ATC units in Saudi Arabia using the proportional stratified sampling technique. The sample size comprised 450 air traffic controllers, from whom 324 questionnaires were received with no missing data, yielding a response rate of 72 percent. The analysis results indicate that most of the findings are in line with the JDR model and previous studies. Furthermore, it was found that intra-functional flexibility and social work support weaken the health impairment process while intra-functional flexibility strengthens the motivational process, as expected. However, there were a few surprising results; for example, job stress only mediated the relationship between training and job performance, whereas mindfulness only exhibited a positive influence on job performance and showed no effect on job stress. This study contributes to the literature in four ways. First, it extends the JDR theory to the ATC context. Second, the JDR health impairment process (demand-stress-performance) was tested using job stress as mediator, and new job demand (job complexity) and personal resource (mindfulness) variables were introduced to the JDR model. Third, the study verified critical linkages

between mental workload–job performance, job complexity–job performance, mindfulness–job stress, and mindfulness–job performance. Fourth, the boundary conditions (social work support and intra-functional flexibility) that alter the relationships proposed by the JDR model were identified. Theoretical implications, practical recommendations to ATC organizations, and limitations and future research are discussed.



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PENGARUH PERMINTAAN KERJA, SUMBER KERJA, DAN SUMBER PERIBADI TERHADAP TEKANAN KERJA DAN PRESTASI KERJA PENGAWAL TRAFIK UDARA DI ARAB SAUDI

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Kawalan Trafik Udara (*ATC*) adalah komponen utama dalam industri penerbangan kerana ia memainkan peranan besar dalam memastikan keselamatan penerbangan. Sekiranya prestasi *ATC* terjejas, tragedi mungkin berlaku. Oleh sebab itu, *ATC* diiktiraf di seluruh dunia sebagai pekerjaan yang bertekanan tinggi. Berdasarkan teori sumber-tuntutan kerja (*JDR*), satu rangka kerja telah dibangunkan untuk menyiasat kesan kerumitan kerja, beban kerja mental, keprihatinan, dan latihan terhadap tekanan kerja dan prestasi kerja melalui peranan penyederhana fleksibiliti intra-fungsi dan sokongan kerja sosial. Walaupun banyak kajian telah meneroka hubungan antara kerumitan kerja, beban kerja mental, latihan, keprihatinan, tekanan, dan prestasi kerja, masih terdapat beberapa jurang yang tidak dijelaskan berkaitan dapatan bercanggah mengenai hubungan beban kerja mental–prestasi kerja, kerumitan kerja–prestasi kerja, keprihatinan–tekanan kerja, dan keprihatinan–prestasi kerja. Tambahan pula, literatur memerlukan lebih banyak penyiasatan tentang peranan penyederhanaan fleksibiliti intra-fungsi dan sokongan kerja sosial, memandangkan kepentingan memahami syarat yang mempengaruhi hubungan tekanan–prestasi kerja di *ATC* Arab Saudi. Kajian ini dijalankan ke atas pengawal trafik udara merentasi unit *ATC* di Arab Saudi menggunakan teknik persampelan berstrata berkadar. Saiz sampel terdiri daripada 450 pengawal trafik udara, dari mana 324 soal selidik diterima tanpa data yang hilang, lalu menjana kadar jawapan 72 peratus. Hasil analisis menunjukkan yang kebanyakan dapatan adalah selaras dengan model *JDR* dan penyelidikan terdahulu. Selain itu, didapati bahawa fleksibiliti intra-fungsi dan sokongan kerja sosial mengurangkan proses kemerosotan kesihatan manakala fleksibiliti intra-fungsi mengukuhkan proses motivasi, seperti yang dijangkakan. Namun, terdapat beberapa keputusan yang luar biasa. Contohnya, tekanan kerja hanya memberi kesan pengantara dalam hubungan latihan dengan prestasi kerja, manakala keprihatinan hanya menunjukkan kesan positif ke atas prestasi kerja dan tiada kesan ke atas tekanan kerja. Kajian ini menyumbang kepada literatur dalam empat cara. Pertama, ia memperluaskan teori *JDR* kepada konteks *ATC*. Kedua, proses kemerosotan kesihatan *JDR* (prestasi-tekanan-tuntutan) diuji

menggunakan tekanan kerja sebagai pengantara, dan pembolehubah tuntutan kerja baru (kerumitan pekerjaan) dan sumber peribadi (keprihatinan) diperkenalkan kepada model *JDR*. Ketiga, kajian ini mengesahkan hubungan penting antara beban kerja mental-prestasi kerja, kerumitan kerja-prestasi kerja, keprihatinan-tekanan kerja, dan keprihatinan-prestasi kerja. Keempat, syarat sempadan (sokongan kerja sosial dan fleksibiliti intra-fungsi) yang mampu mengubah hubungan-hubungan dalam model *JDR* telah dikenal pasti. Implikasi teori, cadangan praktikal kepada organisasi *ATC*, dan limitasi serta kajian masa depan turut dibincangkan.



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LIST OF ABBREVIATIONS

ATC	Air Traffic Control
ICAO	International Civil Aviation Organization
IATA	International Air Transport Association
CANSO	Civil Air Navigation Services Organization
ACI	Airports Council International
TWR	Tower
APP	Approach
ACC	Area Control Center
IMF	International Monetary Funds
IFATCA	International Federation of Air Traffic Controllers' Association
FAA	The Federal Aviation Administration
GACA	General Authority of Civil Aviation
SANS	Saudi Air Navigation Services
ANSP	Air Navigation Services Providers
KKIA	King Khaled International Airport
KAIA	King Abdulaziz International Airport
KFIA	King Fahd International Airport

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter presents a brief background about the global aviation industry. Then, details about the aviation industry in Saudi Arabia, including its airports and air traffic control (ATC), are presented. Subsequently, the problem statement is discussed, followed by the research questions and research objectives. Next, the chapter continues with the significance of the study, definitions of the main concepts, and scope of the study. Lastly, the organization of the thesis is outlined.

1.2 Aviation Industry

Since the flight was born on December 17th 1903, air transport has become an essential form of transportation for many industries (Wittmer, Bieger & Muller, 2011). The aviation industry has grown into a highly complicated industry with numerous professional players. Historically, commercial air transport started at the end of the First World War, as the development of big aircrafts took place in the years after. With the increased demand for air travel, there was a need to use technology to facilitate travel and ensure safety through radar and radio communications (Urdiales, 2019). Air transport maintained its growth, especially after the privatization trend of airlines in the 1980s and the liberalization of air transport (Urdiales, 2019). Such growth was coupled with various related developments in technical aspects of planes (e.g., from glider to jet engines), political ties (e.g., agreements between countries allowing planes to fly in foreign countries' airspace), quality and cost enhancements (e.g., commercial aviation became more reliable and more airlines entered the market, forcing prices to go down), networks, alliances and low-cost operations (e.g., expansion of airlines to new destinations due to increased demand and alliances, ticket price drops following deregulations of ticket pricing and competition from low-cost carrier market), and customer value creation (e.g., online ticket sales, which reduce sales cost by minimizing sales offices and salespeople) (Wittmer & Bieger, 2011).

1.2.1 Aviation Structure

There are a few main players who have built the structure of aviation. First, the International Civil Aviation Organization (ICAO) of the United Nations is one of the most successful organizations; it is responsible for setting rules and regulations for aviation safety, security, efficiency, and regularity, as well as for aviation environment protection. Apart from that, ICAO is responsible for developing the framework that allows international air transport to operate with the key strategic objective of maintaining a safe aerospace (ICAO, 2020). Second, the International Air Transport

Association (IATA) is “the prime vehicle for inter-airline cooperation in promoting safe, reliable, secure and economical air services - for the benefit of the world's consumers” (IATA, 2020). Third is the Civil Air Navigation Services Organization (CANSO), which represents air navigation service providers and ATC providers. The main objective of this organization is to “provide safe and efficient air navigation service provision, maintain an international forum for developing and exchanging ideas on current air traffic management related issues and develop an international network for air navigation services experts to exchange information and promote best practices within ATC” (CANSO, 2020). Last is the Airports Council International (ACI), which was established in 1991 with the main objective of increasing airports’ contributions while maintaining and developing a safe, secure, efficient, and environmentally compatible air transport system (ACI, 2020).

Although IATA is a profit-driven entity representing commercial airlines, it states clearly that safety remains its main priority (IATA, 2020). This declaration has been confirmed by CANSO and other air navigation service providers who offer ATC services. These services are given to aircrafts flying in a designated airspace to maintain their safe operation and to expediate flight flows from/to airports. Thus, the main objective of ATC service is to ensure the safe operations of flights (ICAO, 2016). In fact, a simple ATC error could result in major tragedy (Poole, 2013). ATC services are provided through three units based on the area of responsibility. The first unit is the tower (TWR), which provides ATC for aircraft departures and arrivals in the vicinity or at the airport. The second unit is the approach (APP) or terminal unit, which directs arriving aircrafts’ approach to the assigned runway to land as well as departing aircrafts’ ascent to higher altitudes or a specific point. The third is the area control center (ACC) or enroute control center, which controls departed aircrafts’ higher altitude, supervises over flyer aircrafts (across countries), and guides arriving aircrafts’ descent to a certain altitude. Figure 1.1 shows the area of responsibility of each unit.

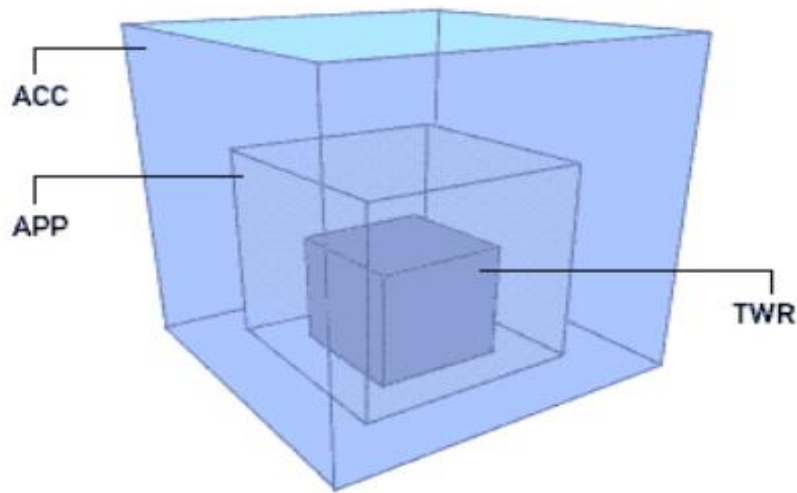


Figure 1.1 : ATC Units' Area of Responsibility (APP= Approach; TWR= Tower; ACC= Area Control Center)
 (Source: International Virtual Aviation Organization 2021)

Although ATC is considered a supporting player in the aviation industry (Wittmer et al., 2011), it is arguably the most important player due to its role of ensuring the safety of flights. Indeed, international and regional airports would shut down their operations if ATC services cannot be provided for whatever reason (ICAO, 2021).

1.2.2 Air Travel Demands

Over the years, the aviation industry has seen major fluctuations in demand regionally and globally due to various factors. For example, the 9/11 attack caused huge losses to the airlines and tourism industry due to tough restrictions imposed on international flights and lower demand (Klitzman & Freudenberg, 2003). Another example is the global economic crisis in 2007, when oil price surges increased the operational cost of flights, forcing many airlines to exit the market (IATA, 2020). Further, the IATA reported that the economic crisis cost the aviation industry two years of growth (IATA, 2020). Also, different viruses have impacted the aviation industry over the years, such as SARS in 2003, avian flu in 2005 and 2013, swine flu in 2009, and MERS in 2015 (ICAO, 2020).

Today, the aviation sector is struggling with the impacts of the new virus, COVID-19, that started in China and spread across the world in just a few months, leading most countries to fully or partially close their borders. The IATA stated that the year 2020 was “the worst year in the history of air travel demand,” as demand for flight seats dropped by about 70% compared to 2019, especially in Europe and the Middle East (IATA, 2020). According to KPMG (2021), COVID-19 triggered the worst global recession

since the Second World War. The global economy and per capita income plummeted in 2020 and were expected to stay down throughout 2021. Global Gross Domestic Product (GDP) dropped 4.4 percent in 2020 from an average growth of 2.8 percent at the end of 2019. However, the International Monetary Fund (IMF) expected 5.5 percent GDP growth in 2021 as a result of financial support from the government (KPMG, 2021). Moreover, ICAO projected that 71 percent of 2019's demand level would recover by June 2021, with the worst-case number being 50 percent. KPMG, as airlines' global consultant, indicated that full recovery will be in 2023, at the latest (KPMG, 2021). From another perspective and in response to COVID-19 standard operating procedures (SOPs), the International Federation of Air Traffic Controllers' Association (IFATCA) (2020) highlighted that 83 percent of ATC providers were suspended from on-the-job training, as ATC facility operations were reduced during the pandemic to manage low ATC service demand. Such action has caused numerous air traffic controllers to lose their current working license and even their sense of working with high aircraft volumes by the time demand increases.

1.2.3 The Impact of Air Travel Growth

Considering the optimistic views of aviation experts, the near future will bring air travel demands to higher levels than in 2019. This indicates the need for every player, including ATC providers, to be ready to manage the gradual or sudden increase of flights (ICAO, 2020). A greater volume of flight movements will directly exert high workloads and pressure on air traffic management as well as more job complexity, considering how complicated the role is (Radišić, Andrašić, Novak, Juričić & Antulov-Fantulin, 2020). Furthermore, there is a global shortage in technical aviation employees, including air traffic controllers and pilots. Indeed, qualifying and placing air traffic controllers in their job takes a long time, which demands existing air traffic controllers to work overtime and for longer hours (Chang, Yang, & Hsu, 2019). In addition, the aviation industry is not able to cope with the human resources required to manage the increase of flights (Gyles & Bearman, 2017). As a result of the shortage and increased workload, air traffic controllers are suffering from fatigue (Chang et al., 2019), which is a source of stress (Qureshi, Iftikhar, Abbas, Hassan, Khan, & Zaman, 2013). ATC services have thus become more stressful than ever, as they have the responsibility to ensure that all flights operate efficiently (Pant, Taukari, & Sharma, 2012). This is seen as one of the reasons young people are reluctant to enter this industry (Chang et al., 2019), which in turn, causes insufficient human resources to manage flight growth (Gyles & Bearman, 2017).

1.2.4 Flight Safety

The safest transportation channel is known as air travel; however, the huge losses associated with its accidents lead to catastrophic phenomena (skybrary, 2021). The Federal Aviation Administration (FAA) indicated that 88 percent of aircraft accidents are caused by human errors, of which ATC is a part (FAA, 2021). For example, in 1976, a collision between two aircrafts resulted in the death of 169 people. The investigation indicated a miscoordination between air traffic controllers, who were found to be under severe stress and heavy workloads (skybrary, 2021). More recently in 2012, a military

passenger flight crashed into a mountain in Sweden due to wrong ATC instructions, killing all the passengers on board (skybrary, 2021). These incidents highlight the importance of ATC services in the aviation industry. Indeed, safety is the biggest concern of all aviation members, which has prompted them to make safety priority number one, as reflected in their vision statements (ICAO, 2021; IATA, 2021; CANSO, 2021; ACI, 2021).

As indicated earlier, higher ATC service demand along with insufficient manpower could lead to ATC failures and errors, which have grave repercussions. Undeniably, the safety of a flight is heavily dependent on the performance of air traffic controllers (Chen, Lu, & Mao, 2019). In the ATC function, even a simple error is unacceptable because it can lead to a collision (skybrary, 2021). A total of 41 collisions have been reported as a result of ATC errors (Poole, 2013). Human errors happen due to different reasons, such as increased mental workload (Edwards, Sharples, Wilson, Group, Rail, Kirwan, & Centre., 2012), high stress levels (Bongo, Mae, Alimpangog, Loar, Montefalcon, & Ocampo, 2018), fatigue (Chang et al., 2019), and air traffic controllers' violations of regulations and rules (Mearns, Kirwan, Reader, Jackson, Kennedy, & Gordon, 2013). Table 1.1 shows examples of simple errors that impact flight safety.

Table 1.1 : Simple ATC Errors and Consequences

ATC Error	The Case	Result	Source
Contradicting instructions between the ATC and the aircraft traffic collision avoidance system	Increased workload accompanied by 2 conflicts aircrafts where the ATC instructed one pilot to descend and leaving the other one as is.	Air-collision	Incomopedia.com
Miscoordination, wrong procedures, sleepy controller	Approach controller gives clearance to an aircraft while 3 fuel vehicles loaded with 7 3 tons on the runway	Ground collision with 3 vehicles on the runway	Incomopedia.com
Passing wrong atmospheric pressure readings	Controllers passes the reading as 757 while it is 737	The aircraft crashed with terrain	Incomopedia.com
wrong assumption and lack of situational awareness of the Air Traffic Controller.	ATC released a flight to descend while there is another flight at lower altitude and with the operation of TCAS, evasive action by the descending aircraft resulted in loss of the control of the flight	Aircraft crashed	Incomopedia.com
ATC bad judgement	Clearing a flight to land while a flight is on the runway	Missed-collision	Skylibrary.com
ATC lack of situational awareness	Clearing an aircraft to cross the runway while another aircraft was about to land causing the landing aircraft to go around for another approach	Runway Incursion	Skylibrary.com
ATC lack of situational awareness	Clearing an aircraft to land while another aircraft on the runway, the landing aircraft crashed with the one on the runway and couldn't avoid it	Collision on the runway	Skylibrary.com
ATC lack of situational awareness	Controller allowing aircraft to takeoff while a vehicle is on the runway, the flight airborne before reaching the vehicle	Runway Incursion	Skylibrary.com
inappropriate phraseology by ATC	Departing aircraft on the runway while another one is crossing the runway	Runway Incursion	Skylibrary.com

Clearly, poor performance among ATC staff can lead to severe tragedy. Errors that reflect low performance include communication issues, lack of awareness, bad judgement, lack of knowledge, and miscoordination. Such errors are attributed to air traffic controllers' job stress (Flyingway, 2019), taking into consideration that fatigue is managed and controlled by the management fatigue system (ICAO, 2020).

1.3 Aviation Industry in Saudi Arabia

The General Authority of Civil Aviation (GACA) of Saudi Arabia emerged from the precedency of civil aviation in 2006. The main vision of this organization is to create a safe and secure aviation environment in accordance with the most rigorous international safety standards, as well as to build a modern airport system that offers consistently exceptional, state-of-the-art service. The key driver of this transformation is aviation industry development via the philosophies of commercialization, safety, and security (GACA, 2006b). GACA moved in this direction after considering the competitive advantages represented by

Saudi's huge strategic airspace location (GACA, 2006a) and two Islamic religious destinations. Currently, GACA builds, maintains, and operates 27 airports in Saudi Arabia and provides ATC services to Saudi airspace users (GACA, 2020).

Before the emergence of GACA, airports and ATC services in Saudi Arabia were run under a centralized system managed by the government. It is well-known that the government's central system is slow in responding to the dynamic changes in air navigation service and airport business operations (e.g., marketing/operational directions and objectives) because of its financial constraints and high costs (GACA, 2006b). The adoption of the commercialization philosophy by GACA aimed to transform Saudi airports from being cost centers to profits centers. It also sought to make air navigation services operate on a cost recovery basis to cover its total cost. To achieve these objectives, GACA initiated a transformation program (GACA 2006b), for which it contracted an international company to develop a new structure and strategic plan. The main strategic changes were the restructuring of GACA and the creation of six strategic business units, including King Abdul-Aziz Int'l Airport (KAIA), King Khaled Int'l Airport (KKIA), King Fahd Int'l Airport (KFIA), Information Technology (IT), Air Navigation Service Provider (ANSP), and Domestic Airports. The main goal of the restructuring was to achieve operational efficiency and effectiveness by decentralizing management. Each of the six units operate independently and effectively to meet the strategic objectives set by GACA. In the second phase of the transformation, GACA created a holding company, to which the ownership of the six strategic business unit was transferred. Thus, the six business units are currently corporatized under the holding company (Matarat, 2020).

With regard to the airport's operational issues, changes were made to the marketing function. New departments were created, such as commercial and advertising development, property development, and traffic development. Such changes were aimed to promote Saudi airports to airlines and commercial organizations. In addition, the traffic development unit's role is to attract more airlines to open new routes to new destinations and to convince existing airlines to open new destinations and increase the frequency of flights. Designed to create a customer-oriented culture and improve service quality, these marketing efforts are expected to increase the volume of air traffic movements (GACA, 2006; Alghamdi, 2019, Dec 10, Phone interview).

Saudi Air Navigation Services, which is the ATC provider in Saudi Arabia, has spent remarkable efforts to operate effectively and provide excellent services to aerospace users. These efforts cover all aspects of its organizational functions, especially human resources. Changes in human resources include developing a new salary scale, setting an employee development plan, attracting new ATC candidates and providing them full training, building a management performance system, and creating a job family for promotion. The goal of such changes is to increase personnel's job satisfaction and prepare qualified personnel to cope with the dynamic changes in the aviation sector. This will allow Saudi Air Navigation Services to achieve its organizational strategies, goals, and objectives (GACA, 2006b; Alghamdi, 2019, Dec 10, Phone interview).

In June 2019, Dr. Alghannam (aviation expert) acknowledged at an aviation business meeting that air traffic controllers suffer from extremely high job stress (Alghannam, June 2019). Furthermore, aviation experts highlighted that there are talks among air traffic controllers about their severe job stress, which is perceived as unusual (Alsalman, August 2019). To verify the claim of controllers' unusually high job stress with ATC management and understand the causes behind it, a phone interview was conducted with the Air Traffic Management Executive director (Mr. Alzahrani, A.) on December 20th, 2019. Indeed, he expressed concerns about the extreme stress level in the ATC service. Mr. Alzahrani said that expected global growth accompanied by the shortage of air traffic controllers has raised a warning to Saudi ATC to increase its operational capacity to handle increased air traffic movements safely and efficiently; this indicates a need for more air traffic controllers to meet the demand of service.

According to Mr. Alzahrani, the ATC has taken serious steps to attract new controllers and train them, which is an ongoing process. Also, he said they had implemented a fatigue management system to increase the work age of air traffic controllers, in addition to strong efforts to find an appropriate strategy to reduce controllers' desire to switch jobs, despite the lower turnover rate compared to other industries. Furthermore, the Saudi ATC has spent considerable efforts to improve the working conditions of ATC air traffic controllers by updating the ATC infrastructure with the latest technology, setting up a recreational facility at the workplace for controllers to relax and refresh themselves, and contracting well-known names in the food and beverage sector to cater to the ATC workplace (Alzahrani, 2019, Dec 20, phone interview)

Mr. Alzahrani further stressed two important issues related to ATC in Saudi Arabia. First, unusual job stress is one of the main factors affecting job performance among controllers. Taking in mind that the ATC function is considered a mental function with minimal physical effort, he indicated that the difficulty of tasks, the complicated areas of responsibility, and the increased workload especially during peak times (e.g., summer, holidays, Hajj and Umrah seasons) are the main causes of job stress. Other causes of job stress include the shortage of controllers during summertime, conflict between pilots and controllers, and controllers' fatigue. He further clarified that the ATC job is known for its stressful nature, which can be managed yet should not exceed an undesirable level of stress. The second issue he raised is that increased workload, moderate support, moderate training, and shortage of air traffic controllers are the main causes of poor performance among ATC. Overall, to him, job stress is the key factor leading to worsening ATC performance (Alzahrani, 2019, Dec 20, phone interview).

Furthermore, Mr. Alzahrani stated that any security issue should be taken seriously by ANSP due to its impact on the country's reputation, which in turn, makes the country be classified as unsafe aerospace by ICAO. Moreover, a higher number of safety-related issues will increase the likelihood of accidents between flying aircrafts or ground vehicles at airports. ATC management should conduct in-depth investigations to reduce the likelihood of accidents and take all necessary measures when an accident occurs. Saudi ATC follows international procedures and policies in case of a report about safety (Alzahrani, 2019, Dec 20, phone interview).

Table 1.2 summarizes the findings of the interview, namely the issues and concerns raised as well as their impacts or explanations.

Table 1.2 : Issues and impacts

Concern/Issue	Impact/ explanation
Increased workload due to local and global growth	Air traffic controllers have more flights at the same time, making them feel stressed and nervous and thus lose concentration, which will lead to errors and mistakes.
Work age of air traffic controllers	Loss of experienced air traffic controllers due to health issues caused by the stressful environment
Lack of full concentration of some air traffic controllers while working	Originates from the high stress, which causes increased errors
Negative reports from airlines	Delays, nervous tone, safety issues, lack of knowledge
Complaints from controllers	Workload, arguments with pilots, long working hours with short breaks in between, disapproval of vacation requests most of the time due to staff shortage, limited training on new knowledge, and limited support from supervisors and colleagues
Young air traffic controllers wish to switch to another job	They complain about the high stress and are afraid of mistakes and errors

1.4 The Problem Statement

The ATC work environment is characterized as highly stressful due to the huge responsibilities associated with the services provided (Pant et al., 2012; ICAO, 2016). This responsibility is associated with the risk of losing human lives and a large value of assets in the case of even the smallest human error (Chen et al., 2019). As such, for the ATC to function well, it needs multiple resources, as follows: 1) skillful, qualified, mindful and knowledgeable controllers; 2) ATC infrastructures such as ATC management system, radio communication, hotlines, and radars; and 3) management support. Some of these resources' efficiency has been compromised due to work overload and inflexible management support, which leads to heightened stress and reduced performance. Thus, there is a need to uncover the resources that support the functioning of the ATC.

The main issue faced by Saudi air traffic controllers is the unusually high level of job stress caused by several factors. One factor is the growth of flight numbers, which leads to a heavier workload and a more complex job. Job complexity varies from one ATC sector to another due to the aerospace design (horizontal and vertical) of the area under responsibility as well as the number of flights flying in this area, which represent discrepancies between the sectors. In reality, some ATC sectors have a smooth area where flights can be controlled without restrictions, while other sectors do not. The more flights in the area, the higher the job complexity and consequently, the more stressed the air traffic controllers. Also, the increase of workload incurs a heavier mental burden to manage flights in a safe manner, considering that ATC is a mental function with

minimum physical demand. This requires air traffic controllers to properly estimate incoming flights ahead of time and perform the best planning prior to flight arrivals in their sectors. As a result, air traffic controllers endure a high level of stress.

The second factor is related to the loss of concentration on some occasions for one reason or another. This makes the controllers stressed and lose the picture of flights, causing errors in the ATC service. The third factor is related to mediocre training, especially on-the-job training. Air traffic controllers need heavy on-the-job training in simulators, where they are made to handle difficult exercises including numerous flights with more conflicts than in real life. This would allow them to manage flights safely when they are placed in real-life situations. However, with merely moderate training, air traffic controllers face challenges in handling many flights, leading to job stress and compromised job performance.

Apart from the practical issues mentioned above, there are five literature gaps in the existing ATC literature. The first gap is related to the job demands and resources that influence the job stress of air traffic controllers in Saudi Arabia. Dimensions of the Job Demands-Resources (JDR) model specific to ATC have been under-researched, as the literature related to general occupations has mainly operationalized job demands as time pressure, role overload, and workload (Soderfeldt, Soderfeldt, & Warg, 1995; Demerouti et al., 2001; Bakker, Lieke, Prins, & Heijden, 2011), problematic reorganization and poor environmental conditions (Bakker, Demerouti, Boer, & Scabufeli, 2003), and budget cost management (Peeters & Le Blanc, 2001). On the other hand, mental workload and job complexity (Pant et al., 2012; Mogford, Guttman, Morrow, & Kopardekar, 1995) are specific job demands that often arise within the scope of the ATC job (Pant et al., 2012; Mogford et al, 1995; ICAO, 2016). As a job demand, the impact of mental workload on job stress is well-established in the ATC context (Bongo et al., 2018) and the job complexity–stress relationship is proven among travel agents (Naqvi, Mark, Shabbir, & Smm, 2017). Moreover, a few studies have indicated that job complexity is a predictor of mental workload (Athènes et al., 2002; Majumdar & Ochieng, 2007). However, the influence of job complexity on job stress has not been tested in the ATC context.

In addition, there are limited studies on the personal resource of mindfulness in the JDR model. Mindfulness refers to the practice of being aware of one's current situation to establish goals and concentrate on resolving the challenges faced (Dwidiyanti, Fahmi, Ningsih, Wiguna, & Munif, 2019). Mindfulness is reported to have a negative relationship with burnout (Robins, Roberts, & Sarris, 2015; Guidetti, Viotti, Badagliacca, Colombo, & Converso, 2019; Taylor et al., 2016), job stress (Grover, Teo, Pick, & Roche, 2016), and emotional exhaustion (Janssen, Van Strydonck, Decuypere, Decramer, & Audenaert, 2020). Also, mindfulness moderates the impact of emotional demands on stress (Grover et al., 2016) and the effects of negative workload appraisal on both emotional exhaustion and depersonalization (Guidetti et al., 2019).

Although mindfulness is highly popular, there are some concerns about its negative influences that might affect health (Van Gordon, Shonin, & Garcia-Campayo, 2017). Also, Britton (2018) indicated that mindfulness could possibly have a non-monotonic or inverted U-shaped curve relationship with other variables at a later point of time. This means that there is a possibility of a positive relationship becoming negative or disappearing (no relationship) over time. For instance, the positive relationship between mindfulness and job performance might cease to exist or become negative over time. Hence, it is imperative to understand if mindfulness is applicable in the ATC context. Further, training is said to reduce stress (Panigrahi, 2017) but its effect in the ATC context has not been tested empirically. Overall, there is a gap in the investigation of the relative roles of job complexity, mental workload, training, and mindfulness in determining job stress among air traffic controllers. The JDR theory acknowledges that the interplay between demands and resources can result in reasonable outcomes if appropriate resources are introduced (Schaufeli, 2017). Given that ATC is commonly associated with a heavy mental workload and complex tasks, with appropriate resources in the form of training and air traffic controllers' mindfulness, overall job stress is likely to decrease.

The second gap is related to the JDR dimensions and personal resources that influence job performance among air traffic controllers in Saudi Arabia. Although the negative influence of mental workload and job complexity (i.e., job demands) on job performance is established (Pereira, 2014; Bongo et al., 2018), ICAO has denied that extra mental workload diminishes job performance, meaning that the mental workload–job performance relationship is unclear in the ATC context. Moreover, the positive impact of training on job performance is proven (Mahadevan & Yap, 2020), but empirical research on the influence of mindfulness on job performance remains limited. In fact, the literature presents conflicting findings on the mindfulness–job performance relationship, which has not been tested within the ATC context. Some studies reported a positive relationship between mindfulness and job performance (Ngo, Nguyen, Lee, & Andonopoulos, 2020) while others reported a negative one (Lyddy Good, Bolino, Thompson & Stephens, 2021). According to Bakker, Demerouti, and Verbeke (2004), introducing appropriate resources can generate positive outcomes (i.e., job performance) in an organization. Hence, it is important to evaluate the relative impact of various job demands (i.e., mental workload and job complexity) and resources (i.e., training and mindfulness) on the job performance of air traffic controllers.

The third gap is related to the mediating role of job stress in the effects of job demands (i.e., job complexity and mental workload), mindfulness (i.e., personal resource), and training (i.e., job resource) on job performance. The mediating role of job stress in the JDR model has been studied in areas like healthcare but not in the ATC context. The impact of job demands and resources on job performance is not always direct. For instance, no direct impacts of personal resources (i.e., proactive personality) (Wang, Zhang, Thomas, Yu, & Spitzmueller, 2017) and job resources (i.e., perceived organizational support, perceived supervisory support) (Nasurdin, Ling, & Khan, 2018) were found on job performance. Also, job complexity has been linked indirectly to mental workload via equipment quality, cognitive strategy, and individual difference (Majumdar & Ochieng, 2007), while Athènes et al. (2002) indicated that job complexity

is a predictor of mental workload. Mental workload has a direct association with job stress within the ATC context (Bongo, et al., 2018); however, there is limited literature on the mediating role of job stress in the relationships between job demand aspects and job performance within ATC.

In contrast, several mediators have been reported between job demand factors and job performance. For example, Bakker and Demerouti (2014) indicated that job demands have an indirect relationship with job performance via exhaustion. Also, personal and job resources have an indirect impact on job performance via work engagement. Similarly, Al-homayan, Shamsudin, Subramaniam, and Islam (2013) reported that job stress mediates the effects of job demands and job resources on job performance.

Moreover, mindfulness as a personal resource is known to have an indirect positive relationship with job performance via creative process engagement and employee creativity (Ngo et al., 2019) and an indirect negative relationship with job performance via surface acting (i.e., unhealthy behavior) (Lyddy et al., 2021). Lastly, the positive outcomes of training within an organization have been heavily researched, such as stress reduction (Panigrahi, 2017) and performance improvement (Choudhury & Latif, 2019). However, no studies have been conducted to investigate the mediating effect of job stress on the training–job performance relationship within the ATC context. Also, the cognitive activation theory claims that stressors (positive or/and negative inputs) pass through an evaluation process, upon which a response to the stress is generated (Ursin & Eriksen, 2004). This means stressors activate stress, following which a reaction takes place accordingly. Furthermore, the JDR theory proposes dual processes; the health impairment process driven by job demands and the motivational process driven by resources. The health impairment process starts with job demands that deteriorate health and well-being, which then worsens job performance. Meanwhile, the motivational process starts with resources that develop positive outcomes like lower job stress, which in turn improves performance. All in all, there is a gap in understanding how job demands and resources eventually translate into the job performance of air traffic controllers.

The fourth gap relates to the use of social work support as another moderator in this study. The job stress–performance relationship is not universally true. While most studies have found a significant and direct negative relationship between the two constructs (Khuong & Yen, 2016), some studies have reported an indirect relationship through job satisfaction (Chen & Fang, 2019; Munandar, Musnadi, & Sulaiman, 2019). Conversely, Jamal (1984) indicated that low job stress has no impact on job performance, while Susanty and Helmiatin (2017) found that the presence of a high level of stress does not impact job performance in the higher education sector. Likewise, Jamal (2011) claimed that at high levels of job stress, nurses' job performance increases while at low levels of job stress, there is no improvement in job performance. Furthermore, according to Abu-Alrab (2004), there is a U-shaped relationship between stress and performance, which suggests that at low or high levels of job stress, job performance is high as well.

The evidence above seems to suggest that social work support may play a moderating role that alters the stress–performance relationship. There are three considerations for this proposition. The first one is the recognition that individuals are different in their socialization capability (Soto & Jackson, 2017) and may receive differential support from co-workers (Morgeson & Humphrey, 2006). The second is the consideration that the JDR theory predicts that social work support reduces the negative impact of job demands on unfavorable outcomes such as psychological strain (Schaufeli & Taris, 2014). Thus, social work support can be considered a buffer that soothes the impacts of employees’ job stress. The third is the consideration that although social work support has been employed in different roles, its buffering role as a moderator is not decisive (Frese, 1999). Indeed, the effects of social work support on job stress and job performance are well-established (Nasurdin et al., 2018; Viswesvaran, Sanchez, & Fisher, 2017), but social work support has been used sparingly as a moderator. In this regard, the social capital theory provides a theoretical basis for social work support. It encourages cooperative behavior between team members (Nahapiet & Ghoshal, 1998) and maintains the shared goals of all group members (Putnam, 1993). Recognizing the fact that each air traffic controller may receive varying levels of social work support, there is a need to understand if social work support strengthens or weakens the relationship between job stress and job performance. There is therefore a gap in the literature to test this notion in the ATC context.

The fifth gap relates to the use of intra-functional flexibility as a moderator in this study. Intra-functional flexibility refers to flexible resource reallocation within teams and the way(s) resources are employed (Micevski, Dewsnap, Cadogan, Kadic-maglajlic, & Boso, 2019). For instance, when there are more flights or abnormal situations in ATC operations, summoning additional members from other crews and using them in the proper positions helps the working crew achieve flight safety as per standards. Despite establishing the influence of job demands and resources on job stress and job performance following the JDR model (i.e., the relationships of job complexity–job stress, mental workload–job stress, mindfulness–job stress, training–job stress), it is possible that an organizational factor like intra-functional flexibility can alter these relationships. In fact, the positive relationship between intra-functional flexibility and job performance has been established, while the moderating role of intra-functional flexibility in the relationship between stressors and salespersons’ performance has also been reported (Micevski et al., 2019). This implies the potential of intra-functional flexibility as a conditional boundary that alters the JDR relationships. Given the fact that different jobs allow different levels of intra-functional flexibility, it is important to evaluate if it applies in the ATC context. So far, intra-functional flexibility’s moderating role in the linkages among ATC demands (job complexity and mental workload), ATC resources (mindfulness and training), and air traffic controllers’ outcomes (job stress and performance) is unclear. It is thus vital to test the applicability of intra-functional flexibility in the JDR relationships to further the understanding of the boundary conditions affecting JDR.

1.5 Research Questions

The literature gaps discussed in the previous section were translated into the following general question:

- What are the influences of job demands, personal resources, and job resources on job stress and job performance among air traffic controllers in Saudi Arabia?

Five main research questions cascaded from this general question, as follows:

- 1- What are the effects of job demands (job complexity and mental workload) and personal and job resources (mindfulness and training) on job stress among air traffic controllers in Saudi Arabia?
- 2- What are the effects of job demands (job complexity and mental workload) and personal and job resources (mindfulness and training) on job performance among air traffic controllers in Saudi Arabia?
- 3- Does job stress mediate the effects of job demands (job complexity and mental workload) and personal and job resources (mindfulness and training) on job performance among air traffic controllers in Saudi Arabia?
- 4- Does social work support moderate the effect of job stress on job performance among air traffic controllers in Saudi Arabia?
- 5- Does intra-functional flexibility moderate the effects of job demands and resources on job stress among air traffic controllers in Saudi Arabia?

1.6 Research Objectives

The main objective of this study was to identify predictors and moderators that influence job stress and job performance among air traffic controllers in Saudi Arabia. The specific research objectives were as follows:

- 1- To investigate the impacts of job demands (job complexity and mental workload) and personal and job resources (mindfulness and training) on job stress among air traffic controllers in Saudi Arabia.
- 2- To investigate the impacts of job demands (job complexity and mental workload) and personal and job resources (mindfulness and training) on job performance among air traffic controllers in Saudi Arabia.
- 3- To investigate the mediating role of job stress in the effects of job demands (job complexity and mental workload) and personal and job resources (mindfulness and training) on job performance among air traffic controllers in Saudi Arabia.
- 4- To investigate the moderating role of social work support in the effect of job stress on job performance among air traffic controllers in Saudi Arabia.

- 5- To investigate the moderating role of intra-functional flexibility in the effects job demands (job complexity and mental workload) and personal and job resources (mindfulness and training) on job stress among air traffic controllers in Saudi Arabia.

1.7 Significance of the Study

The theoretical significance of this research lies in its contribution to the knowledge of the JDR model's application in the ATC context. Studies conducted within ATC have used models or theories such as the SHEL (Software, Hardware, Environment, Liveware) model (Pandey, 2019; Chang & Yeh, 2010), performance theory (Loft, Bolland, Humphreys, & Neal, 2009), swarm theory (Torres, 2012), and High-Reliability theory (LaPorte & Consolini, 1991). Notably, none have employed the JDR theory as a theoretical foundation, to the researcher's best knowledge. Thus, this study aimed to extend the applicability of the JDR theory (Demerouti, Nachreiner, Bakker, & Schaufeli, 2001) to the context of the ATC. Despite the air traffic controller job being acknowledged as one of the most stressful occupations (Pant et al., 2012), predictors of job stress from the job demands and resources aspect have been under-researched. In addressing this gap, this study provides five theoretical significances.

First, this study extends the ATC literature by identifying specific job demand dimensions that drain air traffic controllers' energy, thereby filling the gap on the unclear dimensions of job demands specific to ATC. Mental workload and job complexity (Pant et al., 2012; Mogford, Guttman, Morrow, & Kopardekar, 1995) are the specific job demands that often arise within the scope of the ATC job, verified by the job complexity–job stress and mental workload–job performance relationships. Second, this study contributes to the ATC literature by clarifying the key job and personal resources for ATC. The literature indicates that crew readiness (complete and sufficient qualified air traffic controllers), proper and reliable infrastructure for air traffic management, operational flexibility, and on-the-job and off-the-job training (ICAO, 2016) are specific to the ATC context. Costa (1995) suggested that introducing scientific knowledge, social support, job planning improvement, reduction of work time, decision-making participation, better work conditions, and new automation techniques in ATC would reduce the job stress. On this basis, mindfulness and training might help reduce ATC personnel's stress and improve their performance. By testing these relationships, this study adds value to the ATC literature.

Third, this study investigates the mediating role of job stress in the JDR model within the ATC context. With the unclear role of job stress as a mediator in the JDR model and scholars' request to investigate it in more studies and different contexts, the contribution of this study falls in clarifying and offering insights about job stress in the health impairment and motivational processes under the JDR theory.

Fourth, this study introduces social work support as a moderating variable. Considering that social work support has been employed in different functions but remains inconclusive as a moderator (Frese, 1999), it is clear that examining its buffering role between job stress and job performance in this study adds to the ATC literature. Fifth, this study introduces intra-functional flexibility as a moderating variable. Recognizing that individuals have different abilities (Soto & Jackson, 2017), this study extends the JDR model by identifying the conditions under which the identified JDR dimensions may or may not work. Specifically, intra-functional flexibility has been reported to create healthy outcomes (Micevski et al., 2019) in the workplace. In the ATC context, services are provided 24 hours and a sudden increase of ATC demand may happen due to various causes. This leaves controllers in dire need of additional support from other crews' members. ICAO (2016) has announced that air traffic controllers are needed to manage flights in a safe manner. Additional support can relieve air traffic controllers and enable them to provide ATC services as they should be. Putting these together, providing intra-functional flexibility might alter the impacts of demand dimensions on job stress. Thus, studying the moderating role of intra-functional flexibility contributes to the ATC literature.

Practically, the findings of this study bring substantial insights to ATC management, ATC training centers, the ATC human resource department, and policy makers. First, ATC management will be informed on ways to reduce stress and improve performance among air traffic controllers by understanding the influence of job complexity, mental workload, mindfulness, and training on air traffic controllers' job stress and job performance. Also, the human resource department will have a better understanding of mindfulness as a tool to reduce job stress and improve job performance. This insight will help in the selection and assessment process of new controllers applying to join the ATC. Furthermore, the human resource and ATC operation departments may consider introducing mindfulness sessions at the workplace to increase the mindfulness level of air traffic controllers.

Second, ATC training centers will benefit from the study by knowing the training content to focus on. For example, mindfulness courses may be introduced in the ATC program if it is shown to elicit a significant healthy outcome in the ATC context. Similarly, if training reduces stress, then ATC training centers could suggest higher training hours, with reasonable time intervals, as a way for air traffic controllers to recharge or regain resources before returning to the workplace with a stronger mindset.

Third, by exploring the moderating role of social work support, the human resource department can benefit by introducing appropriate strategies to increase the transparency of communication between controllers themselves or between controllers and their supervisors to create a healthy working environment. Probably, more effective team building activities could be implemented to promote teamwork and communication. Lastly, if the moderating role of intra-functional flexibility is significant in buffering the impact of job demands on job stress, ATC management can consider using intra-functional flexibility to develop an authority matrix and relevant policies as supportive tools in the provision of ATC services.

1.8 Operational Definitions

A total of eight constructs were used in this study. Each of their definitions are summarized in Table 1.3.

Table 1.3 : Definition of key terms

Construct	Definition	Sources
Job performance	Consists of task and contextual performance. Task performance is defined as “the effectiveness with which job incumbents perform activities that contribute to the organization's technical core either directly by implementing a part of its technological process, or indirectly by providing it with needed materials or services.” Contextual performance refers to the activities that “contribute to organizational effectiveness in ways that shape the organizational, social, and psychological context that serves as the catalyst for task activities and processes.”	Borman and Motowidlo (1993)
Job stress	“An unpleasant emotional experience associated with elements of fear, dread, anxiety, irritation, annoyance, anger, sadness, grief, and depression.”	Motowidlo, Packard, and Manning (1986)
Job complexity	The difficulty of tasks and the complexity associated with achieving it and the cognitive ability needed by the individuals.	Morgeson and Humphrey (2006)
Mental workload	Composed of mental demand, emotional demand, temporal demand, and performance demand.	Valdehita, Lopez & López-Higes, and Ramiro (2017)
Intra-functional flexibility	The flexibility of resource reallocation and coordination within teams and how these resources are employed and configured.	Micevski et al. (2019)
Training	“Activities that engender new behaviors.”	Kopp (2012)
Mindfulness	The ability of the individual to be aware of both inner and outer stimuli in the current situation and watch them without being judgmental.	Kabat-Zinn (1990)
Social work support	“The degree to which a job provides opportunities for advice and assistance from others.”	Morgeson and Humphrey (2006)

1.9 Scope of the Study

This study was conducted in Saudi Arabia, which has 13 ATC units providing ATC services by a total of 587 air traffic controllers. These units are Jeddah, Riyadh, Dammam, Madinah, Abha, Taif, Jazan, Qassim, Hail, Tabouk, Yanbua, Alhasa, and Najran. The unit of analysis in this study was air traffic controllers who are responsible for managing flights. Air traffic controllers' perceptions were measured because each of them may experience different levels of stress at work and may have vast differences in their perception of whether stress affects their performance. As highlighted in the problem statement, ATC performance is viewed as a critical issue in the aviation

industry. Underpinned by the JDR theory, this study took into account two job demands (job complexity and mental workload), a personal resource (mindfulness), and a job resource (training) as JDR aspects that can affect job stress and job performance among air traffic controllers in Saudi Arabia. Since the air traffic controller is known as a stressful occupation, this study also examined job stress as a mediator that can potentially impact job performance. In addition, social work support and intra-functional flexibility were proposed as moderators that can alter the strength of the motivational process and/or weaken the health impairment process.

1.10 Organization of the Thesis

This section presents the chapter-based organization of this thesis. The general overview of the chapters is:

(i) Chapter One: Introduction

This chapter starts by presenting the background of the aviation industry. Second, details about the aviation industry in Saudi Arabia are introduced. Third, the problem statement is explained, followed by the research questions and research objectives. Fourth, a short section shows the significance of the study. Fifth, it outlines the operational definitions of the constructs before discussing the scope of the study. The last part presents the organization of the thesis and a chapter summary.

(ii) Chapter Two: Literature Review

Chapter Two presents a critical review of the related literature on job performance, mental workload, job complexity, intra-functional flexibility, training, mindfulness, social work support, and job stress. It starts by defining job performance, along with the different theories, models, dimensions, and empirical studies of job performance, as well as job performance in the ATC. After that, mental workload and job complexity as job demand aspects in the ATC and intra-functional flexibility and training as job resource aspects are introduced. Then, the personal resources, namely mindfulness and social work support, are defined and explained. Following this, job stress' history, definition, and coping mechanisms are presented, followed by the cognitive activation theory of stress. The remaining parts of this chapter include identifying the research gaps and concluding with a brief summary of the chapter.

(iii) Chapter Three: Hypotheses Development

This chapter begins by presenting the conceptual framework of the study, followed by the justification for each hypothesis. A total of 18 hypotheses are developed in relation to the relationships among job demands (mental workload and job complexity), personal and job resources (mindfulness and training), job stress, and job performance. Also, it shows the reasoning for proposing job stress as mediator between the JDR aspects and

job performance. Moreover, social work support and intra-functional flexibility are explicated as moderators that impact the proposed relationships.

(iv) Chapter Four: Research Methodology

This chapter presents the blueprint for how the research was conducted. It starts by introducing the research paradigm, research strategy, target population, sampling frame, sampling technique, and sample size determination. Then, the measurement scales for all eight constructs in the study are presented, followed by pre-test and pilot test procedures and data collection procedures. Subsequently, data analysis is explained using two statistical software, namely the Statistical Package for the Social Sciences (SPSS) and Partial Least Squares Structural Equation Modeling (PLS-SEM). This includes the methodology of data analysis for the measurement and structural models.

(v) Chapter Five: Data Analysis and Findings

This chapter presents the data analysis, starting with the how the data was cleaned and prepared before depicting the profile of the respondents. Subsequently, it explains the evaluation of the measurement model and the higher-order constructs, followed by the descriptive analysis results. Next, the evaluation of the structural model is explained, covering the five assessment steps, mediation effects, and moderation effects. Last, the overall results of the proposed hypotheses are reported.

(vi) Chapter Six: Discussion

This chapter starts by discussing the major findings of the direct, mediating, and moderating hypothesis. Then, theoretical and managerial implications are discussed. At the end, the limitations of the study are reported, which provides directions for future research.

1.11 Summary

This chapter started by providing a brief introduction on the background of the aviation industry, followed by a discussion on the development of the aviation industry in Saudi Arabia. Next, the problem statement, research objectives, research questions, and significance of the study were presented. The chapter ended with the operational definitions of all the constructs, the scope of the study, and the organization of the thesis.

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