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An Analysis of Air Traffic Controllers' Job Satisfaction

Sohel M. Imroz
Embry-Riddle Aeronautical University, imrozs@erau.edu

Farhan Sadique
Penn State University, fvs5201@psu.edu

Nidhi Trambadia

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The air travel industry is flourishing in domestic and international airports, and with that, the number of aircraft is increasing rapidly. A total of 43,480,515 aircraft were handled at the Air Route Traffic Control Center (ARTCC) in 2020, with a forecast of 59,716,387 aircraft by 2040. More than 2.7 million passengers are being served daily by more than 14,000 air traffic controllers every day (Federal Aviation Administration [FAA], 2021). The abrupt pandemic situation temporarily halted this rapid growth; however, the world is slowly getting back to normality as the situation improves through extensive COVID testing and vaccination. Massive demand for flights has again been forecasted as people get back to work and start traveling. As airlines increase their movement worldwide, the flights' efficiency, aircraft fuel efficiency, operation costs, and revenues have become crucial for sustaining profit. Adjacent to all these significant concerns, ground-based air traffic controllers (ATCs) play a crucial role in the airline system and functionality (E & Zhang, 2017) by ensuring the safety of aircraft, pilots, attendants, and passengers. The tasks of ATCs are reliant on the awareness of aircraft movement by direct unobstructed visual observation of maneuvering area. As air transportation is growing, it is essential to consider the sensitive and important job in the field of flight safety. Aviation accidents are deadly, and more than 80% are caused by human error, even though the number of fatalities came down to 137 in 2020 from 905 in 2006; just in 2018, one out of 740,000 flights crashed (International Civil Aviation Organization [ICAO], 2019; Hedayati et al., 2021; Statista, 2021; Xu & Luo, 2020).

Turnover is a common issue for air traffic controllers; just in the 2021 fiscal year, the Federal Aviation Administration (FAA) expects 1200 employee losses due to transfer, resignations, removals, deaths, development attrition, and academy attritions (FAA, 2020b). Management and decision-makers are concerned about employees’ retention rate, particularly

because their job skills are unique and costly to replace. Significant issues are high influence turnover, employees' well-being, and work stress are becoming broader in industrialized and developing countries (Tharikh et al., 2018; Tshabalala & De Beer, 2014; Wang et al., 2016). ATC's crucial job functions may include selective attention, focus, speed of perception, activity management, auditory attention, planning, decision making, reasoning, and continuous use of memory; as a result, the job is ranked as the 4th most stressful job among all (U.S. Bureau of Labor Statistics, n.d.). The highly stressful nature of ATCs' jobs directly limits supply in the workforce, and the airline industry is already facing a shortage in airspace personnel and saturation (E & Zhang, 2017). There are many challenges for ATCs to become successful at their daily performance; enduring stressful work conditions and poor performance can lead to safety hazards costing human lives (Chang & Yeh, 2010; Socha et al., 2020).

Job satisfaction is a well-established precondition for employee retention in today's industry and getting wide attention from social psychology, management, and practical operation. Job satisfaction is a reliable predictor that improves employee retention (Biason, 2020). Employees perform above average if they are satisfied or have a positive feeling about their job (Alromaihi et al., 2017). A general understanding of aspects contributing to their job satisfaction can help human resource executives and policymakers improve employment practices and create a sustainable environment. There have been noticeable changes in ATC's workplace in the last few decades, such as remote working opportunities, technological advancement at job functions, open office seating, and online collaborations. More actions can still be foreseen through a better in-depth understanding of job satisfaction and flexible work design. Many contributing

factors of employee job satisfaction have been explored and pinpointed by different researchers in the past. However, no intensive literature review has been done on air traffic controllers' job satisfaction to create a shared understanding among interested readers. Thus, the primary purpose of this paper is to provide a holistic directory of determinant factors and synthesized reinforcements for air traffic controllers' job satisfaction.

Job Satisfaction for Air Traffic Controllers

The most accepted definition of the widely researched *job satisfaction* is provided by Locke (1969), where job satisfaction is explained as a delightful or unpleasurable emotional state derived from one's job values. Job satisfaction can be measured through the intrinsic factors to the extent individuals like or dislike their job, depending on socio-demographic status, such as age, work experience, job characteristics, supervision, support, communication, fairness, career development, and environment (Chen et al., 2019; Spector, 1997). Satisfied employees are the critical blood vessels for an organization, because they are motivated to do their work and inclined toward organizational goals, directly influencing turnover intention, absenteeism, work culture, and most importantly, the overall work output (Miller et al., 2009). The fundamental benefit of job satisfaction is it helps to create loyal employees for the organization, and derives behavior from accomplishing long-term results. Organizations are expected to create a safe and healthy working environment for the employees, which is a requirement for job satisfaction.

Employees' attitudes toward work are affected by job stress through emotional experiences, such as engagement, which affects both job satisfaction and turnover intention (Allisey et al., 2014; Bowling et al., 2015; Kazemi et al., 2015; Yoon et al., 2021). Job satisfaction can positively impact employee performance to achieve organizational goals, group effectiveness, and employees' job withdrawal behaviors (Chen, 2018). Turnover intention can be

defined as an employee's possibility of leaving their current organization, and increased turnover intention with decreased job satisfaction is a mediator of the actual turnover (Chung et al., 2017; Mobley, 1977; Steel & Ovalle, 1984). The three types of ATC, aerodrome, area controllers, and approach controllers in control tower, perform duties in a unique work environment with minimum human interaction, which often depends on the type and number of traffics in the airport. There is already a shortage of experienced, qualified, and well-trained ATCs (E & Zhang, 2017); an increased turnover can result in many adverse consequences (i.e., reduced air traffic flow, increased passenger delays, increased workload on the remaining ATCs, etc.). Job dissatisfaction is the most effective prognosticator of turnover tendency and makes it easier for employees to quit their organization (Jou et al., 2013). Therefore, a holistic picture of contributing factors needs to be investigated and better understood to increase the aviation industry's overall safety.

Air Traffic Controllers' Job Characteristics

For more than twenty years, job characteristics have been investigated to understand the impact on employees' wellbeing and health consequences (Cascino & Mélan, 2019). It was commonly investigated through four different perspectives: demographic characteristics, work-related characteristics, organizational characteristics, and social variables (Abdulla et al., 2011; Chen, 2018; Jo & Shim, 2015; Miller et al., 2009; Zhao et al., 2012). The understanding of the characteristics facilitated an improved workplace environment. Air traffic control is categorized as a stressful job due to high job demands and low control over their job functions. According to the U.S. Bureau of Labor Statistics (n.d.), the duties of ATCs include monitoring and directing the movement of aircraft, controlling ground traffics, instructing on issues for takeoff or

landing, transferring controls, and alerting response staff in the event of an emergency; most of the duties are inherently cognitive in nature and require spontaneous actions. ATCs' tasks are classified into three different categories based on the flight operations: area/en-route (responsible for aircraft safety at high altitudes), approach (responsible for efficient landing), and aerodrome/tower (responsible for immediate decision using visual observation) (Jou et al., 2013). ATCs use sensing organs and multiple types of equipment (e.g., computer and radar, light strips, headphones, and so on) simultaneously to gather critical information and accumulate/analyze data. In general, they do not have a fixed time or date they are scheduled to work, and they mainly rotate around anytime during the day, night, and evening including weekend and holiday shifts (U.S. Bureau of Labor Statistics, n.d.). Pilots are responsible for the safety and maintaining separation of immediate traffic, but ATCs still oversee for further assurance of safety under emergency conditions maintaining maximum concentration (Metzger & Parasuraman, 2001). Some causal factors of risk for ATCs include individual factor, supervisory factor, fatigue, communication and coordination with the pilot, airspace, and procedure, weather, equipment, training and experience, flight data and display issues, airport and surface, emergency, and traffic management (Teixeira, 2020; U.S. Bureau of Labor Statistics, n.d.).

Furthermore, an individual's ability to utilize cognitive strategies such as managing uncertainty, situation recognition and reaction, planning and anticipation, and maintaining workload is identified as crucial for ATC (Hedayati et al., 2021). Effects of such a work environment can cause mental strain or fatigue, mental exhaustion, mood disturbance, and sleeping disorders. Unfortunately, employees often accept these severe effects as natural outcomes after a long career as an air traffic controller (Cascino & Melan, 2019). Costa (1995)

has attributed perceptions toward air traffic control through job demand, operating procedure, working times, working tools, work environment, and work organization.

Other researchers have viewed air traffic control job characteristics based on job requirements and job resources. The job requirement is the combination of demands from work responsibilities, the organization's expectations, and over-commitment (Siegrist, 1996; Theorell & Karasek, 1996). Job resources, which are tremendously crucial for non-statutory employee welfare and a healthy mindset, include social support at the workplace and relative work culture (Cascino & Mélan, 2019, Dell'Erba et al., 1994, Theorell & Karasek, 1996). In addition to their regular tasks and duties, ATCs often perform various tasks within their capacity as aerodrome, approach, or area controllers; that may include additional maintaining, monitoring, evaluating, planning, and implementing safe and efficient traffic flows (Corver et al., 2016; Histon et al., 2002). The challenging part of ATCs' job is to plan for unforeseen circumstances and simultaneously follow safety standards and guidelines provided by the authority to ensure safety. There is no margin for error in this job as human lives may be at risk due to the slightest mistake. These physically harmful and emotionally distressing job characteristics may also create unfavorable circumstances where ATCs are uncomfortable or unable to perform their jobs.

Analysis of Factors Affecting Job Satisfaction of Air Traffic Controllers

Air traffic controllers are the connecting personnel among the pilot, technical employees, management, and even other controllers. Theoretically, from taxi to landing, ATCs perform intensive work in an isolated working space near large airports, where human errors may cause aeronautical accidents (Jou et al., 2013). The literature review

reveals five consistent factors directly impacting the job satisfaction of ATCs. These factors are the ambiguity of job functions, overwhelming workload, complex task performance and uncertain work demand, job fatigue, and work-family conflict. The following section elaborates on these factors.

Ambiguity of Job Functions

The ambiguity of job function is a critical factor for air traffic controllers. Costa (1995) identified 46 sub-activities and 348 distinct tasks for the ATCs under six main activities: continuous situational observation, conflict resolution, sequence management, route planning, assessing weather, and resource management. Ambiguity of ATCs' job function depends on operational disturbance such as environmental condition, aircraft performance characteristics, optimal descent and wind condition, shortage of previous data availability, or delayed decision-making process (Corver & Grote, 2016; van der Eijk et al., 2012). The altitude and velocity need to be anticipated by the ATCs, and several weather-related factors can be crucial, including severe weather conditions, pilot's visibility, or technical failure. The ATCs always perceive uncertain job functions due to changing trajectories and situational factors, which might have severe outcomes, including the risk on human life (Loft et al., 2009). In 2019, there were 4.5 billion scheduled passengers and 115 aircraft accidents worldwide (ICAO, 2019). ATCs' decisions are often influenced by the perceived risk of human life, creating additional stress on their daily job function (E & Zhang, 2017; Loft et al., 2007; Rantanen & Levinthal, 2005). Their job function requires a complex set of knowledge and cognitive skills, including data processing, logical reasoning, decision making, and spatial perception. ATCs must also consider extraneous variables (such as the perceived risk of weather) to minimize risk perception, whereas unpredictability creates ambiguity in their job functions and future decisions (Loft et al., 2009).

Overwhelming Workload

The number of aircraft movement escalations and an increasing number of emergencies surge the ATCs' workload. From 2018 to 2019, the number of international tourists increased from 1.4 billion to 1.46 billion, with 59% traveling by air (Chang et al., 2019; Statista, 2021a). The workload is a significant constraint to airspace capacity and comprises factors such as training level, work experience, equipment logistics, and sector complexity. According to the Federal Aviation Administration (2020a), the FAA's Air Traffic Organization (ATO) serves more than 16,405,000 flights each year, with a daily rate of 45,000 flights from 520 airport traffic control towers. According to Loft et al. (2007), air traffic density, derived from a total number of aircraft divided by workstations, can predict air traffic controllers' workload (Corver et al., 2016).

ATCs' job typically involves high expectations and overwhelming responsibilities, as the job demands complex task performance with high perceived risk. When the workload increases beyond an acceptable limit, it directly impacts job functions' accuracy and safety. The work balance between the mentioned en-route, approach, and airdrome duties of ATCs is essential to reduce stress and complexity; the check and balance of tasks will also help ATCs consciously make accurate assumptions to avoid potential conflicting judgment (E & Zhang, 2017). Employees can face burnout due to heavy workloads. A significant number of employees leave jobs due to an unbalanced heavy workload that must be limited under acceptable boundaries (Djokic et al., 2010; Neal et al., 2014). To ensure worker's safety and satisfaction, many authors called for a systematic evaluation of workload (Socha et al., 2020), and ATC management can utilize such information while planning and allocating tasks.

Complex Task Performance and Uncertain Job Demand

The workload, physiological, and mental demands are very high for air traffic controllers. Job uncertainty and possibly catastrophic consequences of a mistake or error make these demands even more burdensome for the ATCs (Öge et al., 2018). The extreme importance of the job and no room for mistakes create a highly complex work environment for the ATCs (Corver et al., 2016). They face uncertain work schedules between day and night due to their work nature, which changes depending on different external variables such as uncertain future trajectories or future work demand (Averty et al., 2008; Loft et al., 2007, 2009; E & Zhang, 2017). To maintain a good state of mind, the workload managers use a workload database, which helps them cope with any incoming critical events simultaneously (E & Zhang, 2017). An unbalanced work shift between day and night creates a challenge for the body clock, adversely affecting mental health. Timely breaks and task timing are important to consider; ATC's working longer hours without breaks display higher fatigue (Chang et al., 2019). Uncertain trajectory and flight's technical efficiency create difficulties in maintaining the workload and create conflict in work distribution. These challenges directly impact ATCs' job performance in an already stressful situation (Corver et al., 2016; Tharikh et al., 2018). They often deal with unpredictable events maintaining minimum safety standards, which involves quick decision-making without violating policy. Even though automation creates ease for ATC's by supporting and sharing the decision-making process of crucial daily life activities, the job and tasks of ATC's are still significantly complex in a safety-critical environment.

Job Fatigue

Fatigue is the mental and physical state that can cause several human errors. Air traffic controllers' job fatigue can be caused by overwhelming job responsibilities, irregular job

schedules, physical and mental stress, continuous workload, successive working days, microsleep, or overwhelming responsibilities (Chang et al., 2019). According to Jou et al. (2013), fatigue derives from the stress of making multiple safety decisions simultaneously without human error. Fatigue is a state of mental and physical weakness that decreases ATCs' reflection and cognitive decision-making ability. Fatigue in ATCs can be caused by shift work, schedules, workload, and time on task (Chen et al., 2019). Fatigue level depends on an individual's capacity and perceived workload depending on their experience, skill, and motivation (Chen et al., 2019). An isolated semi-dark workspace creates more physical and mental stress on the ATCs and negatively affects their professional capabilities, responsiveness, and attentiveness (Jou et al., 2013). Job fatigue can be challenging for individuals considering their mental wellness. Job fatigue is a prominent reason for high turnover resulting in low employee morale. The ATC's job fatigue can create complexity and safety concerns and increase difficulty ensuring aviation safety (Jou et al., 2013). In the Aviation Safety Reporting System, 21% of reported incidents are related to pilots or ATC's fatigue, but the fatigue evaluation cannot objectively reflect the psychological status (Chen et al., 2019). There is still an urgent need to address such issues and develop potential countermeasures, and the challenges are different for each airport depending on their capacity, limitations, and flight movement.

Work-Family Conflict

The work-family conflict reflects the inter-role interfere of work with an individual's personal life roles and interests. Work and personal life balance are essential for each employee's mental wellness. Different parts of the ATC's job can create an

imbalance in work and family life, such as not having enough time outside of work, or missing birthdays and important family occasions, including Christmas. Work-family conflict creates an undeniably challenging situation, but the ATC workplace remains open 24 hours a day, 365 days a year. ATCs are highly trained for their adverse job condition and selected from a pool of qualified, talented applicants. Still, the awareness around mindfulness and mental health is a big concern to ensure a safe work environment, and there is growing evidence of the global impact of mental illness (Harnois & Gabriel, 2000). Cascino and Mélan (2019) categorized ATCs' work-family conflict as time-based, stress-based, or behavior-based, leading to depression or mental health problems for the ATCs. By default, the job nature creates emotional exhaustion and impacts ATCs' job satisfaction or turnover intention, and leaders of the airline businesses need to pay more attention (Karatepe & Choubtarash, 2014; Oge et al., 2018).

Recommendations for Maintaining ATC's Job Satisfaction and Future Research Study

It is essential to safeguard air traffic controllers' mental and physical wellness to maintain travelers' safety, and avoid human errors. As a highly stressful job, ATCs need increased capacity, efficiency, safety, and most importantly, modernization to keep up with the rapid growth in air travel (Metzger & Parasuraman, 2001; Sheehan, 1999). Some of the factors impact their job satisfaction more than others, but researchers also recognized different ways to retain ATCs' job satisfaction. Some adjustments, such as taking frequent breaks between long working hours, can psychologically help ATCs recover from fatigue. Working environment factors such as equipment, sound, and emergency call-in can create more stress and affect sleep quality (Chang et al., 2019). Different technological advancements are making headway to improve job functionality of ATCs. New technologies can better help ATCs with aircraft trajectory, which will save them from continuous monitoring for a possible collision. ICAO prescribed a minimum

distance between aircraft, which increases the ATCs' response-lag time and decreases pressure while making emergency decisions. Different factors, such as cognitive ability, personality, cognitive style, strategies, and human errors exposure, significantly impact individual decision-making. In recent times, advanced artificial intelligence for aircraft separation-analyzer probabilistic decision support has become functional. All these innovations will support ATCs in the perceived risk of their job (van der Eijk et al., 2012).

ATCs still need to go through tremendous development to balance work and family, considering the importance of mental health. Civil Air Navigation Services Organization, International Civil Aviation Organization, and International Federation of ATCs worked together on fatigue management and published a Fatigue Management Guide presenting adverse job-related issues and recommendations (Chang et al., 2019). Eighty percent of aviation disasters occur due to human error, primarily from psychological and physiological conditions (Shappell et al., 2007; Socha et al., 2020).

This study was limited to literature reviews, but much progress can be made by utilizing a closer look at actual practices. Researchers can investigate more to improve air traffic controllers' job conditions. The factors can be tested and established with empirical research; future researchers should investigate different mediating factors of job satisfaction and perceived organizational and supervisory support. This paper provides a holistic picture of the situation, and further development of the concept is needed to identify the impact of different factors on job satisfaction. The recommendation could be strengthened with empirical researchers to support the assumption and validate the result. Researchers can get more field-based primary information on job satisfaction and

compare different factors and their mediating effect on job satisfaction of ATCs. Increased job satisfaction through analyzing those factors can influence employee motivation and loyalty to their organization.

Conclusion

Even though ATCs use technologies to perform most of their job functions, their contribution will remain essential to ensure automated systems function properly. As a highly stressful job, ATC's job functions need more attention, and more insights can be used to better understand the job context, challenges, and strengths. For many people, the past years' pandemic was about isolation and loss of essential lives; as we are fighting against the pandemic, we also need to move forward with a renewed understanding of high-stress job functions. This article identifies the most critical factors for future researchers to improve ATCs' job satisfaction. As we gear up to provide a better workplace for everyone, we must consider ATCs a priority. Naturally, the job is high-risk, where a simple mistake or error can turn into a disaster. Researchers are continuously identifying different issues of ATCs' job conditions and ways to improve the situation. However, this article will contribute to the field through a synchronized report combining all the related findings and challenges for decision-makers to craft the ATC's role. There is ample opportunity to improve job conditions. There are endless possibilities to increase job satisfaction and safety by linking the factors identified through individual research and action. The factors presented in this paper could be more generalizable if tested on the actual field, where the scope was minimal. However, the accumulative knowledge and findings will expedite future research to improve the job satisfaction of air traffic controllers.

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