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Factors Affecting Air Traffic Controllers Performance

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ABSTRACT

The study conducted on the human factor with relation to performance on air controller performance. The study has successfully identified human factors on the performance of Air traffic control, it was found that, like other professions is affected by many environmental factors, both internal and external, which may be reflected on the performance of the air controller's work at airports. From the finding, it indicated that many of the aviation accident or incident - that occurred in the world and in which hundreds of lives were lost- are caused by human factors. It was found that 75% of aviation accidents occur because of human errors, while other studies pointed out to 90% of incident and accident happened by human factors. It was found that the air traffic controller was exhausted or suffering from psychological stress because of family or material problems, or as a result of the pressure of the work itself or other human factors.

I. INTRODUCTIONS

The recognition of the performance of air traffic controllers (ATCOs) at Saudi Arabia Airports as a key sector with a viable stimulus that can promote the development of any country towards the achievement of a competitive and virile economy has long been created [1]. This is demonstrated by the contribution of ATCOs to the generation of jobs, poverty alleviation, economic empowerment and even the distribution of production, as well as a major challenge for many developing countries [2]. The analysis of the moderating impact of Teamwork Ethics on the relationship between human factors (Individual Environment, Cognitive process, Team Environment) on ATCO's performance thus leads to a novel insight into ATCO's performance literature [3]. First the combination of resource-based theory (RBT) and the principle of cognitive process is a rare analysis that is unlikely to be available in recent literature. Second, this study explains the positive influence of the cognitive process (attention, vigilance and situational awareness) that helps ATCOs to succeed at the airport [4].In addition, by analysing the relationship between human factors (workload, exhaustion, stress, communication, teamwork, trust) and the performance of ATCOs, this study gives entrepreneurs, ATCOs in Saudi Arabia Airport, the opportunity to develop and introduce strategies that will effectively enhance business operations and improve performance [5]. In addition, it assists ATCOs in the successful exploration and use of human factors inside the airport. This study also serves as a guide for policy makers to establish and implement the required policies that will serve as a mechanism to enhance the overall growth and development of ATCOs at Saudi Arabia airports [6]. This will further improve the excellent performance of ATCOs at Saudi Arabia Airports and will contribute to the country's economic growth. Finally, the incorporation of the concept of Teamwork [7,8] Ethics into traditional management practices would allow ATCO's supervisor to resolve some of the unethical problems that are prevalent in today's business climate, which will help to improve productivity and efficiency in ATCO's operations and performance [9].

Standards of human performance toward Air Traffic Controllers: Air traffic control is an environment critical to safety. The safety and effectiveness of all air travel is the responsibility of the Air Traffic Controllers (ATCOs). There are no physical obstacles or protection for protecting aircraft in flight, unlike other critical safety industries. In order to maintain flight safety, controllers should therefore

constantly retain high standards of human performance. Human performance threats need to be acknowledged and mitigated in an ethical environment of increased traffic and efficacities requirements to maintain flight safety and efficiency. As the global economy is being highly interconnected, the aviation industry is one of the fastest transport sectors in the world [10]. Commercial airlines transported more than four billion passengers and generated a global revenue of US$ 534 billion in 2017 [11-15]. Air transport also plays an important role for tourism, contributing to economic growth, especially in developing countries [16]. The number of international tourist arrivals has risen from 1.24 billion in 2016 to 1.32 billion in 2017; more than half of visitors have opted to reach their destination by air transport [18]. Air transport also offers access to global markets and contributes to the development of world trade. Approximately 61.5 million metric tons of cargo were transported by air in 2017, generating about US$95.9 billion in revenues [19]. All these developments did not come overnight, but it happened through a series of ages and times, and each time had its own character and its own problems, and this is what necessitate us as researchers to recount the evolution of historical air transport in worldwide, and this what we will mention in the following Table1.

Table 1 Air traffic statistics at the world

Year	Number of passengers in billion	Air traffic movement in million
2007	2452	26016011
2008	2500	25498093
2009	2490	26122523
2010	2707	29637929
2011	2872	30564978
2012	3006	30771384
2013	3140	31464398
2014	3.319	32339782
2015	3558	33362839
2016	3797	34687965
2017	4071	35892803

Source: Prepared by the researcher based on statistical data from ICAO Reports.

The table above indicate the growth number of passengers and air traffic movement through the years from 2008 to 2017[20-23]. As shown in the statistical reports issued by the International Civil Aviation Organization. Looking at the table clearly shows that both the number of passengers and traffic movement

is increasing annually. To determine the level of change between numbers of passenger and air traffic during 2008 to 2017 can be found in Table2.

Table 1: The rate of change in the global during 2008 and 2017

Year	Number of passengers (in Million)	Change in the number of passengers	Percentage in number of passengers
2008	2500	0	0.0%
2017	4071	1571	62.8%

Source: Prepared by the researcher based on statistical data from ICAO reports.

The above table shows the percentage change in the number of passengers between 2008 and 2017, where the percentage rose to more than half and reached 62%, which confirms the importance of air transport and the extent of most people turning towards it.

Table **Error! No text of specified style in document.** Change in the number of movement in the world during 2008 and 2017

Year	Air traffic movement	Air traffic charge	Percentage of air traffic charge
2008	25498093	0	0.0%
2017	35892803	1571	62.8%

Source: Prepared by the researcher based on statistical data from ICAO reports.

It is clear from the above table that the rate of change in air traffic increased by 40.8% compared with 2008, which is very large compared to the change that has occurred in last year, which confirms the need for research on this particular area of study as shown in figure 1.

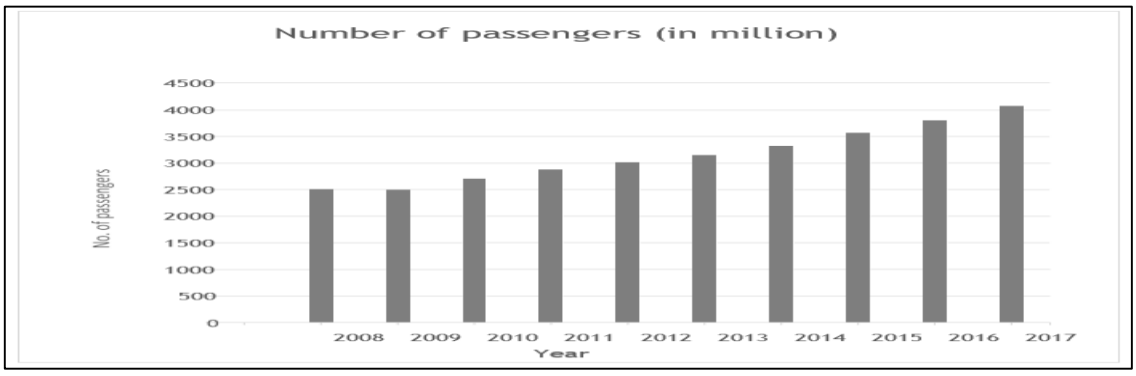

Figure 1 Number of Passengers (in Million)

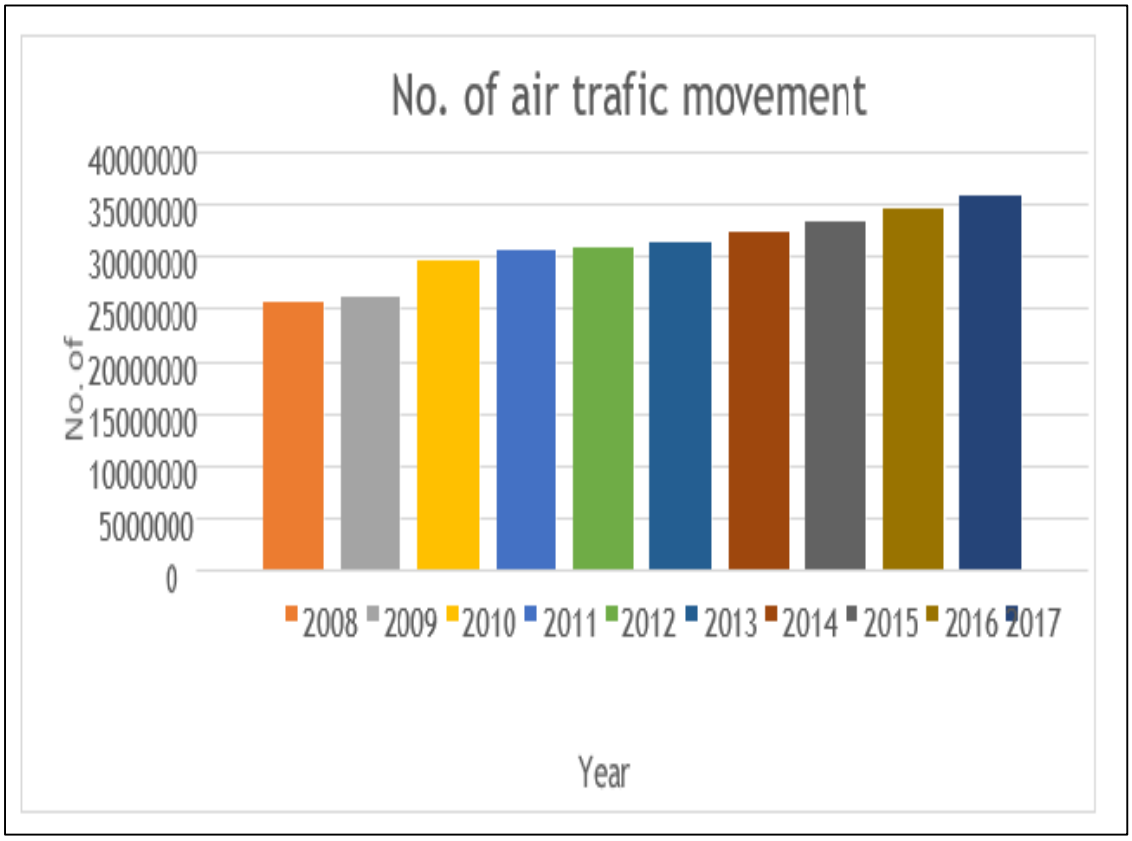

Figure 1:The Number of Air Traffic Movement

The rapidly increase in air transportation industry in the world, interface growth in KSA air transportation, where we found that there is a remarkable development in this field, through demand of air traffic movement and number of passengers during the years 2008 to 2017 as shown in figure 2.

Table 4 Air traffic statistics at Saudi Arabia

Year	Number of passengers	Air traffic movement
2008	42312	407987
2009	44287	432113
2010	47953	450997
2011	54460	479755
2012	64773	558791
2013	68120	565631
2014	74749	589216

2015	81861	646693
2016	85287	70881
2017	91821	74129

Source: Prepared by the researcher based on statistical data from GACA

The Table shows the development of air transportation in KSA, through the number of passengers and air traffic during the years 2008 to 2017. As shown in the statistical reports issued by the General Authority of Civil Aviation in KSA, looking at the table clearly shows that both the number of passengers and traffic is increasing annually, this confirms the importance of this sector and its vital role in economic development and supporting income growth. To determine the level of change between passenger numbers and air traffic during 2008 and 2017, the researcher designed following tables:

Table 2:The rate of change in air traffic movement in KSA during 2008 and 2017

Year	Air traffic movement	Air traffic movement change	percentage of Air traffic movement change
2008	407987	0	0.0%
2017	741293	333306	81.7%

Source: Prepared by the researcher based on statistical data from GACA annual report

Table 2 illustrate that rate of change in air traffic movement increased by 82% compared with 2008, which is very high compared to the change that has occurred in the world, this confirms importance of the economic situation and high demand on the air transportation in the Kingdom of Saudi Arabia.

Table 3 Rate of change in passengers in KSA during 2008 and 2017

Year	Number of passenger (in million)	Change in number of passengers	Percentage of change in number of passengers
2008	42312	0	0.0%
2017	91821	49509	117.0%

Source: Prepared by the researcher based on statisticak data GACA

Annual report the rate of change in number of passengers in 2017 was very high compared to 2008, which reached to 117% as shown in figure 3

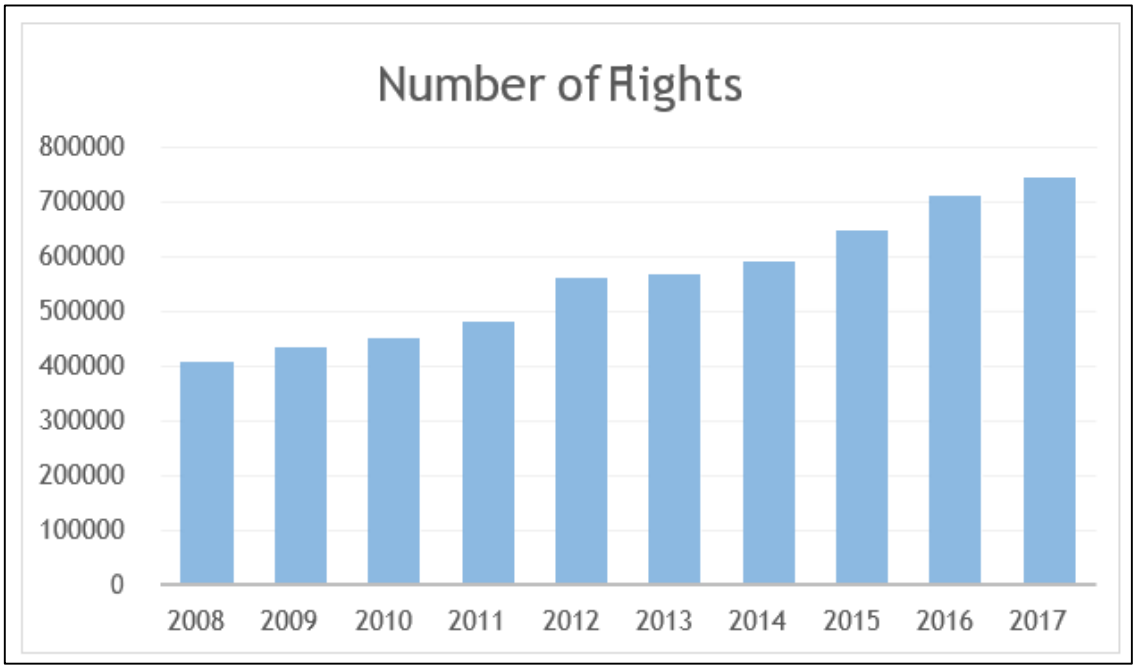

Figure 2:Number of Flights

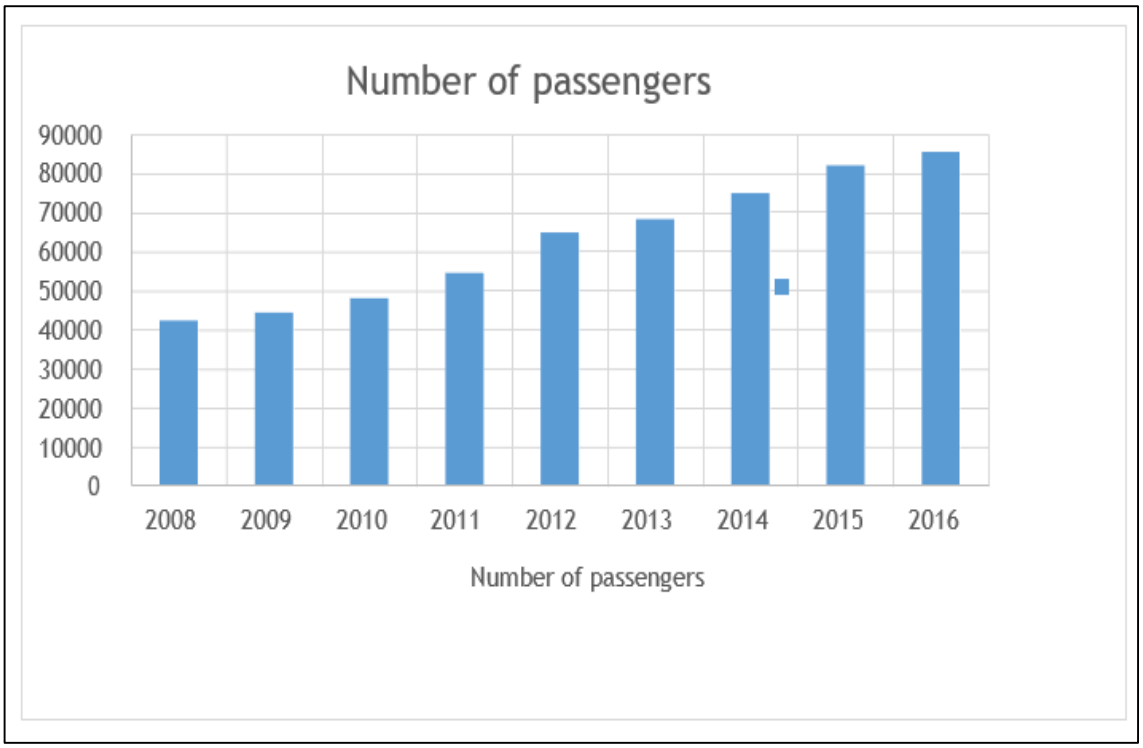

Figure 3: Number of Passengers

Air traffic movement and the number of passengers was very high, and these increases may also be accompanied by an increase in the number of accidents and incidents that occurred at Saudi airports, and thus the researcher illustrate the number of incidents and accidents in the following Table and figure 4.

Table 7: The number of accident and incident in KSA during 2008 and 2017

Years	Accident	Incident
2008	1	125
2009	3	72
2010	3	147
2011	2	244
2012	1	205
2013	0	149
2014	4	316
2015	3	293
2016	1	606
2017	3	628
Total	21	2785

Flight accident and incident with human factors : As indicated in the table above, we notice the total number of accident and incident increased significantly in 2017[24-30]. This confirm the need to do a lot of studies in this vital field in order to identify the causes of the increase and development of appropriate solutions. Nowadays, with the appearance of phenomenal increase the volume of air transportation, air traffic control service has attained, its importance to ensure the safe air transportation system. However, air traffic control operation is the job that must use fast decision on the international standard basis that specified by the International Civil Aviation Organization (ICAO) for safety, convenient and flow traffic [31]. Therefore, air traffic controllers must obtain training practice until become skilful and experience for the job operation [32]. Air transportation Consist of several components, the air traffic control serves is one of the most important elements in air transportation industry, which seeks to promote the safe, orderly and expeditious flow of air traffic. Although ATC services responsible aircraft on the ground and in airspace, en- route [33]. Air traffic control systems, that integrate human operators with their equipment, are increasingly efficient, thus, when an incident occurs, there is typically an aspect of human error involved. Euro control indicated that human error contributes up to 75% of air traffic incidents. Operator errors may include errors of concentration, judgment or communication by the Controllers or their Superiors, as in the case of mode or misunderstanding, which may be due to poor design or inadequate training [34]. Air traffic control is the service provided by the air traffic controllers who are responsible for expediting and maintaining a safe and orderly flow of aircraft traffic [35]. This study is unique to the success of ATCOs and the research focuses on human factors. Thus, in this study the researcher seeks to enhance the role of the air traffic controller, and to identify the most important human factors that may affect the controller performance, as well as the development of some conclusions, recommendations, and suggestions to the decision makers in order to choose what helps him to control the impact of these factors, as well as to reduce the risks and maintain the safety of air traffic flow.

Mental and Physical Capabilities for Effective Air Traffic Controller: In the same context, it is possible to say that the job of air traffic controller requires a high concentration of the mental and physical capabilities of the

controller. It has been found that it is one of the most suffering job. The air traffic controller feels, stress, fatigue and risk during his work due to his responsibility for the safety of the passengers, especially in crowded airports [36]. Over 30 years and more, the researcher working in several airports in the field of air traffic control, in addition to observations of his colleagues who worked with them, he notices a lot of human factors related to the performance of air traffic controller. Despite the high efforts made by Western researchers on the subject of human factors workload, stress, fatigue, attention, Vigilance, SA, Communications, Teamwork and Trust) and its relationship with the performance of the air traffic controller, but there is a great shortage for these studies in the Middle East, so we need more studies about this subject[37]. With a high potential for incidents, [38] indicates that air traffic management is surprisingly effective. However, in 75-90% of cases, human error has been attributed as a primary or secondary factor when aircraft have exceeded the standard controlled minima referred to as an 'incident'[39]. Human factors (such as workload, fatigue, stress, vigilance, attention, SA, communications, trust, teamwork) are "major determiners of a human error". And it has been shown repeatedly to adversely affect the performance of air traffic controllers[40]. Therefore, it is important for the resolution of air transport safety incidents to provide a comprehensive and context-specific understanding of the links between human factors and performance of air traffic controllers. Human factors and error investigations have for more than three decades been investigating the effects on performance of different environmental factors (for example fatigue or stress and mental workload) in many configurations [41]. The effects of fatigue on air traffic control performance were also examined by [42].

The findings showed that individual performance measures decreased in combination with increased self-reported fatigue as controllers progressed through the four-day schedule. Such based research has resulted in a body of literature and a thorough understanding of the relationship between environmental factors and performance. As a result of this experience, in the sense of air traffic control, individual problems such as fatigue, vigilance and situational awareness issues have now generally been recognized or adequately mitigated by architecture, operational and human factors and safety expertise. However, variables do not exist in isolation in the existing control environments. Colloquially, it is understood that several human factors can be present at any one time. For example, a controller who is stressed or overwhelmed can experience a high workload and co-occur with poor communication (e.g. incorrect phraseology) or teamwork (e.g. unexpected handovers). These co-occurring factors can interact to negatively influence controller performance differently from individual factors alone. This is supported by the recognition that air traffic control accidents are frequently identified as multi-caused in nature, or are seen as having no direct causes but multiple contributors, as highlighted by the so-called 'Swiss Cheese' and Resilience Engineering models [42]. As a consequence, residual threats for accidents also result from the interaction of numerous human factors and the resulting cumulative effects on performance. However, the relationship and interactions between co-occurring human factors and the associated correlation with human performance have received little attention in the literature [43]acknowledged that research into human factor relationships is intermittent, and results are contentious. Perhaps less research has been carried out and is unique to the context of air traffic control.

There is also a gap in understanding the relationship and possible interaction of various human factors and the resulting relationship with human performance. There is a growing recognition in the literature that this research gap could have restricted and ecologically valid understanding of the occurrence of human factors and the relationship with performance in the air traffic sector (Cox, 2007). In addition, insufficient understanding of the combination of multiple human factors and performance or error has limited the study of performance decline and human error to a reactive, retrospective review of possible causes as opposed to constructive strategies for the prevention of performance decline [44]. This in turn, affects the efficiency and efficacy of compensation strategies to protect the performance of the controller and avoid a decrease in performance. It is therefore important that the current research emphasis be expanded from single factors to multiple factors and contribute to this understanding gap. Several recommendations for research on the interrelationship between human factors that affect success underscore the need and significance of addressing this research gap [45]. Research in this thesis into multifactor relationships and associations with performance will provide value by addressing the current gap between literature and real-world concerns and furthering understanding of the occurrence of human factors in an ATC setting. In addition, understanding of the nature of human factor influences in association with performance decline will be extended, which may facilitate the development of recommendations for reducing negative influences. [45], indicates that air traffic control is a safety critical environment. Air traffic control is the process of organizing the movement of aircrafts and directing them efficiently to minimize delays as well as managing the flow of aircrafts into and out of the airport airspace. This process also includes providing a helping hand in emergency situations with the support of the concerned parties [45-7] Therefore, measuring the performance of the air traffic controller is one of the most complex and difficult tasks, as it requires a strong focus on the work and a high mental presence to perform more

than one task at a time, where there is no room for errors or lapses. In addition, air traffic controllers should have a high level of vigilance and dedication in order to become the movement of aircrafts is easy and smooth, avoiding collisions and dangerous obstacles[48,49]

II. CONCLUSION

The study has successfully identified human factors on the performance of Air traffic control, it was found that, like other professions is affected by many environmental factors, both internal and external, which may be reflected on the performance of the air controller's work at airports. From the finding, it indicated that many of the aviation accident or incident - that occurred in the world and in which hundreds of lives were lost- are caused by human factors. It was found that 75% of aviation accidents occur because of human errors, while other studies pointed out to 90% of incident and accident happened by human factors. It was found that the air traffic controller was exhausted or suffering from psychological stress because of family or material problems, or as a result of the pressure of the work itself or other human factors.

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