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Interventions for Occupational Stress Management in Air Traffic Providers

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Abstract

Last decade, the aviation industry was fast-growing, and air traffic providers are under pressure to manage and accommodate demands for more flights. Therefore, aerospace capacity management is anticipated by the air traffic controller's performance, and it's a key success factor towards air transport industry resilience productivity. On the other hand, air traffic controller tasks are very complicated and high demand, resulting in occupation stress affecting air transport providers employees. This paper deals with the challenges to identify occupational health in the work environment of air traffic providers, focusing on traffic controllers. According to a system of system approach, the key resources of stress are reviewed, and the interventions to manage occupational stress upon the quality of services and human resources performance are highlighted. The paper outputs provide key messages to managers and decision-makers upon stress management to high demanded workplaces and especially regarding air traffic controllers, providing the framework for comparisons with other high demanded occupational conditions.

Keywords: Stress Management, Occupational Health, Occupational Safety, Human Capital Management, Air Transport Providers.

1. Introduction

Worldwide, Air Traffic Services (ATS) are under huge pressure due to the continuing growth of air traffic. According to ATAG (2018), if aviation were a country, it would rank 20th in size by GDP (like Switzerland or Argentina). Aviation provides the only rapid worldwide transportation network, which makes it essential for global business and tourism. It plays a vital role in facilitating economic growth, particularly in developing countries. Airlines transport over four billion passengers annually, with revenue passenger kilometers approaching nearly 8 trillion in 2017. Aviation's global economic impact (direct, indirect, induced, and tourism catalytic) is estimated at \$2.7 trillion, equivalent to 3.6% of world gross domestic product (GDP), play a vital role for economies heavily depended on market accessibility, (Dimitriou and Sartzetaki; 2018a).

Furthermore, air transport contributes to socioeconomic development, (Dimitriou and Sartzetaki; 2018b). By facilitating tourism and trade, it generates economic growth, provides jobs, improves living standards, alleviates

poverty, and increases revenues from taxes, (Sartzetaki 2019a). ACI (2017) traffic forecasts highlight that air passenger traffic in Europe will increase by up to 26.0% by 2040, while in Asia-Pacific, this increase will reach 38.8%. UNWTO (2018) recognize the linkage of aviation and tourism and estimate that international tourist arrivals by air will reach 900 million by 2030, far exceeding other modes of transport. Therefore, air transport industry personnel is a key factor in meeting future needs and challenges (Sartzetaki 2019b).

The high demand for additional routes and air transport network expansion, resulting in key challenges to airspace capacity management routing considering the fragmented route planning, the existing regulatory framework, and the technology limitations and adaptation cost. Last year, airspace fragmentation was affecting emerging markets in Asia because of the rapid development of the air transport sector in the East and especially in China. Therefore, air traffic control performance by air navigation providers constitute a key issue towards air transport eco-system sustainable development.

The improvement of aerospace management is a key driver towards efficiency, service quality, and productivity of the aviation industry. Public and private air traffic services providers are committed to developing their operations' competitiveness through the implementation of Quality Management Systems (QMS) to improve the quality of service and to prevent occupational stress of their personnel. European Commission has launched a program entitled the Single European Sky (SES) initiative, which seeks to promote a more efficient way of handling the air traffic over Europe. A reorganization of air traffic management will be introduced during this process, and Air Traffic Control (ATC) centers in Europe will be merged. New technology will further be implemented, and the air space will be rationalized.

The process and the nature of the services delivered by air traffic controllers (ATCO) are under consideration, related directly to air transport safety and occupational health (Eurocontrol, 2004). The subject of workload and stress among ATCO is becoming extremely important, and, unfortunately, innovation and changes are not easy to be implemented, mainly because of the occupational nature, tasks, demands, and timeframe. Controllers stress management and the impact on the quality of service and performance are under question.

This paper deals with the occupational stress management in ATC. By a system of system analysis, the key stress resources are identified, promoting the key areas needs to be acting to improve working conditions and personnel performance. The analysis highlights the consequences of stress on health and well-being, promoting key interventions that should be taken into consideration towards effective air traffic management. The paper is organized in five sections: firstly, the introduction illustrates the of ATC in air transport industry; secondly, the sources of ATC is presented; in third section the stress consequences are mentioned; in next section the interventions to air traffic management is discussed; afterward concluding remarks are given; and finally, the reference list is situated.

2. Stress sources in ATC

In a systematic manner, the human condition with the term stress was introduced by Selye (1956), following his work with animals and the finding of a generalized response to a variety of harmful physical stimuli. This response-based approach is, however, not particularly appropriate for explaining human stress, as it assumes that the response to a stressor will always take the same course. Recent theories of human stress focus instead on transactional models in which appraisal, auditing, and self-assessment are central features (ICAO; 2006). The crucial point is that stress is not simply a dimension of the physical or social environment, in terms of demands or events, nor simply the responses associated with the consequences of stress, (ICAO; 2008).

Stress occurs when there is some imbalance between the perceived demands on an individual and the resources available for dealing with those demands (Costa; 1995). The effects of environmental changes are moderated by individual interpretive and evaluative processes. This notion of a mismatch is seen in models of occupational stress, such as the person-environment fit model, which illustrates that a mismatch between work demands and

opportunities, and individual needs and resources, is associated with job strain. Factors which are important in such a model include the nature, intensity, duration, and predictability of "stressors" and the availability and selection of individual resources such as styles of behavior in response to an event, personality, previous experience of similar events, perception of control, and social support. Potential stressors include heavy work demands, role ambiguity, role conflict, job loss, shift work, noise, pollution, poor relations between workers and supervisors, and lack of participation in decision-making and control over work processes (Costa; 2001).

Stress is a part of everyone's life and not necessarily a negative phenomenon, being a physiological stimulus usually connected with human activities and interactions of them with the relevant environment (Iqbal, 2013). Stress can sometimes become a harmful risk factor for health when it is perceived as an imbalance between an excess of demands and the individual ability to meet them. This causes a perturbation of the psychophysical equilibrium, taxing physical, psychic, and behavioral responses aimed at coping with it. If this coping fails, stress can have harmful consequences on physical, mental, and social well-being, with high costs both for the individual and society. Stress at work can be generated by job demands, environmental conditions, work organization and human relations; its impact on job satisfaction, performance efficiency, and health can vary widely depending on the psychophysical characteristics and coping resources of individuals, as well as on the social support received, (Iqbal, 2013; Pylvas et al., 2015).

Generally, Air Traffic Controllers (ATCOs) are considered a group of professionals having to deal with highly demanding and risky tasks. In fact, ATC as a work encompasses a set of various tasks requiring very high levels of knowledge, language proficiency, experience and expertise, as well as the practical application of specific skills pertaining to cognitive domains (e.g. spatial perception, information processing, logic reasoning, decision making), communicative aspects and human relations. Analysis of ATC operations shows that the cognitive and operational processes of an ATCO vary not only according to the number of aircraft under control but also with the number and complexity of problems to be solved. ATCO must constantly reorganize his or her system of processing flight information by changing operating methods (in particular, cognitive processes, conversation, coordinating with assistants, anticipation, and solving problems) as they arise and interact with each other. This is carried out by means of the precise and effective application of rules and procedures that, however, need flexible adjustments according to differing circumstances, often under time pressure (Costa, 1995; 2001).

At the same time, the job includes high levels of responsibility, not only with regard to risking lives but also for the high economic costs of aeronautical activities. According to several surveys, the main sources of stress reported by ATCOs are connected both to operative aspects and to organizational structures. For the former, the most important are peaks of traffic load, time pressure, having to bend the rules, limitations, and the reliability of equipment. The latter is mainly concerned with shift schedules (night work in particular), role conflicts, unfavorable working conditions, and the lack of control over work (FAA, 2014).

As the workload increases, the ATC tends to employ more procedures in less time is growing, along with a reduction to the pre-given flight information and the relaxation of certain self-imposed qualitative criteria. It is evident that the number of decisions becomes complex resulting in stressful conditions while the controller's attention is stretched to the maximum. As a result, it is frequently reported many errors even during low traffic. This is due to the great effort required to regulate the psychophysical reactions, maintaining a high level of arousal and vigilance even in conditions of "underload" (Iqbal, 2013; Pylvas et al., 2015).

3. Stress consequences on ATCO health and welfare

ATCOs are widely recognized as an occupational group which has to cope with a highly demanding job that involves a complex series of tasks, requiring high levels of knowledge and expertise, combined with high levels of responsibility, not only with regard to risking lives, but also the high economic costs of aeronautical activities. The International Labor Organization (ILO) commissioned a manual on Occupational stress and stress prevention in air traffic control (CONDI/T/WP.6/1995), Which reviews the sources and consequences of stress in air traffic

control and the measures which have been taken in a number of countries to prevent and reduce stress in the occupation. Conclusively, the ATCO key stress sources are depicted in the following figure.

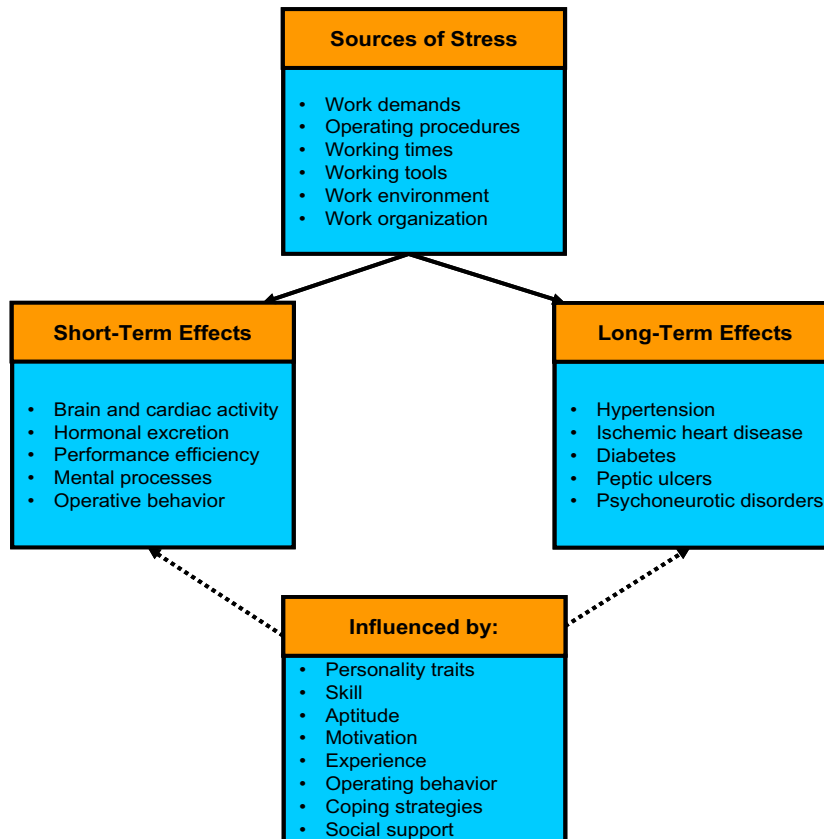


Figure 2. Main consequences of stress for ATCOs (Costa, 2001).

Stress for air traffic controllers is connected, on the one hand, with the intrinsic characteristics of the job and, on the other hand, with the work organization and conditions in the workplace. It is important to bear in mind that the psychophysical responses of individuals also depend on their personal characteristics and coping strategies. For the profession of ATC, it is evident that the job entails generally high psychological demands while being subjected to a considerable degree of external control. ATCOs often complain that they have a feeling of lack of personal influence, and this can play the role of a powerful stressor, also considering that the job requires high levels of responsibility.

Actually, "demand" and "control," as well as "social support," can vary widely according to several factors dealing with different working situations, e.g., work environment, equipment, work planning and procedures, workload distribution, team composition, working hours, rest pauses, shift schedules and human relations. The consequences on an ATC's performance and well-being may differ widely among individuals in relation to many factors dealing with age, lifestyles, life events, work experience, personality traits (introversion, anxiety, type A), behavioral characteristics (mood, sleeping habits, morningness), attitudes, motivation, and physical and mental health.

Moreover, many other factors related to social conditions can play an important role in this respect, e.g., socioeconomic status, housing conditions, commuting, family attitudes, social support, and integration. Therefore, all these aspects can have an influence on an ATCO's job satisfaction health and well-being according to different circumstances (see Fig. 2). They can interact and interfere with each other, giving rise to not only possible additive or multiplicative, but also subtractive effects, so that it is often very difficult to evaluate and compare the effective

stress and strain in different groups and individuals. This is the reason why many studies on the stress of air traffic controllers reported apparently contradictory findings.

About the short-term effects, can be categorized in terms of changes in hormonal secretion (e.g., adrenaline, non-adrenaline), heart rate, blood pressure, muscular activity, cerebral waves, work performance (errors) and behavior (sleeping, smoking, eating and drinking habits). These responses can indicate a normal, physiological adaptation of the individual to external stimulation, as well as an excessive strain due to an imbalance between demands and resources. A great number of research results indicate that the above responses are related to the workload, which can be assessed in terms of the number of aircraft under control or expected to come under control, peak traffic counts, duration and type of communications, tight work schedules, and number and complexity of problems to be solved. However, big differences among air control centers can be recorded, mainly in relation to air traffic density. On the other hand, they appear to be greatly influenced by subjective factors, such as personality traits (anxiety, introversion), aptitude, skill, ability, motivation, experience, and operating behavior.

Demanding occupational activity may be a risk factor for stress-related symptoms, such as headaches, chronic fatigue, heartburn, indigestion, and chest pain, as well as for serious illnesses, such as hypertension, coronary heart disease, diabetes, peptic ulcers and psychoneurotic disorders. It is quite easy to foresee the high costs from both the existential and the economic point of view that these negative consequences of stress can have, not only for the single person, but also for companies and society. Therefore, prevention and control of stress becomes a compulsory target for employees, in order to safeguard their physical, mental and social health; for companies, in order to improve the efficiency and reliability of the service; as well as for society as a whole, in order to guarantee the highest levels of safety and comfort for all included and affected by this very important work activity.

4. Interventions for the Occupational Stress Management

The analysis case study is Greece. Briefly, Greece attracts a high number of tourists because of the warm weather, the excellent climate, the 16.000-km of coast along the Mediterranean, the spatial allocation of Greek islands in the Mediterranean. Since tourism destinations are a long distance from the tourist home residences, (highest share Germany, France, Holland, UK), air transportation becomes very important, and the aviation industry fulfills the task for over 70% of the international tourist arrivals in Greece. In terms of passengers, 62 million passengers arrive or depart from Greek airports in 2018. The five largest airports in Greece are Athens, Heraklion, Thessaloniki, Rhodes, and Chania, which handle almost 28 million passengers. It is noteworthy that for Heraklion, Rhodes, and Chania, almost 90% of the passengers are leisure travelers during the summer, and almost 65% of the traffic in Athens and Thessaloniki accommodated during the summer season, (Sartzetaki et al. 2019).

According to the FAA (2014) and Eurocontrol (2004) analysis framework, a survey of ATCO serving a sample of 35 out of 40 Greek airports is contacted. The survey structure includes a questionnaire focusing on ATCO stress management comprehensive and the proposed interventions to improve stress management. The structure of intervention is following those presented by Costa (1995; 2001) and highlighted by Eurocontrol (2004) and FAA (2014). The following paragraphs breakdown the key findings, and the questionnaire results upon ATCOs' occupational stress management.

4.1. External Socio-Economic Environment

A very important parameter in stress management is social support. According to many researchers, it is one of the three factors that concur in determining stress conditions. It can be seen in two main aspects: a) the availability of social services for ATCOs' needs and b) the recognition at a social level of the importance of ATCOs' activities and, consequently, c) its appreciation by the general population.

The first stage to active external support is to understand deeply how stress impacts daily life, and this may impact totally different for any employee. Self-assessment is, therefore, indispensable for maintaining the will to work, and to work well. This is probably due to scarcity of information and therefore, the ATC services providers should

increase their activities in the field of public relations in order to give people proper understanding and formal information about the ATCOs' activities and more specifically, about the complexity of such activities, so that people can better appreciate and understand the importance the ATCOs' profession and its role in our modern world.

4.2. Interventions on the used technology

The procedures of ATC services equipment upgrade such as total radar coverage of air space, is the main factor which enables the requested shift in quality, not only in terms of work efficiency, but also in terms of stress levels, by reducing cognitive, memory and communicative loads as well as uncertainty and unforeseen ability of the situations (that are, in most cases, the main sources of strain). Technological development towards to operating under "multi-radar" assistance permits a further increase in levels of reliability and safety as well as a decrease in stress levels.

The improvement in coordinating the information flow among the air traffic control centers in order to assure an increasingly safe, regular, and expeditious air traffic flow is the other milestone that allows ATCOs to operate safely and quietly. This can be achieved by implementing modern telecommunication and radio assistance systems and by improving the efficiency and reliability of equipment, as well as by the progressive automation of the aeronautical information service, flight data processing, and air traffic management. These allow for better planning of air traffic and, consequently, a more balanced workload among centers, sectors, and individual ATCOs. These improvements may also subsequently reduce the possibility or the seriousness of many unforeseen situations, by allowing for more reliable information and more time for solving problems and making decisions, while eliminating many stressful and risky traffic peaks.

It is widely accepted that the introduction of advanced automated systems in ATC activities can radically change job demands and content; therefore, it has to be carried with the proper scientific assistance. The goal of progressive automation is to maximize system safety and efficiency by reducing human workload and error. However, it can also increase some problems related to both cognitive processes and operative procedures. There is a justifiable concern for increased human boredom, decreased motivation, loss of situational awareness, over-reliance on and misuse of automated systems, and deterioration of skill.

4.3. Interventions in Working Place and Task Structure

It is very important to give particular attention to assure that environmental conditions in the ATC workplaces are suitable and comfortable as concerns, in particular, lighting, noise, and microclimatic conditions. Key areas of interest are:

Lighting: ATCOs' task is performed almost exclusively in front of a visual display unit, so particular attention should be paid to providing lighting conditions that favor an optimal visual performance. Lighting conditions are completely different inside the control centers and the towers. In radar centers, dim light (under 200 lux) is usually used to favor the visual contrast on the screen. It has to be considered that the introduction of modern screens are brighter and in color, allows an increase of the illumination levels in the control room (up to 500 lux), thus avoiding excessive (and troublesome) luminance contrasts between central and lateral visual fields, making the environment more stimulating, thus increasing vigilance and alertness. The lighting should be indirect, obtained preferably by mixing natural and artificial light directed onto the ceiling and the walls and thus reflecting into the room. This gives diffuse lighting in the work environment without shadows and glare. Each artificial lighting unit should contain two or more phase-shifted tubes to avoid flickering, which is extremely annoying, causes visual discomfort, and makes the reading of the different traces on the screen more difficult. In the control towers, it is important to avoid excessive illumination levels due to external bright light using both anti-reflection glass and curtains; it is also necessary to have the possibility of positioning and to shield the visual display units to avoid indirect glare due to bright reflections on the screen.

Noise: the levels of noise inside ATC workplaces are usually under the risk level for loss of hearing but can have significant effects in terms of interference with speech communication, the disturbance of mental concentration, and annoyance. We have to underline the peculiarity of verbal communication, carried out in a foreign language for most of the pilots and ATCOs, and containing many unfamiliar, technical, and cipher words that are used in the radiotelephony language.

Indoor air quality: the proper temperature of the workplace is another important factor supporting the maximum efficiency of performance. It is well-documented that conditions of thermal discomfort favor loss of concentration and efficiency of mental tasks with a consequent increase of errors and irritability. Microclimatic conditions must be maintained within the range of thermal comfort that is air temperature between 20 and 24°C, humidity between 30% and 70%, and air velocity between 0.05 and 0.5 m/sec. To ensure these conditions, it is necessary to install adequate air conditioning systems which must be maintained efficiently to guarantee a good indoor air quality. Indoor air, in fact, can be polluted both from human activities (odors, exhaled carbon dioxide, smoking, etc.) and by environmental contaminants (chemical substances, microbes, etc.). So it is obvious that indoor air must be periodically changed (at least three times per hour) and purified (passing through adequate filters) in order to avoid people complaining of symptoms related to the so-called "sick building syndrome" (lethargy, tiredness, headache, blocked nose, dry eyes, sore throat, wheeziness, cough, general itchiness) that can disturb not only work performance, but also cause sickness and absenteeism.

Workstation design: the configuration of the workstation, along with standardization of the panel layout, is required. Practice has many times proved that an appropriate use of colors, symbols, line shaping, windows, and figures facilitates and hastens data recognition and extraction. Furthermore, it is worth mentioning that drastic changes in workstation design and man/machine interfaces, often made possible by technological improvements, should be adopted very carefully, as they can cause excessive stress and decreased performance due to difficulties in the adaptation of mental processes and operating procedures.

Visual display units: the interaction between the ATCO and a visual display terminal is mainly characterized in terms of data acquisition and interactive communication. The ATCO has a continuous dialogue with the radar-computer system by calling up information, scanning traces, inputting, reading, and deleting data. The ATCO concentrates mainly on the radar screen and periodically glances at the side displays and keyboard. The radar screen should be placed in the centre of the visual field and should be adjustable in height, distance and angle to give the operator the possibility of arranging the best working position in order to avoid, on the one hand, prolonged contraction of the neck muscles and, on the other hand, an excessive effort of visual adjustment with consequent visual discomfort and fatigue.

Therefore, it is recommended that the screen be placed within a viewing angle of 5° above and 30° below the horizontal plane of sight and that the eye-screen distance is between 50 and 70 cm to facilitate the visual adjustment. To give the operator the possibility of coming closer to the screen in order to focus better on traces in moments requiring particular attention, it is necessary that the table-top be not overly large but, at the same time, able to support the arms without interference with the keyboard.

Sitting postures: ATCO usually remains seated in front of the console, changing position slightly according to the working conditions. ATCO normally sits in the middle of or forward on the chair with his or her arms on the table-top when he or she is actively operating and needs precise control of the radar screen and leaning on the backrest when he or she is on stand-by. A prolonged, constrained sitting posture causes muscular-skeletal discomfort and pain, particularly at the level of the neck, the shoulders, and the lumbar tract. To avoid or alleviate such disturbances, it is important to use suitable chairs which allow a comfortable sitting posture while working, as well as useful muscle relaxation while on stand-by or resting in front of the screen. A good chair should be designed for a forward and reclining sitting posture, adjustable in height and angle, rotating on a five-legged base. It should also have user-friendly controls; have wide arms and a high backrest, a pad for lumbar support and a headrest. The seat should be made of a sufficiently resistant padding of foam rubber covered with non-slip and permeable

material, and it should also have a slight hollow, and a rounded front edge turned upwards about 4 to 6 degrees above the horizontal plane. The break periods between operational duties should also be used as "postural pauses," the controller should stand and walk around, stretching his body. Moreover, a program for improving physical fitness should be planned, aimed at preventing lower-back pain by providing gymnasiums to be used by the ATCOs during their relief periods. There should also be technical guidance aimed at showing the most appropriate exercises that should be done for the most effective "postural pause."

4.4. Interventions to personality and behavior

The proper and adequate management of occupational stress requires that the individual learn how to deal with it effectively through the adoption of certain personal lifestyles and behaviors. People should avoid ineffective ways of reducing occupational stress, which can have an apparent short-term positive effect but, in the long run, can cause further problems in health and well-being. Examples of these are smoking, alcohol drinking, and drug consumption. To stay in satisfactory condition, people should pay particular attention to physical exercise, eating habits, sleeping patterns, relaxation techniques, and leisure activities. There is no doubt that physical exercise, if carried out regularly and in a non-competitive way, is beneficial for all the body functions improving both physical and psychological wellbeing.

Training is of crucial importance for the education of ATCOs in terms of stress management. A custom-made training program aiming at understanding the needs and capacities of the individual, and balancing individual needs with organizational needs, is able to improve not only technical learning but also motivation, job satisfaction, and human relations. Training should also aim, in particular, at teaching occupational and specific coping strategies in order to improve the capacity of event appraisal and problem-solving. Additionally, ATCOs should be trained to develop action-oriented and problem-focused coping abilities. Positive acceptance and reappraisal of stress situations, active coping, and seeking social support for instrumental and emotional reasons must be strengthened, while inclination towards restraint coping, behavioral, and mental disengagement should be restricted.

An important part of the training should also be devoted to improving the interaction between ATCOs and pilots, promoting meetings aimed at increasing a mutual understanding of each other's work tasks, problems, and operational behaviors. Refresher courses on the proficiency of the English language for non-native speaking people are very important for improving self-confidence and avoiding stressful and risky misunderstandings while communicating on radio frequencies and on the telephone.

5. Concluding remarks

Psycho-organizational aspects can be identified as affecting quality and safety outcomes in high-risk organizations with highly reliable operations. Occupational stress is affecting the workplace across industries. This fact, coupled with its rising cost to the individual, to industry and to society - as a whole - has greatly heightened awareness of the need for effective and innovative ways of tackling stress. Occupational stress is related to cost rising of services and human capital management for organizations, providers, and enterprises. Therefore, its widely recognized the greatly heightened awareness of the need for effective and innovative ways of tackling stress.

The implementation of QMS and stress prevention plans at the ATC workplace has proved particularly effective in combating stress, by unknowledge the stress sources and causes, rather than merely treating its effects. According to a system of system approach, this paper provides compact and coherent directions to prevent stress in specific occupations, particularly exposed to stress. This paper indicates several preventive measures targeted to stress management in ATS providers, rather than the stress treatment of its effects. The paper promotes key drivers for action that ATC managers should be taken into consideration and promotes measures that can become an integral part of the necessary organizational development of an air transport enterprise.

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