European Journal of Business and Management
ISSN 2222-1905 (Paper) ISSN 2222-2839 (Online)
Vol.6, No.7, 2014

Managing the Performance of Air Traffic Controllers: Developing and Proposing a Conceptual Perspective

Yasir Shafique (Corresponding Author)
Army Public College of Management and Sciences (APCOMS)
Khadim Hussain Road, Rawalpindi Cantt, Pakistan
+92-300-5113768
Ysk79@yahoo.com

Abstract

Identification of the factors which can have adverse and negative effects on the operational performance of the ATCOs across the globe is of paramount importance and calculating their impact is essential for the safe and expeditious flow of air traffic in the skies. This Research paper suggests a conceptual model elaborating the standards which needs to be followed by all types of air traffic controllers, what are the factors which affect the working capability of an ATCOs, how to identify those factors, who is responsible to identify those factors, what remedial measures can be taken for the eradicating those issues, who will review the performance of an affected ATCOs and in the end what all options can be exercise to revive the carrier of an ATCOs. The paper concludes with some recommendations for future research.

Keywords: Air Traffic Control, Performance Management, Behavioral, Psychological and Physiological Aspects of Human Behavior.

Introduction

The aviation industry, encapsulates development, operations and maintenance of the aircrafts to fulfill the requirements of airlines on one hand and modern military on the other. All these three phases forms the bottom threshold for the running the industry. From a novice point of view, the very fact becomes evident that aeronautical engineers and aero technicians are the human capital which is required for the development of the aircrafts. In real world this requirement is fulfilled by huge companies like Boeing and airbus as far as we talk about commercial aircrafts and the big names in fighter aircraft industry are Lockheed martin, Northup Grumman and McDonald Douglas from USA, Sukhoi of Russia, Saab of Sweden and Dassault of France. Maintenance has got different types. A lot of it is covered by the manufacturer but the airlines do have their own crew to work on that and provide the requited technical assistance.

The airlines not only employ the pilots but also staff for ticketing counters, baggage handling, and maintenance crew for turnaround of the aircraft. To manage the airports, normally the civil aviation authority of the respective country exercises the control over the airports. Operations at the airport are thus run by employing a huge number of people including positions from air traffic controllers to housekeeping.

Who are air traffic controllers? What all planning is required in their setup of work? How their performance can be gauged? How their capacity can be enhanced and further developed. How their performance rating is done? How different issues they might face can be resolved and how they can be rewarded? These are the questions which forms the base of this research. So encapsulating the whole matter, we need to understand what is performance management? Secondly, how performance of air traffic control officers is managed?

Performance management can be defined as “It is the systematic process by which an agency involves its employees, as individuals and members of a group, in improving organizational effectiveness in the accomplishment of agency mission and goals” (U.S. office of personnel management, 2013). Another definition states that “s 'a process which contributes to the effective management of individuals and teams in order to achieve high levels of organizational performance. As such, it establishes shared understanding about what is to be achieved and an approach to leading and developing people which will ensure that it is achieved'. It is 'a strategy which relates to every activity of the organization set in the context of its human resource policies, culture, style and communications systems. The nature of the strategy depends on the organizational context and can vary from organization to organization (Armstrong & Baron, 2004). In both definitions, it is evident that there should be effective management of employees and it should be done according to defined standards and strategy for the overall effectiveness and smooth operations regardless of the type of the organization. The constructs of the strategy depend upon the nature and type of organization which is generally civil aviation authority in this case.

In general, air traffic controllers are the people who control aircrafts on the airports and after their takeoff from the airport (Exforsys Inc, 2006). They do voice communication with the aircraft's to give them directions and maintain safe, orderly and expeditious flow of the air traffic (Exforsys Inc, 2006). They have numerous duties to perform one there are maintaining their watch which includes getting and passing the weather statistics to the pilots, do the clerical work including clerical tasks which may include analyzing weather reports and fuel requirements, compile pilots reports and flight plan documentation, complete daily logs, keep messages from the aircraft and review all reports for clarity and completeness, give necessary instruction to ground workers, handling the aircrafts experiencing emergencies, handing over and taking over the aircrafts enter their area of responsibility and leaving their area of responsibility respectively and lastly, observe strict compliance of government and civil aviation rules and regulations(Exforsys Inc, 2006). One can imagine that what level of responsibility they have while performing all these duties. It is of paramount importance that the air traffic controllers should be clear about their duties and responsibilities at different stages of their carrier span and if a problem arises, it should be timely identified and rectified to avoid major mishap. For this, having a generic conceptual model dealing with performance management of air traffic controllers might help us to integrate all the links in this chain.

Problem Statement

Keeping this very fact in view and the existing literature, the researcher plans to develop a Performance Management model for Air traffic controllers across the globe. The structure of the model has been designed keeping in view the requirements which are required to be fulfilled, before caring out the duties and responsibilities associated with this job.

Significance of the study

This research is a contribution to the body of knowledge by giving a clear roadmap to develop more sophisticated performance management models for air traffic controllers and other specialized roles in aviation industry. More refined and complex methods can be employed to gauge the other behavioral, psychological and physiological aspects of human behavior which can play key part in shaping up their performance. The civil aviation authorities across the globe can use and deploy this model in actual scenario with minor adjustments. Thus, they can manage the performance of air traffic controllers having different levels of experience, skills, knowledge and abilities.

Originality of the study

The conceptual model dealing with performance management of air traffic controllers working in aviation industry across the globe is never been developed by any other researcher till date. This is a visible gap in the body of knowledge. Thus, it can be said that this research work does fills the gap and is a significant contribution to the body of knowledge.

Scope of the study

This research is carried out using all those constructs, which are already known. Moreover, this model is exclusively developed for those air traffic controllers, which are on active duty regardless of the level of their proficiency. More thorough work is required to conceptualize a generic model which can cater for all the major professions in the aviation industry in general and air traffic controllers in particular. The air traffic controllers which are either not performing active duty or those who have been declared unfit for this profession due to any reason have not been catered for in this model. The addition of more behavioral, physiological and physiological constructs, which play an important role in shaping up the performance of an air traffic controller, can also be made part of future researches.

Rationale of the study

The researcher has spent more than four years in this profession as an active air traffic controller and is well qualified to control military as well as civil air traffic within Pakistan's airspace. During his tenure he has observed the mishandling and unjustified measures taken by the authorities to rectify a behavioral, psychological motivational or physiological problem faced by an ATCO i.e. Air traffic control officer on active duty. Those unjustified actions not only resulted in dire consequences for the carrier of those ATCOs but also for the organization. This sheer negligence of the concerned was because of non awareness to the correct performance management cycle which needs to be followed while tackling an in house performance related issue. This breed

of men/women i.e. ATCOs are specially trained and operate in a highly nerve-racking environment. This known fact; calls for an altogether different performance management treatment when compared to other ground crew in aviation industry. All these facts and figures prompted the researcher to develop a conceptual model to manage the performance of air traffic controllers across the globe.

Objectives of the Study

This research has been carried out with an objective of developing a comprehensive conceptual model which can cater the performance management needs of air traffic controllers across the globe.

Literature Review

The psychological responses to change in workload in an air traffic control related environment were proved by an investigation which was done on eight air force air traffic controllers who performed three scenarios on TRACON i.e. Terminal Radar Approach Control which is computer based air traffic control simulation. In two simulated scenarios, one with varied traffic volume and the other with varied traffic complexity, manipulation were done and their effect on controller's workload were assessed using NSA-TLX i.e. a subjective assessment tool using six subscales namely mental demands, physical demands, temporal demands, own performance, effort and frustration and physiological measures including EEG, eye blink, heart rate, respiration and saccade. Significant effects were found on controller's workload with the increased difficulty level related to traffic volume and complexity (Brookings, Wilson & Swain, 1996).

Quite compelling evidence has been found by a research which was carried out in which 4,325 air traffic controllers and 8,435 second class airmen were examined for Hypertension, Peptic Ulcer, and Diabetes. For hypertension and peptic ulcer the evidence is moderately strong and for diabetes it is slight but suggestive (Cobb & Rose, 1973)

The assessment of psycho physiological stress was done by taking saliva samples of 158 male air traffic controllers before and after two working sessions. A significant increase in the concentration and secretion rate of salivary immunoglobulin A (sIgA), as well as in the concentration of salivary cortisol was recorded. The increase in salivary immunoglobulin A was not correlated with actual and perceived work load whereas increase in salivary cortisol was correlated with both workload measures The findings showed that observed sIgA increase is due to positive emotional engagement. This physiological response can be used as a tool to differentiate between positive and negative stress effects or between effective and ineffective adaptation/coping with situational demands (Zeier, Brauchlia & Jemelkab, 1996)

The issues which critically affect the human performance in air traffic control are discussed by Isaac & Ruitenberg (1999) in their research. Physiology issues include stress, fatigue and shift work problems, Psychology issues mention the reasons of human error in air traffic control and how to manage it. Social psychology factors such as issues of communication and working in teams are discussed. The issues related to environment like ergonomic principles, working with new technologies, hardware, software, development of documentation and procedures and a detailed note on changes which have brought a change in the air traffic control environment is included.

When the reliable automation is done in the air traffic controller's environment, it works and aids the air traffic controller in decision making, improving his performance and reducing the workload. Inaccurate automation leads to manual decision making and increased workload. The results of this study can help in future design of automation and procedures for future air traffic control systems (Metzger & Parasuraman, 2005).

Automation which aids the air traffic controllers to make decisions regarding collision avoidance actually lowers their situational awareness and in case of automation failure the time taken to detect the incoming threat is longer. The results clearly indicated that decency on automation lowers the performance and situational awareness of the air traffic controllers (Sethumadhavan, 2009)

Three major mechanisms associated with automation which directly impact situational awareness. First is Changes in vigilance and complacency associated with monitoring. Second is assumption of a passive role instead of an active role in controlling the system and third are changes in quality or form of feedback provided to the human operator. Due to the complex nature of the automated systems, the higher level of situational awareness (comprehension and projection) is automatically challenged during ongoing system operations (Enslay, 1996)

A research conducted by Langan-Fox, Sankey & Canty (2009) linked the fast occurring changes in the air traffic control systems and the roles and responsibilities of air traffic control officers. Human factor issues are evolving because of these changes and reliable methods should be adopted to discover new human issues related to these changes. On one hand situational awareness and workload have been key areas which have been researched by using variety of measures but on the other trust, stress and boredom are totally neglected. These areas need attention as they are highly vulnerable areas due to fast changing air traffic control environment.

A study conducted on a sample of 20 ATCOs from Rome was conducted by Costa (1993). Recordings involved subjective ratings (mood, physical fitness, fatigue) and objective measures (heart rate, vanillyl mandelic acid excretion, reaction times, critical flicker fusion, oral temperature). In addition, die subjects filled out questionnaires for personality traits (extroversion, neuroticis, and anxiety) and behavioral characteristics (morningness, rigidity of sleeping habits, vigourness to overcome drowsiness). Finding were concluded with a positive note that all these subjective and objective measures have positive affect on the air traffic controllers regardless of the workload.

A test conducted on 52 ATCOs provide the positive evidence of changes in alertness on some of the NIOSH performance measures within work days and across days of the week. Changes in test performance and mood ratings support the decline in self-reported sleep time across the work week (Schroeder, Rosa & Witt, 1998)

At study conducted on a sample of 205 male air traffic controllers was done using standardized questionnaire and taking saliva sample after every investigated working session. The questionnaire parameters represented psychological stress symptoms, such as complaints of physical discomfort, depression, negative self-communication, work-increased anxiety, coping behavior and subjective rating, and interpretation of various aspects of the working situation. 10-15% of the sample showed results corresponding to symptoms of high stress related to workplace or private life. The cortisol response also showed positive evidence regarding workload. Findings in this research recommended that ATCOs' complaints regarding excess work stress should be taken seriously (Zeier, 2007). Fatigue and Stress in Air Traffic Controllers was also verified by a study conducted on a sample of 68 air traffic controllers by Grandjean, Wotzka, Schaad & Gilgen (1971).

A study conducted using a sample of forty five ATCOs simulating an air traffic control task examined the degree to which reported boredom is related to monitoring efficiency on a complex task and explored the general pattern of physiological and subjective changes associated with boredom. The results showed positive levels of boredom, monotony, irritation, attentiveness, fatigue, and strain (Thackray, 1977)

The steadiness of many intricate and significant systems strongly relies on human operators, both through human consistency and human ability to handle effectively the unanticipated events. The ergonomics field studies of air traffic control activities helped in the analyses of communication within teams of controllers. It showed that how operators use instinctively the natural variety of communication to successfully maintain mutual awareness. This is the key for dependable collaboration, for the sake of worldwide system fidelity that rests on mechanisms such as error detection, recovery, and prevention (Rognin & Blanquart, 2001)

A research clearly deliberates the factors that have been found to influence the rate of occurrence of air traffic control operational errors, and examines the relationship between the severity of operational errors in an en-route environment and the traffic characteristics at the time (Geoffrey, 2002).

Results of the study exposed that ATC-related accidents and incidents are uncommon events. However, whenever such accidents or incidents were reported, they usually involved one controller trying to interact with multiple aircrafts during daylight under VFR conditions. An in depth scrutiny of the description reports using the Human Factors Analysis and Classification System (HFACS) discovered that skill-based errors (attention failures and memory lapses) were the most common and supervisory and organizational factors such as controller training, procedures, and oversight were cited in only a small fraction of the incident and accident reports (Pape, Wiegmann & Shappell, 2001).

Key Findings

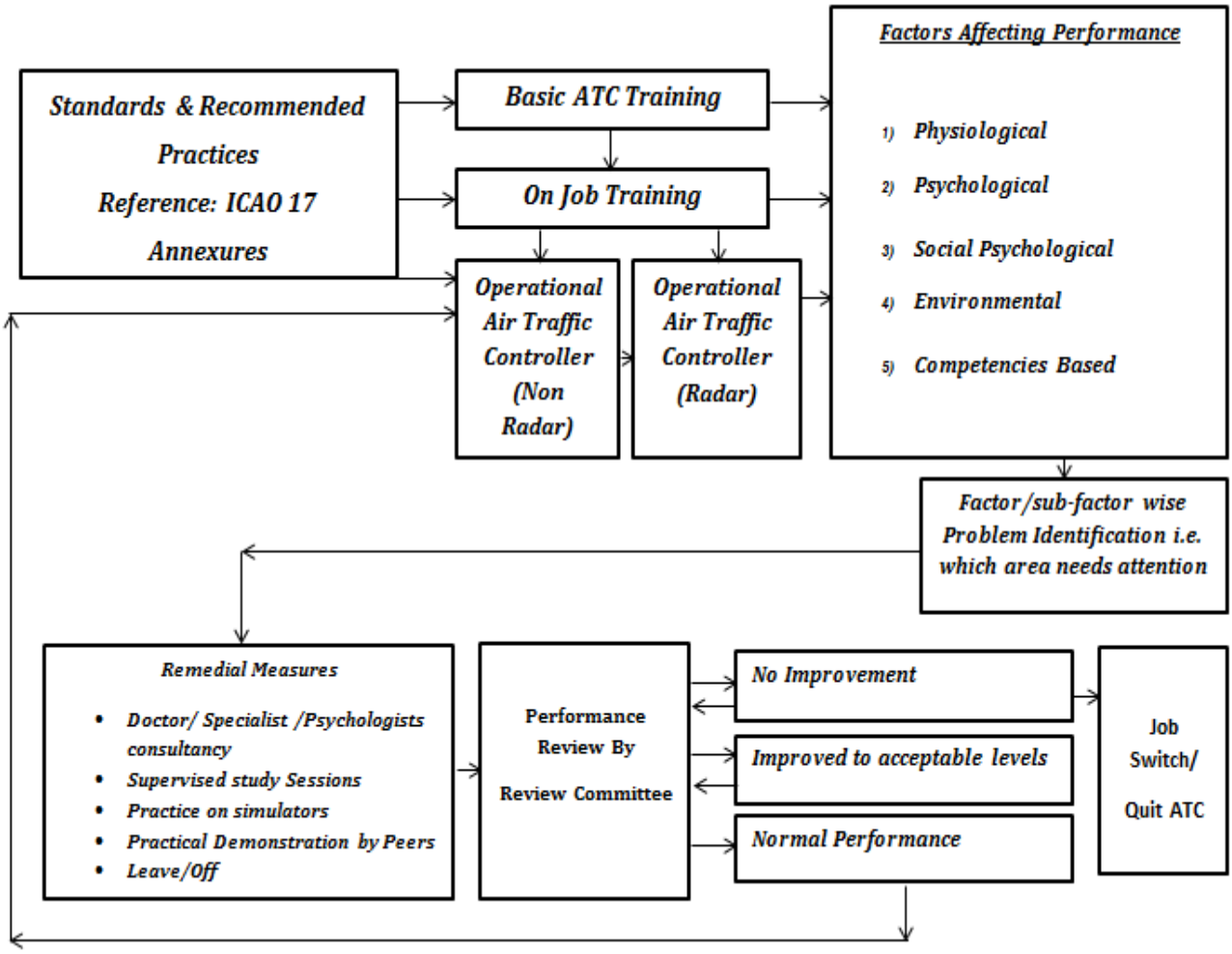
a) Change in workload configuration causes variation psychological responses.
b) The percentage of physiological issues i.e. hypertension, peptic, diabetes and ulcer etc. are common in ATCOs.
c) ATCOs are exposed to excessive physiological stress while performing their duty.

d) The Psychology issues faced by ATCOs include human error and its management, stress, fatigue, depression, anxiety, Family problems, personality disorders, trust complacence, over reliance, emotional stability, motivation, and perceptional problems.
e) The social psychology issues like communication, clear articulation and linguistic ability issues, working in teams, workload, and shift work problems are also part and parcel of ATCOs job.
f) The evidence of environment related problems which include ergonomic principles i.e. equipment setup, working with new technologies, boredom, vigilance, monotony, spatial ability, attention to detail, planning and decision making, action execution are also to be counted in.
g) Competencies issues like organizing skills, situational awareness, sense of duty and responsibility, problem solving & decision making skills, presentation & communication skills, leadership skills & team spirit, job knowledge and its application, initiative & adaptability, attitude towards QHSE are frequently originate in ATCOs job.

Methodology

This is an exploratory research based solely on visions extracted from the analysis of the current literature, reports, periodicals and books related to the topic of study in order to explore the factors affecting performance of Air traffic controllers across the globe. This conceptual model development will help resolve unattended issues faced by the air traffic controllers in routine. An extensive and intensive literature survey was carried out in which topics from Physiology (visual and long term memory, hypertension, basic medical fitness), Psychology (human error and its management, , stress, fatigue, depression, anxiety, Family problems, personality disorders, trust complacence, over reliance, emotional stability, motivation, perception), Social Psychology (issues of communication, clear articulation and linguistic ability, working in teams, workload, shift work problems), Environment of air traffic controllers (Ergonomic principles i.e. equipment setup and working with new technologies, boredom, vigilance, monotony, spatial ability, attention to detail, planning and decision making, action execution) and Competencies including organizing skills, situational awareness, sense of duty and responsibility, problem solving & decision making skills, presentation & communication skills, leadership skills & team spirit, job knowledge and its application, Initiative & adaptability and Attitude towards QHSE i.e. Quality, health, safety and environment were studied in detail. This effort of the researcher leads him to conceptualize and elaborate the following model

Model Elaboration



Source: Researchers own processing

In every performance management model, generally the first stage of the model, the standards is set which can later be used as a threshold to measure the performance or gauging the level of performance of the employee. Same is the case here as the first stage of this model defines the standards and recommended practices which are required to be followed during all the phases of air traffic controlling i.e. training, on job training and independent operations. These standards and recommended practices are not set by the civil aviation authority and the air traffic controller, regardless of his status rather they are already set by International Civil Aviation Organization (ICAO) for the whole industry. It is mandatory for all the air traffic controllers across the globe to follow those standards and recommended practices. ICAO has 18 annexures. All these 18 annexures have those standards and recommended practices which are to be followed by all the civil air traffic controllers across the globe.

The list of these annexures is given as follows:

Annex 1	Personnel Licensing
Annex 2	Rules of the Air
Annex 3	Meteorological Service for International Air Navigation
Annex 4	Aeronautical Charts
Annex 5	Units of Measurement to be Used in Air and Ground Operations
Annex 6	Operation of Aircraft
Annex 7	Aircraft Nationality and Registration Marks
Annex 8	Airworthiness of Aircraft
Annex 9	Facilitation
Annex 10	Aeronautical Telecommunications
Annex 11	Air Traffic Services
Annex 12	Search and Rescue
Annex 13	Aircraft Accident and Incident Investigation
Annex 14	Aerodromes
Annex 15	Aeronautical Information Services
Annex 16	Environmental Protection
Annex 17	Security: Safeguarding International Civil Aviation Against Acts of Unlawful Interference
Annex 18	The Safe Transport of Dangerous Goods by Air

Source: International Civil aviation organization, (2013). Catalogue of ICAO Publications Retrieved from http://www.icao.int/publications/Pages/catalogue.aspx

The basic ATC course is run for the new and fresh graduates selected to become future air traffic control officers. Their further grooming is done by subsequent courses run at different stages of their carrier. The list of courses along with their duration is as follows:

Course title	**Duration (in weeks)**
Basic ATC	40
Approach Control (Non Radar)	12
Area Control (Non Radar)	12
Radar Approach /Area Control	12
ATC Assistant Course	16
OJT Techniques for ATCO's	04

Source: Civil aviation training institute, (2013), School of air traffic services and communication operation Retrieved from http://www.catipakistan.com.pk/ats.htm

The basic ATC course is the prerequisite for the on job training for procedural or non-radar air traffic controlling in the actual environment. After a reasonable period of time as defined by the concerned authorities, other courses are planned like Approach controls (radar/non-radar), Area control (radar/non-radar) for the carrier progression of the air traffic controller keeping in view their previous performance. Normally the senior air traffic control officers are deployed as Approach and area controller with both radar and non-radar qualification. The same seniority level and the required training is also required to conduct the on job training of new air traffic controllers or experienced air traffic controllers upgrading from one category to another. As the training and experience are gained by an air traffic control officer, the multiple factors start causing disruption in the normal flow of work. It is a known fact that air traffic controlling is among the top five most stressful jobs in the world. Due to this fact the air traffic controllers across the globe face a lot many problems which are categorized in five different categories by the researcher. These major factors are further sub divided into sub factors. All these factors cover physical as well as non-physical problems. The initial screening is done by identifying the main factor and then the sub category is diagnosed before taking any remedial measures.

Physiological factors are widely discussed which can cause a lot of disruption in the normal operating efficiency of an average ATCO. As compared to other factors, they are easy to identify by both the air traffic controllers and their supervisors. These factors include visual and long term memory issues; hypertension i.e. raised blood pressure and basic medical fitness issues which include back ache, head ache, sweating and many more. It is recommended that as soon as an ATCO feels any of these symptoms, he/she should report immediately to his supervisor.

Psychological issues are more difficult to identify among people in general and among ATCOs in particular. Their intensity cannot be judged that easily and moreover they start hindering the controlling without any major signs. Human error caused by the lack of concentration is among the top problems which an air traffic controller can face. Usually these types of personalities are declared error prone at the later stages. Stress, fatigue, depression, anxiety, family problems, personality disorders, trust, complacence, over reliance on others, emotional stability, motivation, perception is the other issues which falls into this category. Supervisors need to maintain strict monitoring on the general behavior of the junior ATCOs. The best way is to keep on asking them if they feel any kind of over burden which they can relate to any known issue.

A lot of ATCOs face issues which can be categorized as social physiological issues. This category includes issues related to verbal communication in general and over RT i.e. radio telephony with the aircrafts. English is the official language in which ATCOs communicate with the aircrafts and sometimes non native ATCOs face issues with the articulation and linguistic ability. This is a serious hazard specially while dealing with international flights and their aircrews. A very well established fact leads us to conclude very easily that this issue can pave way for a major disaster. A lot of other issues like working in teams, workload and workload sharing, problems related to shift work can be counted in this category.

It is a common observation that even experienced drivers tend to lose concentration if a slight change in the environment is made intentionally or unintentionally. Environment related issues are very common in most working setups. These problems are not intentionally induced but due to the different factors they settle down. The major issue in this category is the ergonomic issues i.e. equipment setup which is used by the air traffic control officer and working with new technologies. These problems are very easy to identify both by ATCOs and their supervisor. In case of new technologies, proper training related to their operation should be given to the ATCOs so that their comfort level can be augmented. Other issues are boredom, vigilance, monotony, spatial ability, and attention to judge details, planning and decision making, action execution which can be counted in this category. It is primarily the job of the supervisors to keep a watch on their junior ATCOs for any kind of indications.

Sometimes the issue is directly related to the competency level of the air traffic control officer. It includes organizing skills which is an ability to analyze and plan tasks, organize resource for optimum utilization and monitor results till completion of tasks (Pakistan caa, 2013) ,situational awareness which is awareness of the surroundings and the future implications of these surrounding (Pakistan caa, 2013), sense of duty and responsibility means that one should be aware of the importance of tasks and duties assigned and should know how and when to complete them in best possible ways (Pakistan caa, 2013) ,problem solving & decision making skills means logically carries out diagnosis of problem, develop & implement solution & takes rational, sound & timely decisions based on relevant information & facts (Pakistan caa, 2013) , presentation & communication skills means able to present facts and ideas verbally and in written form in a clear, effective and convincing manner (Pakistan caa, 2013), leadership skills & team spirit means develops in subordinates the will and desire to work towards common objectives, assign work to subordinates a/c to their capabilities, exhibits team spirit to achieve shared aims (Pakistan caa, 2013), job knowledge and its application means posses knowledge of methods, techniques & skills, conversant with all phases of job related matter, apply theoretical knowledge at work (Pakistan caa, 2013) , initiative & adaptability means does things before being asked to or forced by events, ability to alter behavior and opinions in the light of new information and responds constructively to changing situation (Pakistan caa, 2013) , attitude towards QHSE means maintains quality, knows importance of environmental aspects, occupational health &safety & takes preventive measures to control hazards and risks (Pakistan caa, 2013). All these sub factors are the major contributors in raising the competency level of any air traffic control officer. The competency issues directly affect the operational capability of ATCOs and these are to be addressed on priority.

The Five factors i.e. physiological, psychological, social psychology, environment and competency including their sub factors can be the major contributors towards the sub standard performance of ATCOs as per the previous researches. There can be other factors as well and these factors can differ from culture to culture. The

point which the researcher is trying to prove here is that if the performance of the ATCOs is hampered due to any reason then then subsequent actions should be taken to identify the problem and then take remedial measures. Now, question arises that how the factor and sub factor wise problem identification can be done. This leads us to a new dimension of research. One easy method is factor wise analysis. The supervisors and peers can look for any clues which can lead them to make certain conclusions regarding the problematic area.

If the ATCO is facing any psychological issue the symptoms will be obvious. In this case the affected controller should immediately be referred to the medical doctor or specialist who can thoroughly check the patient and suggest what should be done to cure the illness, if there is any. He tends to forget things very frequently, most of the times he/she will be confused while working, uncomfortable posture while sitting, rocking the chair unnecessarily, pressing his/her neck, short temperament and sweating hands are all the clues which can help the supervisors to identify that there is some physiological issue. Similarly if the general behavior of the controller is not up to the mark, the supervisors should talk to the ATCOs and try to identify that what particular issue the ATCO is facing. Psychological issues are hard to pinpoint but even if the supervisors identify the main factor i.e. then the remedial measures are hard to suggest. For these types of issues the ATCO is referred to professional psychologist for identifying and dealing with the issue. The social physiological issues can be tackled by counseling. Convince the affected ATCOs to change his life style, habits and social environment to cater for the issues related to working in teams, workload and workload sharing problems. In case of issues are related to the working environment of the ATCO, and then the supervisors should take the notice and do the efforts to make the ATCO comfortable. Even ATCOs should make an effort to draw the attention of supervisors towards uncomforting factors in the environment. A day off/ leave should be encouraged if an ATCO is facing any family related issue which is bothering him/her. In case of competency related issues, proper coaching and guidance should be given with dedicated time to go through the written material or extra time for practice in simulator labs should be arranged for the controller. Moreover, practical demonstration can also be given to the air traffic controllers by supervisors to tackle any particular situation.

Now after a reasonable time the review committee should be setup to check upon the performance of the Affected ATCO. The committee should comprise of Senior Air traffic controllers and supervisors along with medical doctors and psychologists if necessary. In case the performance is found to be normal then the committee should deploy the ATCO on active duty as soon as possible. If the performance is satisfactory and in the improving stage then a reasonable time should again be allocated so that the improvement process can be continued. If there is no improvement and issues are or cannot be resolved then again after a reasonable period of time or immediately, as the situations demands, the Air traffic controller may be advised to quit the job or if possibility arises, he may be offered a job switch.

The researcher has designed this conceptual model, keeping in view the socio economic and cultural issues and the minimum physical and mental state which is essential for doing active air traffic controlling.

Conclusions

This conceptual model has number of implications on the performance management of the air traffic controllers across the globe. There is no performance management model specifically designed for ATCOs in aviation industry. It is widely accepted fact that performance management of each category of employees cannot be the same in this fast changing environment with more and more automation and technological adding to the complexity. The dimensions which critically affect the performance of Air traffic controllers have increased due to the nature of the job. Thus, correct, precise and timely determination of the issues with solutions needs to be employed to cater all the needs and requirements of the ATCOs. Normal performance appraisal systems cannot be utilized in this domain to cater for the future needs.

Recommendations

This conceptual model can be employed for the performance management of the employees in the aviation industry, in general and for military as well as civil air traffic controllers in particular but with slight and necessary modifications, as and when necessary. This conceptual model is designed with all the secondary sources of information available in the form of research papers, catalogues, performance appraisal forms related to aviation industry. More rigorous and thorough analysis using the scientific investigation methods should be employed to verify the factors mentioned. More thorough analysis should be done to investigate and come up with additional factors and their effects on ATCOs. This model provides all the basic information regarding the

generic life cycle of ATCOs performance management, which factors are to be catered and which can be neglected. Moreover, what remedial measures can be taken keeping in view the social, cultural and general behavioral environment of our country, are only explained. Further refined research can also be done in this domain. Similarly, in this paper those factors which have total positive affect on the performance of the ATCOs are not discussed. The focus remained only on those factors which cause hindrance in the normal workflow. Further research may be initiated to elaborate factors which encourage the positive attitude, behaviors, thinking patterns helpful in creating a supportive environment and conditions for the ATCOs.

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