INVESTIGATING THE IMPACT OF THE CNS/ATM ENVIRONMENT ON THE ORGANIZATIONAL STRUCTURE OF AIR TRAFFIC CONTROL WITH THE APPROACH OF INCREASING FLIGHT SAFETY

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ABSTRACT

This research was done with the goal to analyze the structural aspects of the organization in the CNS/ATM environment. After analyzing the related terminology of the subject within and outside the country and doing primary interviews with experts, the questions of the research were devised with attention to Robbins structural model (complexity, formalization, centralization). In this research, 100 questionnaires were distributed among the experts and authorities in the air traffic control section who were thoroughly familiar with the CNS/ATM subjects. To analyze the data from the questionnaire, techniques such as plentitude calculation, percentage and average and Freedman test were utilized to prioritize the coefficients and factors. The results of the analysis of the data indicates that the structure of air traffic control is high in the aspects of complexity and formalization , and low in the aspect of centralization; therefore, for better performance in the CNS'ATM environment, the organizational structure must work toward lack of centralization. In the end, suggestions and methods are suggested for those who are involved and executives.

Keywords: The CNS/ATM environment, organizational formalization, organizational centralization, organizational complexity, organizational structure

INTRODUCTION

During the 80s, with the increase in the number of flights and the limitation in the controlled space, in order to observe the standard distance for safety, ICAO formed a technical committee entitled Future of Air Navigation System to present methods to respond to the increasing growth of demands and optimal use of space. After conducting several researches and investigations, this committee suggested the plan for communications, navigation, surveillance; air traffic management (CNS/ATM). This system, with the utilization of new and space-based technologies and devising operative methods and with regional and international regulations, has attempted to reduce delays, manage air traffic regionally and globally, accurate locating and navigation, organization of communication and optimization of surveillance, utilization of new technologies and methods in land systems and airplanes and ordering the air space of the countries (document no. 1, 2002, 9750).

On the other hand, political, social and economic observations, integration and flexibility of the country's air space and appointing optimal flight paths for airplanes equipped with modern systems indicate the necessity of this research. Selznick considers the organizational structure as a compatible organism that is formed as a response to the individuals' characteristics and commitments and the impacts of the external environment (Ahranjani et al., 2002, 120). In Cooper's idea (2003), organizational function depends on the correspondence between the structure and the nature of the environment in which it works (Cooper et al., 2003: 250).

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In other words, organizational structure indicates a method in which individuals and occupations are ordered in an organization, in a way that the possibility to do organizational affairs is provided (Sharafoddin, 2004). According to the unanimous say of the experts of management, the structural characteristics of organizations have a significant impact on the approaches and behaviors of the employees. In Mayer's view (1979), the organizational structure is to simplify the complicated patterns of human behavior. It is for this very reason that designing the proper organizational structure is very significant in determining the organizational efficiency. Proper organizational structure in itself, does not lead to success, but poor structure makes successful function impossible, without the individual management having any impact in this matter.

Organizational structure must have the ability to acceleration and facility of decision-making, properly react to the environment and solve the contradictions between units. Therefore, dynamic, complicated environment and expansive changes, especially in the field of information technology, changes in the organizational structure of the air traffic control section of armed forces are inevitable. Now, the question is that what kind of structure can both empower intra-organizational coordination and provide the requirements for reaching the organization's high goals and consequently, improving the level of flight safety and air defense in the CNS/ATM environment.

Main question "What is the best organizational structure for air traffic control in the CNS/ATM environment to increase flight safety?"

Organizational Structure

Organizational structure is shown in the organizational chart. The organization chart is a visible symbol of all of the organization's activities and processes. In defining the organizational structure, three main principles are pointed out:

1. Organizational structure determines the formal relations of reporting in the organization.
2. Organizational structure determines the individuals who work in groups in departments and the classification and division of departments that work in the entire organization.
3. Organizational structure includes the plan for the systems through which the activities of all departments are coordinated and integrated, and as a result, the effective connection system is guaranteed (Daft, 2010).

Organizational structure indicates the method in which individuals and occupations are ordered in an organization, in a way that the possibility to do organizational affairs is provided (Sharafoddin, 2004). In determining the structure of an organization, there is a contingency approach; in other words, the organizational structure is determined with regard to the conditions and the contingents. The factors that determine the effectiveness, function and efficiency of the organizational structure are strategy, technology, organization environment and size.

It must be noted that what today is regarded as an important contingency factor for the organization, may be replaced with other factors in the future and an effective and efficient organizational structure must be able to balance the internal compatibility (formalization , centralization, complexity) with external compatibility (strategy, technology, size and environment). Attention to contingency factors in today's flustered environment is a matter of vitality and in certain cases, determines the organization's survival. Therefore, with these factors in mind, a structure must be designed to be able to provide the grounds for the realization the goals and strategies of the organization. Since organizational structure includes that aspects of formalization, complexity and centralization, they are discussed here.

CNS/ATM ENVIROMENT

Environment CNS/ATM is include of Communication, Navigation, Surveillance and Air Traffic Management.

Communications

In the current air navigation communication system, the transformation of information is done through sound, based on analogue technologies and on VHF and UHF frequencies between air traffic control units and flying objects. While according to the goals of the CNS/ATM plan, the transformation of information in the digital form and through the connection of data was considered and sound information is used as a backup in times when the connection is lost. Sending the needed information through the navigation long distance communication network gives the ability to reach a great amount of information. In fact, information transformation through linking the data digitally is the key to reach a section of air traffic control and it is through this that the major goals can be reached (table 1). The communication section in this plan has the duty to transcend navigation messages and data between users and automatic systems. Added to this, systems for supporting navigation and surveillance functions are also used. Therefore, among the several needs to modern technology, the first priority should be given to the information technology.

Navigation

Supporting navigation systems that are now used by fighting-tactical, transportation and fuel airplanes in armed forces include TACAN, VOR, SHORAN, NDB and ILS and each of these devices have their shortcomings. Among these shortcomings the impact of climate changes, the necessity to be in the visual line and coverage limits can be mentioned. By using the navigation systems of the CNS/ATM plan that are presented in table 2, the following characteristics are reached:

i. Increasing air paths with the regional navigation characteristic by using RNP and RNP5
ii. Added to the utilization of air ways with the regional navigation characteristic and the primary navigation system, the global navigation satellite system is also used
iii. The possibility to utilize the global geodetic 84 systems in expansive areas
iv. The utilization of the system of landing by the device and a limited number of systems for landing by microwave when getting close
v. Current navigation systems include NDB and VOR and will eventually be collected

With regard to what as stated, airplanes must gradually be equipped with regional navigation facilities so that we can have air ways with high flexibility.

Surveillance

Surveillance systems that are utilized now can be divided into two groups of dependent and independent surveillance systems. The act of surveillance is now done based on reporting sound position or based on the use of primary or secondary surveillance radars. In dependent surveillance systems, the location of the airplane is determined using received signals from the supporting navigation systems in land and then, is reported to the units of air traffic control for the control and surveillance services. This system in the Communication, Navigation and Surveillance / Air Traffic Management includes the following items:

I. Automatic dependent surveillance system: Received messages and information from these systems are taken from the data sources within the cabin. The systems inside the airplane send messages and information to land stations automatically and based on predefined communication standards.

II. Air collision warning systems (independent): Using the surveillance systems of this plan, the following capabilities can be reached:
   a. Utilization of secondary surveillance radar of A and C mode in the near future and S mode in some of the stations' controlling space and areas with high traffic load
   b. Utilization of automatic dependent surveillance system in some regions
   c. Utilization of original surveillance radars outside the stations' areas

Air traffic Management

The main foal in air traffic management is to enable airlines to plan internal and external flights and for their flights to follow the timed schedule and also for them to have the flight path and height with the least amount of deviation or maximum safety. The parts of air traffic management include the following items:

I. Airspace management: The main goal for the utilization of airspace management is the maximum use of the airspace structure, the use of the space that is given in the form of a dynamic shared time and the division of the space by classifying it with regard to the needs of the users. It must be mentioned that the above management must be together with air traffic control and managing the flow of air traffic.

II. Air traffic services: Air traffic services have different elements including flight information services, warning services, air traffic consulting services and air traffic control services. The most important goals and duties of air traffic services are the following:
   a. Preventing the collision of airplanes in a controlled space
   b. Prevention of collision between airplanes and the barriers around the airports
   c. Acceleration and organization in the flow of flights
   d. Presenting services for flight and warning information for the flights' safety
   e. Integrity and awareness of related organization in cases of emergency states in airplanes and participation analyzing the accident, investigation and rescue

By investigating the research methodology, organizational structure and the CNS/ATM environment, researchers have discussed the aspects that were pointed out in that environment. This basis for the following conceptual model is shown as the research's theoretical framework.

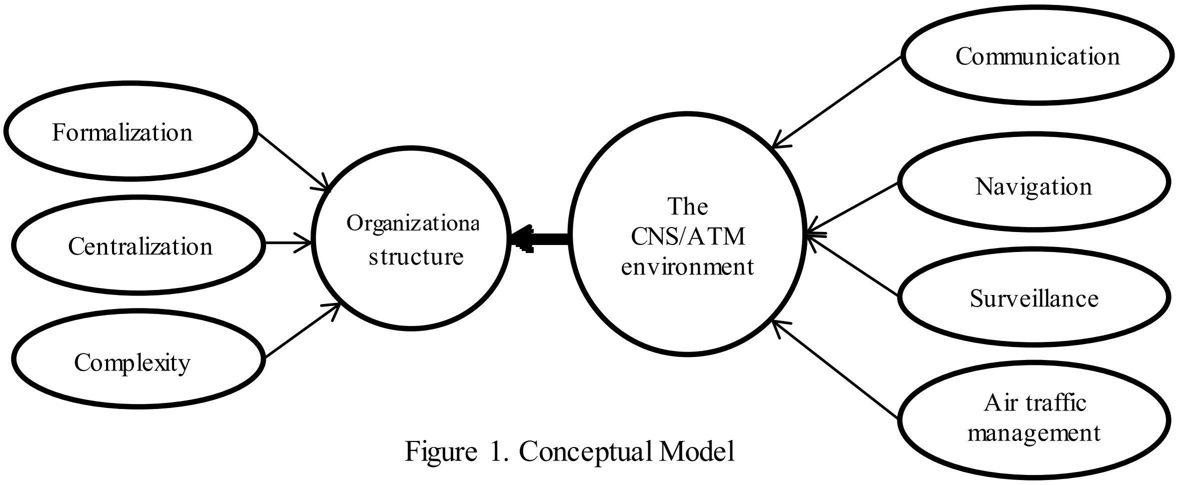

Figure 1. Conceptual Model

RESEARCH METHODOLOGY

This research is functional in terms of its goal and is of descriptive-scaling nature and method and the data collection is mostly done through field method. The statistical group is consisted of 100 experts and elites of air traffic control who were chosen and are completely familiar with the CNS/ATM environment. With regard to the small number of the statistical group, census was done.

To investigate the readability of the research, added to the fact that the study's main coefficients and the questions of the research were chosen by the theoretical studies related to the subject, the figurative readability was used. In this way, the primary version of the questionnaires was distributed among some of the university professors to receive suggestion regarding its content and its ability to evaluate the needed coefficients and they unanimously validated the questionnaires with minor adjustments.

To calculate the research's stability capacity, the Cronbach alpha coefficient was utilized. To analyze the impact of the compatibility between the working environment and its coefficients with the organizational identification, the regression test and the SPSS software and to test the pattern, the models of structural equations and the LISERL software was utilized.

ANALAYSIS AND RESULTS

With regard to the data related to the replier's demographic characteristics, the highest amount of plentitude is related to individuals with expert positions with 57.7 percent and individuals in management positions come after with 33.3 percent. 46.7 percent of the repliers had 10 to 15 years of service and 25.1 percent had 5 to 10 years of service. 63.3 percent of the repliers have BA and BS degrees and 30 percent of them have MA and MS degrees. 90 percent of the repliers had the educational degree for air traffic control.

Table 1. Descriptive analysis of the structural aspects in the CNS/ATM environment

Questions	*Average*	*Variance*	*Standard deviation*	*Maximum*	*Minimum*
Complexity	3.728	0.297	0.544	4.800	2.600
Formalization	4.244	0.092	0.302	4.780	3.560
Centralization	2.673	0.334	0.578	3.670	1.670

Table 2. Ratings of the structural aspects of the organization of air traffic control in the CNS/ATM environment

Structural aspects	*Repliers' ratings*
Complexity	2.16
Formalization	2.78
Centralization	1.06

Table 3. Rating structural coefficients in terms of the complexity aspect

Coefficients of the complexity aspect	*Ratings of the repliers*
Organizational communications	3.83
Clarity of hierarchy	2.78
Different job positions	2.24
Level of education and expertise	3.32
Geographical expansion	2.83

Table 4. Rating coefficients of the organizational structure in terms of the formalization aspect

Formalization coefficients of the organizational structure	*Repliers' ratings*
Matching function with job description	4.37
Standardizing the activities	4.61
Setting rules and regulations	5.77
Applying rules and regulations	4.60
Clarity of rules and regulations	5.61
Clarity of rules and regulations	5.42
Employees' following of rules and regulations	5.54
Employees' awareness of the task	5.24
Employees' awareness of long term objectives	3.84

Table 5. Rating coefficients of the organizational structure in terms of centralization

Centralization coefficients of organizational structure	*Ratings of the repliers*
Appointing freedoms	3.57
Management control	3.02
Employees' freedom	1.96
Reviewing strategies before applying	3.95
Freedoms of the employees and executives	3.31

Table 6. Coefficients and factors of the organizational structure in the CNS/ATM environment

Coefficients of organizational structure in the CNS/ATM environment	*Repliers' ratings*
Organizational communications	13.78
Clarity of hierarchy	10.12
Different job positions	7.90
Levels of education and expertise	11.81
Geographical expansion	9.96
Matching function with job description	12.22
Standardizing the activities	12.57
Setting rules and regulations	14.67
Applying rules and regulations	12.33
Clarity of rules and regulations	14.35
Clarity of rules and regulations	14.03
Employees' following of rules and regulations	14.29
Employees' awareness of the task	13.73
Employees' awareness of the long term objectives	10.95
Appointing freedoms	5.84
Management control	4.57
Reviewing strategies before applying	7.01

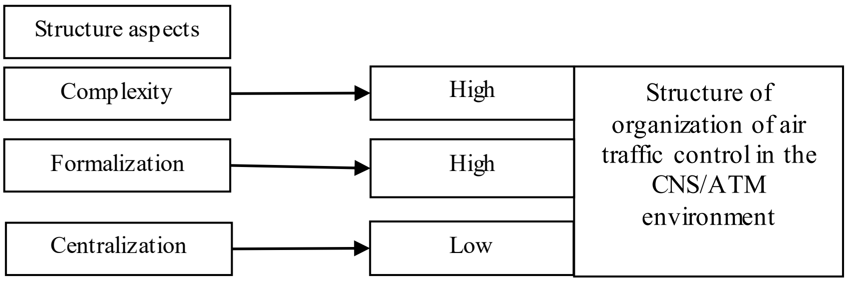
Structure aspects
Complexity
Formalization
Centralization
High
High
Low
Structure of organization of air traffic control in the CNS/ATM environment

Figure 2. Priority aspects of organizational structure

ARGUMENT AND CONCLUSION

Organizational structure is the result of organization collection and designing the organization which includes the total of relations, rules and regulations that even if they are formed unofficially, are officially approved and form the individuals' activities to gain the shared organizational goals. The structure of each organization determines its ability to respond to environmental challenges and empowers the processes for actualizing the methods and realizing the organization's goals. Therefore, the necessity to do research regarding the important and significant factors in the CNS/ATM environment on the structure of air traffic control is an inevitable affair. Among these sections is air traffic control. Unified, strong and structured air traffic control provides the grounds for the increase of the organizational power between decision making organizations in the country. On the other hand, the entrance of modern air traffic systems and satellites have created a challenging core for establishing air defense and national security that can help the employees of the air traffic control department in doing their organizational duties and reaching the predetermined goals on the one hand, and on the other, face crisis and unpredicted accidents. In this respect, researchers' investigations show that one of the current challenges of the air traffic control department is the unevenness in the organizational structure. According to this research, this subject must be looked upon with a comprehensive and extra-organizational perspective and it was tried to analyze the CNS/ATM environment on the structure of air traffic control and investigate different aspects of organizational structure in the CNS/ATM environment by reviewing different aspects of the organizational structure and familiarizing with modern systems.

With regard to the results of the research, the amount of formalization in the air traffic control structure in the CNS/ATM is low. The amount of formalization in the studied community can be decreased by reducing the determined and inflexible job descriptions, standards and difficult and scrutinizing processes, and appoint the whole task and responsibility to the group and team by creating teams and groups instead of appointing a portion of the job to one person. Reducing the employees' freedoms causes the loss of a great part of the employees' operational energy. However, reducing the amount of formalization in the organization needs learned and educated people who can innovate and apply their judgments in the correct path. It must be noted that the analysis that was done on the studied group showed that all the employees of the air traffic control department enjoy the minimum education level of expertise and this can be regarded as a strength point. On the other hand, in the formalization aspect of the organizational structure, the variance of setting rules and regulations, clarity of rules and regulations and the employees' following of the rules and regulations have appointed the highest ratings to themselves, respectively. Therefore, it can be concluded that to be situated in the CNS/ATM environment, the organization must set rules and regulations and employees must follow the rules and regulations. So in order to establish flight safety, timely and correct decision making and avoiding any kind of stoppage in doing operative affairs of different flight units and accelerating in the flowing process of the affairs of air traffic control, there is a need for rules and regulations that can both guarantee aviation safety and also facilitate the decision making process of the air traffic controller. It must be noted that with the results that were reached in the research terminology, it is desirable for the formalization to increase as much as the increase in complexity.

In relation with the amount of centralization in the organization, with regard to the its negative relation with the application of the CNS/ATM plan, the employers must be invited to participate and they must be given sufficient freedoms to make important decisions. In the centralization aspect of the organizational structure, the coefficients of the amount of the freedoms of the executives and the employees, reviewing the strategies before applying them and appointing freedoms have taken the highest ratings, respectively. Therefore, it can be concluded that there must be decentralization in the organizational structure in the CNS/ATM environment and the employees must enjoy a high levels of freedoms and to reach this, they must also have high levels of education and expertise, and this coordinates with the results from the complexity aspect. In case some of the freedoms were appointed to the employees, it must be according to the operational regulations and agreements. In this way, the amount of delays can be reduced. With regard to the fact that in every moment, employees may face unpredictable conditions, they must have a high level of freedoms and high decision making abilities so that they can act in time.

With regard to the results from the research, in terms of the complexity aspect, repliers have given the highest rating to the organizational communications coefficient and it is followed by the coefficients of levels of education and expertise and geographical dispersion. Therefore, in the CNS/ATM environment, organizational communications are of very high importance and also, the employees must enjoy high levels of expertise and education.

SUGGESTIONS

1. With regard to the fact that in the view of the repliers, formalization must increase, it is suggested that the rules and regulations of ICAO be used as a pattern and utilized in our country with attention to the security/defense affairs.
2. Since the CNS/ATM is a global plan and air traffic control must enter this environment, measures must be taken to send personnel abroad for training.
3. Since automation has a key role in the CNS/ATM, teaching information technology must become obligatory for all employees of aviation in general, and for the employees of air traffic control in particular.
4. With attention to the notion that the repliers unanimously agreed that complexity must increase in the organizational structure and that organizational communications must be in the repliers' priority, measures must be taken toward automation in order to facilitate and increase communications.
5. All the regulations within our country, including those taken from the American Federal Laws are obsolete and to increase formalization in aviation, the ICAO rules must be followed.
6. To increase formalization and unify air rules and regulation, a committee consisted of the sides of interest in the level of forces must be formed.
7. With regard to the fact that employees must have high levels of decision making abilities, it must be tried to employ people with higher intelligence.

8. With attention to the clear script of the International Airways Organization regarding the integrity and close interaction between military and non-military organizations, a committee must be formed for coordination.
9. With regard to the global CNS/ATM plan, all the aviation personnel must have the level 4 ICAO degree.
10. Different tools including fables, ceremonies, costumes and culture of following the rules must be institutionalized in the employees.
11. As much as the mechanisms of information transportation to decision making points increases, decentralization increases. Therefore, it is suggested that by establishing the proper system of information management, provide the grounds for transporting information to decision making points.
12. In order to train the needed expert human forces in the middle and high management levels of the country's aviation industry, to reach the goals of flight safety, improve security level, effectively and efficiently manage and order the aviation organizations and establish the needed interaction with all the executive and rule-making departments of the country in aviation affairs, authorities must work toward training efficient, committed and able experts with the capability of constantly increasing their efficiency and presenting operative plans and doing organizational tasks and create the field of air traffic control for higher education.

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