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SCOR BASED MAINTENANCE MANAGEMENT MODEL SUGGESTION FOR COMMUNICATION NAVIGATION AND SURVEILLANCE SERVICES IN CIVIL AVIATION SECTOR

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ABSTRACT
The astonishing developments in information, communications and transportation technologies in the 21st century have resulted in an increase in the number of loadings and passengers carried through the air, which in turn has led to the global expansion of civil aviation activities. The main purpose of this research is; (CBM) in accordance with the standards determined by international civil aviation authorities such as ICAO and EUROCONTROL to be performed in the Communication, Navigation and Surveillance (CNS) Services and Systems in the field of Turkish civil aviation. As a result of the research, a new SCOR-based maintenance management model has been suggested for logistical and supply chain management processes in accordance with the standards determined by international civil aviation authorities such as ICAO and EUROCONTROL to be applied in CNS systems and services in Turkish airspace.
Keywords: Civil Aviation Services, communication navigation observance, CNS, maintenance management model, supply chain management, TZY, SCOR model

Since the human being is a moving creature that has a carrying power and has a variety of social and commercial relations, the transportation sector has been up to date from the oldest communities (Arı, 2011: 2).

Although their qualities and methods have changed over the centuries, the needs of people and their mental characteristics have been forced to mobilize, travel and transport. After discovering the man who invented the wheel for this, the paddle and the sailboat, all the corners of the world have been recalled, and these discoveries have turned into different dimensions with the industrial revolution (Kuyucak, 2010: 198).

When the 21st century has begun, the air transportation sector has become the most advantageous way of transportation compared to other alternative transportation sectors thanks to globalization's dynamism, the most concrete face of the technological developments in the world, speed, comfort and time saving provided to people. (Otamış, 2013: 4).

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Airway transportation can be explained in the simplest way as "the transportation of all living beings from one place to another by any air vehicle" (Korul and Küçükönal, 2011: 505).

The astonishing developments in information, communications and transportation technologies in the 21st century have resulted in an increase in the number of freight and passengers carried through the air, which in turn has led to the global expansion of civil aviation activities.

With this spread and enhancement, air transportation has become the most attractive, safest and fastest mode of transportation that people of today are using all the time. However, the fact that people have become more and more popular than ever in the history of air transport has led to inadequate airports and airports. For this reason, international civil aviation regulatory agencies such as the International Civil Aviation Organization (ICAO) and the European Air Navigation Safety Organization (EUROCONTROL) activated in the national civil aviation organizations such as the DHMİ and DGCA of Turkey, all the civil aviation safety subsystem has determined to provide quality and efficient air transport rules and managerial models.

The common purpose of the universal rules for "Communication Navigation and Surveillance (CNS)" systems and services, which is currently managed according to such rules and models recommended by international civil aviation authorities, is to realize safe, quality and efficient air transportation.

CNS units in place with numerical air-ground data transmission systems support the aircraft in order to support the automation onboard the aircraft in order to complete the navigation safely, even when a plane is airborne, even if it is miles or miles away from the country that it belongs to (Ünal, 2014: 15).

Thanks to this support and technology, the takeoff, flight and landing of the aircraft are performed safely. Therefore, devices in the CNS units must be operated on a 24-hour basis, without any malfunction, obstacle or problem. Otherwise, flight safety will be dangerous (CNS / ATM, 2010: 6).

Especially, before anything else the flight is safe is directly related to the running of the CNS services at all costs. CNS systems operating in the Turkish civil aviation sector need to maintain systematic maintenance and repair of the failures, periodic maintenance and repairs of navigation aids, as well as surveillance / radar equipment and equipment, in accordance with international standards and a model framework.

"SCOR Model Processes" is frequently mentioned and applied as a reference model in the literature related to the planning of supply chains and the evaluation of maintenance performances which are widely used in today's maintenance approaches (McKone et al., 2001; Hipkin, 2001; Tsang, 2002; Cholasuke et al., 2004 Marquez and Gupta, 2006; Wang et al., 2007; Stevenson, 2009; Heizer and Render, 2012).

The most important, vital and subjective success factor in SCOR model-based maintenance management model; (Garg and Deskmukh, 2006; Marquez and Gupta, 2006; Marquez, 2007), to prevent the emergence of unexpected failures or to reduce the failure modes to a minimum level.

It is emphasized in the literature that SCOR model-based maintenance management can be adapted to large production systems consisting of multiple subsystems and multi-part organization structures, especially in sectors and enterprises that produce services where high technology and electronic devices are used (Marquez and Gupta, 2006; Wang et al., 2007; Stevenson, 2009; Heizer and Render, 2012).

In parallel with the rising growth of the aviation industry, the need for effective and adequate maintenance activities is also increasing considerably. The main reason for this is the need for a sensitive and clean operational approach that cannot accept failure in all subsystems of aviation.

The purpose of this research is to try to develop a pro-active maintenance management model by taking into account the compliance of the Turkish Civil Aviation Sector with the national and international requirements of the maintenance activities performed with the scope of the Communication Navigation and Surveillance (CNS) services. Within the context of this research;

1. Does the existence of the planning process in the design of the CNS Maintenance Management Model have a positive effect for the CNS maintenance activities?
2. Does the availability of the procurement process of the CNS Maintenance Management Model positively affect CNS maintenance activities?
3. Does the existence of the application process in CNS Maintenance Management Model design affect CNS maintenance activities positively?
4. Does the delivery processexisting in the CNS Maintenance Management Model affect the CNS maintenance activities positively?
5. Does the existence of the return period in the design of the CNS Maintenance Management Model affect the CNS maintenance activities positively? Answers for these questions will be sought.

METHOD

Both qualitative and quantitative research methods have been used in the research. In the theoretical context, the literature has been searched and the basic concepts have been examined in detail. In the scope of quantitative research, survey datum was collected by survey.

The universe of the research is limited to the CNS systems and units operating in the Turkish civil aviation sector. In this context, research data are limited to CNS systems and services maintained at airports belonging to civil air traffic.

The technical supervisors who work in the population within the General Directorate of Civil Aviation constitute the ATSEP licensed and other technical personnel working from the CNS units. By the way in general of Turkey it is found in working on issues mentioned by 2014 there are 587 authorized personnel survey the employees who actually work 450 in the period (off-duty, when in training abroad and reporting the personnel losses There are approximately 450 people) has formed the population.

Measurement Tools:

Within the context of the research, a

questionnaire consisting of four parts was carried out with the participation of ATSEP and other technical personnel working in CNS units. The "You" subject in the first part of the questionnaire included demographic variances such as; age, gender, marital status, educational status, working time, areas, foreign language levels, totally 11 questions were asked to sample mass.

In the second part of the questionnaire, CNS treatments and requirements related to existing activities in Turkey under the spotlight, a scale was formed consisting of 5 questions for identifying problems in the functioning of the CNS maintenance practices and systems.

Thus, it was aimed to focus on the participants' thesis and to identify the problems that are common in CNS services.

In the third part of the questionnaire, there is a scale consisting of 32 expressions and a 5-point Likert scale for the current status of CNS maintenance activities and management practices in the literature and related legislation. Participants were asked to state their opinion about each of the expressions directed to them as "1. Certainly, do not agree, 2. Do not agree, 3. Undecided, 4. Agree, 5. Certainly Agree.

In the fourth part of the questionnaire, a total of 30 expressions (Planning Scale, Supply Scale, Application Scale, Delivery Scale and Restitution Scale) consisting of 6 subscales and five subscales (Planning Scale, Supply Scale, Application Scale, Delivery Scale and Restitution Scale) developed based on the literature according to the processes of SCOR- It is directed.

Survey data were uploaded to the SPSS 20.0 program and the Varmax Factor loads were examined by means of this program in order to understand the validity of the data firstly and the scales used in the questionnaire. Later, it was determined whether the questionnaire data were reliable according to Cronbach Alpha values by correlation and structure validity analyzes.

In the research, CNS personnel's opinions were taken about the basic processes of the SCOR model-based CNS maintenance management model suggested in this research through the expressions formed according to the 5 Likert scale. Thus, it is desired to measure the effectiveness of the SCOR model-based maintenance management processes suggested in the research. For this purpose, after the reliability and validity of the scales in this part ofthe questionnaire was tested, the research findings were interpreted by looking at the arithmetic mean of the scales and the regression analysis findings. Firstly, the findings obtained from the factor analysis and correlation analysis that enable the question groups to be formed by measuring the reliability and validity of the scales included in the pilot questionnaire, then the arithmetic mean calculations and regression analysis findings are interpreted as descriptive tables under the following topics.

In this framework, a pilot survey study was conducted by distributing 20 ATSEP and technical personnel firstly questionnaire forms given them to measure the validity and reliability of the questions before the questionnaire distributed all the samples. Questionnaire forms were taken into consideration to determine the reliability, validity and factor analysis in the SPSS 20.0 program before this sample was distributed. As a result of the analyses made, groups of expressions related to the factors gathered in 5 basic headings were obtained, consistent with the theoretical part of this study.

FINDINGS

First of all, in order to test the reliability of the scales used in the questionnaire, factor analysis was performed on the variables in the data set in the survey form. For this situation, the Kaiser-Meyer-Olkin (KMO) sample qualification value was calculated.

Table1. **Kaiser-Meyer-Olkin and Bartlett Test**

Sampling Sufficiency Scale		,961
Bartlett Chi-Square Scale	Approx. Chi-scale	11129,310
	Df	640
	Sig.	,000

As a result of the analysis, it was found that the KMO sample qualification value of the questionnaire scale was found as 0,961, which is quite higher than the recommended value 0.50. In the second stage, the statements on the questionnaire were subjected to Varimax factor analysis and the results of these analyzes (factor loadings, total explanatory variance, and communalities) are given in Table 2.

Factor analysis findings in the table determined that the reliability of the scales used in the questionnaire was high by observing that the factor loadings of all 32 items in the questionnaire were above 0.50 and below 0.30 of the cross-loadings. Besides, it was confirmed that each factor has the highest value under each factor (according to the factor loadings given in the table) and that the questionnaire questions were grouped correctly and included in the questionnaire scales. Eventually, a correlation analysis was performed to test the reliability of the questionnaire and the Cronbach's

alpha coefficient values of the questionnaire were examined and the findings are indicated in Table 3.

Table 2. **Factor Loadings Anaylsis Findings**

Questions	FACTORS				
	Planning	Supply	Application	Delivery	Restitution
S.7	,702				
S.8	,772				
S.9	,690				
S.13	,948				
S.14	,696				
S.5	,722				
S.23	,601				
S.1		,605			
S.6		,743			
S.10		,677			
S.11		,599			
S.12		,639			
S.15		,743			
S.2			,621		
S.16			,735		
S.17			,638		
S.18			,607		
S.19			,603		
S.20			,590		
S.21			,557		
S.3				,633	
S.24				,639	
S.25				,623	
S.26				,645	
S.27				,617	
S.28				,563	
S.4					,718
S.22					,609
S.29					,651
S.30					,581
S.31					,567
S.32					,509

* With Basic Components Analysis the Varimax Converting were used.
** Total Explained Variance: %79,08.

Table 3. **Correlation and Reliability Analysis Findings**

Factors	Average	Std. Deviaton	1	2	3	4	5
1.Planning	3,3223	0,917	1				
2.Supply	3,7881	0,835	,837**	1			
3.Application	3,3109	0,923	,736**	,719**	1		
4.Delivery	3,0323	0,796	,796**	,733**	,701**	1	
5.Restituton	3,9289	0,815	,851**	,817**	,721**	,698	1
CronbachAlpha Reliability Coefficiency			0,981	0,935	0,972	0,961	0,903

As it is seen in the table, the Cronbach alpha coefficient value of each questionnaire for each factor was found between (α = 0.903 - 0.981). This result points out that the question groups for each factor are highly reliable.

Before testing research hypotheses with the help of regression analysis, it was desirable to obtain general advice from the CNS staff on the basic processes of the SCOR model-based CNS maintenance management model. The findings are given in Table 4.

Table 4. **CNS maintenance management model processes' arithmetical average findings**

SCOR Model Based CNS Maintenance Management Model Processes	Arithmetical Average	Scale Average
PLANNING PROCESS (It consists of; D-7, D-8, D-9, D-13, D-14, D-5 and D-23 numbered expressions existing in the survey form.)	4,29 4,03 4,25 3,92 4,16	**4,17= Agree**
SUPPLY PROCESS (It consists of;D-1, D-6, D-10, D-11, D-12 and D-15 numbered expressions existing in the survey form.)	4,32 4,28 4,33 4,32 4,17 4,45 4,37	**4,29= Agree**
APPLICATION PROCESS (It consists of; D-2, D-16, D-17, D-18, D-19, D-20 and D-21 numbered expressions existing in the survey form.)	4,14 4,30 4,29 4,36 4,34 4,32 4,28	**4,31= Agree**
DELIVERY PROCESS (It consists of; D-3, D-24, D-25, D-26, D-27 and D-28 numbered expressions existing in the survey form.)	4,31 4,23 4,25 4,27 4,26 4,25	**4,25= Agree**
RESTITUTION PROCESS (It consists of; D-4, D-22, D-29, D-30, D-31 AND D-32 numbered expressions existing in the survey form.)	4,28 4,16 4,30 4,21 4,26 4,26 4,19	**4,23= Agree**

In this frame, the arithmetic averages of all the scales in the questionnaire form, which are the basic processes of the model, are calculated and shown in Table 4. As seen in the table, the CNS staff of all the managerial processes planned to take part in the suggested model reported a very positive opinion on the positive side. In this context, there is a 4.31 ratio of maintenance applications included in the model, a ratio of 4.29 for the supply process, 4.25 for the delivery process, 4.23 for the restitution process, "agree" with the 4,17 ratios related the process.

This collective result is, first of all, the CNS maintenance management model suggested by the maintenance literature is fairly well-defined and well-defined; suggests that the suggested maintenance management model will ensure that CNS maintenance activities are carried out effectively.

As a consequence of the regression analysis, the arithmetic average should be stated last before testing the hypotheses; According to CNS staff, the "maintenance practices" process, which is the third of the five sub-core processes planned to be included in the model, has been the most favorable opinion giving maintenance management model

process.

Regression analysis was also done to test the hypotheses developed with this research; Findings that relate between dependent and independent variables are given in Table 5.

Table 5. **Regression analysis results**

	Dependent Variance			
	CNS Maintenance Management Model			
Independent Variances	**Standard Beta (β)**	**t value**	**p-value**	**VIF Value**
1.PlanningProcess	0,24	2,65	0,000	2,525
2.SupplyProcess	0,31	2,70	0,001	4,164
3.ApplicationProcess	0,49	4,87	0,000	3,429
4.DeliveryProcess	0,17	3,11	0,002	4,687
5.RestitutionProcess	0,29	2,03	0,000	1,833
		R^2 = 0,42		
		F = 30,11		

To test the hypothesis, the R2 value and the Anova analysis results were used to determine if the model's power of explanation was sufficient. In view of the findings in this context, the model describing the changes on the effectiveness of the suggested CNS maintenance management model of the applications defining the processes of "maintenance planning", "maintenance restitution", "maintenance application", "maintenance delivery" = 0.42, which looks as sufficient (R2 = 0,42; F = 30,11).

In this context, when we look at the analysis findings shown in table 5, it is seen that the relationship between model and planning process is statistically meaningful and positive (β = 0.24 and p <0.01). These acquired findings can be said that the planning process in CNS Maintenance Management Model design will affect the existence of CNS maintenance activities positively.

When we look at the analysis findings shown in Table 5, it is seen that the relationship between the model and the procurement practices suggested is statistically meaningful (β = 0.31 and p <0.01). These findings can be said to have a positive impact on the availability of procurement processes and CNS maintenance activities in the design of the CNS maintenance management model.

In this context, it is seen that the relationship between model and maintenance practices is statistically meaningful and positive (β = 0.49, p <0.01). It is also crucial that the value of (β = 0.49) is meaningfully higher and positive than the other variables.

In this frame, it is seen that the relationship between the model and the recommended maintenance delivery practices is statistically meaningful (β = 0.17, p <0.01). These gathered findings can be said that the delivery processes in the design of the CNS maintenance management model will affect the existence of the CNS maintenance activities positively.

In this frame, when we consider the analysis findings shown in the table, it is seen that the relationship between the model and the restitution process and applications is statistically meaningful (β = 0.29 and p <0.01). These findings can be said that in the design of the CNS maintenance management model, the existence of the return period will affect the CNS maintenance activities positively.

Finally, after all the research hypotheses have been tested, it is advisable to look at the hierarchical order of the positive effects on the independent variable relative to the values of each dependent variable (β). According to an order made in this context; 1. Application Process β = 0,49> 2. Supply Process β = 0,31> 3. RestitutionProcess β = 0,29>, 4. Planning Process β = 0,24> 5. Delivery Process β = 0,17.

In these findings, it is seen that there is a positive relationship between the CNS maintenance management model and the suggestedmaintenance management practices and processes, which is the strongest, weakest, right, application, supply, return, planning, and last order deployment practices and processes. It is also possible to state that all the regression analysis results obtained are consistent with the scale arithmetic analysis findings.

RESULT

As a result of this research, a new proactive maintenance management model for Turkish airspace CNS services and systems is suggested, in line with the standards set by international civil aviation authorities.

The suggested "SCOR-based CNS Maintenance Management Model" has been designed to be implemented by CNS service providers that are authorized by Turkish DGCA, the sole authority for

civil aviation regulations, to be implemented in the maintenance of existing civil aviation CNS systems and devices in our country.

In this context, it is suggested to first plan the maintenance strategies and policies for the maintenance activities in the CNS systems at a high level and then to re-plan all maintenance applications in the CNS services based on the model.

It would be very important to explain that the general management of Civil Aviation and senior management of the Service Providers seen as a potential force to reduce the overall costs of maintenance for equipment in CNS systems and to provide competitive advantage to other countries in terms of civil aviation activities.

In addition, senior management and other directors need to make purchases in accordance with the "recommended maintenance model" of all new device and equipment investment decisions for existing CNS services. Finally, the suggested maintenance model envisions a maintenance strategy that will include continuous improvement, design changes and innovations so that excellent maintenance of all maintenance activities in CNS services can be achieved.

Thus, a picture of the general maintenance of the CNS can be adapted to the organizational structure. The maintenance philosophy required for the physical assets present in an enterprise /organization to maintain their functionality as expected in a reliable manner for the longest time is reflected.

In the first phase of the suggested "SCOR-based CNS Maintenance Management Model", restructuring of the "maintenance planning" process has been taken as a basis. However, in new maintenance planning; it is foreseen that the principles of the supply of materials, equipment and equipment necessary for maintenance activities, principles of application of maintenance, principles of re-distribution of materials from maintenance, principles of returning devices to manufacturer and training needs of personnel to be involved in maintenance work .

Besides these, the requirements related to the analysis of the risks in the maintenance period according to the model, the determination of the maintenance budget, the establishment of the necessary maintenance organizations and the multidisciplinary research and development work that concerns the maintenance process needs to be determined.

All procurement needs should be met in the second phase of the suggested "SCOR-based CNS Maintenance Management Model". Within the procurement process included in the model; Equipment, test equipment, transport equipment, etc., which are required separately for each of the CNS subsystems and which will be used in maintenance applications. Equipment supply, supply of human resources to serve in maintenance work, short- and long-term strategic partnership and outsourcing contracts.

Within the application process of the suggested "SCOR-based CNS Maintenance Management Model" as a result of the research; During maintenance activities in CNS subsystems, the principles on how to perform the authorization, the principles for providing the pro-activities in the maintenance activities, and the ways and modes of follow-up for the organizational culture change and settlement in relation to the maintenance process should be determined.

In this context, the application guidelines, criteria and standards necessary for assessing the performance of maintenance activities must be derived in advance. At this stage, it is recommended that authorization and assignment of duties in relation to the applications, controls and controls necessary for the establishment of the feedback mechanism of the CNS maintenance management model.

Besides, while maintenance activities in CNS systems are underway, a communication channel facility for information sharing and communication between all concerned units, either directly or indirectly through maintenance, will be very important.

With "delivery process" in the fourth stage of the "SCOR-based CNS Maintenance Management Model"; When maintenance plans for CNS equipment and devices are being made, it is suggested that the principles of distribution of spare parts of CNS equipment, the provision of the maintenance specialist personnel as soon as possible, the pre-determination of the delivery and transportation management of defective and maintained materials.

Again, the maintenance model suggested in this phase is suggested to set the principles for the storage of spare parts, materials to be recycled and other maintenance materials, and the principles for the distribution of repaired and maintained materials.

The suggested "SCOR-based CNS Maintenance Management Model" is the final stage of the "restitution process". In this context, the CNS subsystem is planned to replace the defective spare part with the CNS subsystem where the material to be maintained belongs to the CNS units. In particular, the essentials and processes related to the recruitment of the CNS subsystem will be done

by the maintenance doer for the determination.

Finally, it should be cared that the planning and maintenance of the suggested maintenance management model for the separate management of the maintenance activities of the devices and equipment in the CNS system will enhance the cooperation and harmony between the maintenance units themselves and / or maintenance units and other CNS units.

This will raise both the quality and performance of maintenance activities for the devices in the CNS units, and will also pioneer to a decrease in the number of malfunctions in the CNS systems.

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