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The Effect of Organizational Limitations to the Decision-Making Process in the Context of Crew Resource Management: The Factors Leading Pilots to Make Bad Decisions and an Implementation

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Abstract

The decision-making process has always been the focus of researches in many fields. In this context, the bad decisions pilots make before, during or after the flight are of great importance when considered from the perspective of human factor in aviation industry. This study investigates how organizational limitations effect the decision-making processes of pilots by using data obtained through surveying 222 pilots working in public and private sector in Turkey. The evaluation of data was conducted by correlation and regression analyses. The findings show that bad decisions within the process of decision-making are effected by performance limitations, CRM limitations, management limitations and that CRM is the most important factor in the declaration of bad decisions.

Keywords: Organizational limitations, decision-making, pilot, aviation

1. Introduction

Decision-making has been analyzed greatly in terms of organizations due to its being one of the activities a person engages in most frequently in the course of life. Rational decision-making model has been developed and methods guiding individuals in making the “most correct” decision in the organization have been analyzed. That being said, decision-making models have been proven to be difficult to implement due to the difference in people's capacity of perceiving and interpreting information, and decisions are seen to be reached through intuition on occasion. Human factor was determined to be the main factor with a rate of 70% in the aviation accidents in the last fifty years (Jensen,1995). Analyzing the flight accidents, Jensel and Benel established that 52% of fatal accidents result from faulty decision-making and that this rate is 35% in non-fatal accidents (Benel, 1977). The reduction of the number of accidents due to human factor within the scope of Safety Management System depends on the reduction of the errors within the decision-making process. Individual differences and organizational limitations are able to effect the decision-making mechanism directly or indirectly. Although individual differences mostly originate from the innate characteristics of individuals, organizational limitations are open to change through the change or innovation in the organization culture or strategy. No studies directly analyzing this subject were encountered in the literature related to the effect of organizational limitations on the decision-making process of pilots. In this study, which was designed to fill this gap in the field literature, the way organizational limitations effect decision-making process in the context of resource management was analyzed in the light of data gathered from a group of pilots working in the public and private sector.

2. Decision Making, Crew Resource Management and Organizational Limitations

The essential property of "decision" is the selection any individual makes in any kind of event. The decision of the individual is the individual's selection between the alternatives in the subject after an evaluation. Decision-making is the total of the mental, bodily and emotional processes related to the selection and preference between the ways, tools and opportunities that would enable one to reach various objectives. Making a decision is, in a way, processing information (Koçel, 2003). Decision-making, simply, is the operation of selecting the effective act (Dinçer, Fidan, 1996).

The process of decision-making creates psychological stress on the individual. This is a technical matter and it is the act of eliminating the problems and obstacles that arise in the way of reaching the objectives (Eren,2003). There are many factors effecting the decision-making process. The decision-makers have to find the option that would realize the objectives which are in contradiction with each other in the most effective way by considering more than one criterion while making a selection between the alternatives. The decision makers make their decisions after evaluating their own resources and the areas of action by considering the ways in

which they would influence other people and units. In case the resources are inadequate, the decision made may not be the best decision for the business. The effectivity of the decisions is related to providing the desired results and it is determined by the fact of obtaining the desired results (Ersöz, Kabak, 2010).

In aviation sector, decision-making is the most important act expected from the crew by every authority in the world in terms of flight safety and security. The crew has to be in a continuous process of decision-making from the aircraft acceptance of the pilot in command to the flight planning before the takeoff and the approach to the gate after the flight. The decision-making in aviation is defined as the continuous systematic thinking of the pilot with the purpose of finding the best option according to the present conditions, determination of the situation and the arrangement of the events containing the estimate of the situation in order to make the final decision (Terzioğlu, 2010). The decisions in aviation are related to realization of the operational objectives such as getting the passengers to their destinations safely. In addition, the presence of team members, if any, helps to eliminate the limitations originating from having only one decision maker (Oranasu, 2010).

The literature related to the decision-making process in aviation is divided into two categories in general. First category is defined as classical decision-making by many researchers. Classical decision-making, stipulates a progress through the linear steps of the decision maker (Cannon-Bowers, Salas & Pruitt, 1996; Hammond, McClelland&Mumpower,1980). Although the specific steps vary, they typically include; the definition of the problem, development of alternatives, the comparison of potential advantages and disadvantages, the selection of a certain alternative and the evaluation of the degree of problem solving of the chosen alternative. The second category in decision-making in aviation defines the process as being based on the totality of rational intuition and the knowledge and experience of the decision makers. This process is being expressed with the term "natural decision-making" in the recent years (Deitch, 2001).

Crew Resource Management (CRM) training is the total of educational strategies helping the development of team work in the cockpit by using thoroughly tested methods focused on a certain objective (Salas et al, 2000). The purpose of CRM (Crew Resource Management) is enabling the best possible utilization of the available resources (Salas et al, 2002). CRM is found at the implementation stage of decision-making process of multiple team flights. Although the term CRM has been ignored for a while, it was first suggested by John Lauber in 1977 (Salas et al, 2006). The question of “is CRM enough?” was dealt with in 1979 in a study conducted by NASA and new models related to the effective usage of all the available resources and team coordination were developed (Helmreich et al, 1990). Aviation industry has become aware of the importance of human errors and human factor in the accidents 30 years ago and developed programs known as CRM directed at the reduction of the known errors and increase of efficiency. (Helmreich, 1993). CRM is the most commonly used technique educating the aviation sector's personnel on team work and this technique attracted the attention of other sectors dealing with high risk in the recent years (O’connor et al, 2008).

Helmreich et al. (1993) suggested that the most important users and supporters of CRM training are commercial airlines (Salas et al, 2002). The idea suggesting that the errors originating from human factor could be avoided in some way with trainings, led experts to initiate a series of training activities aimed at giving cockpit team attitudes, behaviors and beliefs that could prevent the errors. Effectivity of the trainings was measured by way of evaluations processes conducted before and after the training activities which started under the title of CRM and directed at preventing the errors, and trainings were observed to have a positive contribution to the prevention of errors (Musson , Helmreich, 2004). So, the training activities were made permanent but the accidents continued to happen despite all the measures taken. Researchers explained this situation with the hypothesis proposing that CRM implementations could be effected by various factors and they continued their research by including different factors in their studies (Mengeci, Topçu, 2011).

It is possible to classify the errors made by pilots as procedural, perceptional and decision-making errors. Modern cockpit designs are being developed everyday with the purpose of reducing especially procedural and perceptional errors made by pilots and this is achieved to a large extent by way of increasing the situational awareness of pilots. But it is hard to say the same success was achieved in terms of decision-making. Cockpit designs, checklists, trainings, written rules, individual control mechanisms are being developed in order to reduce all kinds of errors. Intelligence, skill, knowledge, mood, emotional condition, psychological condition, social factors, personality and character may be listed as factors effecting the decision-making process in aviation sector.

Although sector-based analyses conducted in America show that 70% of aviation accidents originates from team coordination or communication problems, 25 out of 37 aircraft accidents, which have occurred from 1978 to 1990 related to crew behavior, are observed to be originating from tactical decision-making errors. We may analyze the reasons of the accidents due to poor aviation decisions under various factors. These are information of poor quality, organizational pressure, environmental threats and stress sources (Orasanu, 2010).

Jensen and Chappel(1983) have formed a list of 43 fatal errors most frequently committed by pilots in general in their study. Some of these errors are analyzed in our study under four factors as errors due to training, individual errors, errors due to CRM and errors due to experience.

Organizational limitations represent the situations and events hindering the transformation of employees' skills and efforts to work performance of high level (Spector, Jex, 1998). Organizations may limit the decision makers by creating deviations from the rational model. These limitations could be in shape of limitations of evaluation and reward systems, formal rules, time, and events of the past. The reward systems of organizations determine which choices serve personal benefits the most and therefore effect the process of decision-making. Formal rules prepare the ground for rules and regulations to provide the correct attitude for the employees even in the smallest companies and therefore limit their opportunities of making a selection. There are strict time limitations for almost every important decision. This type of situations could make the gathering of all data before making a decision very difficult if not impossible. The decisions cannot be made in a fictional environment; they all have their own grounds. The decisions made in the past are like ghosts that limit present options and disturb the current situation constantly. The choices we make today are results of the choices we made in the past (Robbins and Judge, 2012). Evaluated from the perspective of pilots, our study contains six limitations that could effect the decision-making process. These are: the limitation of performance, the limitation of time, the limitation of the past events, the limitation of CRM, the limitation of procedure and the limitation of management.

In order to explain the process directing pilots to make poor decisions, our study analyzed whether organizational limitations (performance, time, past events, CRM, procedure and management) effect the choices that could be wrong in the process of decision-making (training, individual, CRM and experience) or not.

Hypothesis 1: There is a positive relation between the performance limitation and the errors within the process of decision-making in the context of CRM.

Hypothesis 2: There is a positive relation between the time limitation and the errors within the process of decision-making in the context of CRM.

Hypothesis 3: There is a positive relation between the past events' limitation and the errors within the process of decision-making in the context of CRM.

Hypothesis 4: There is a positive relation between the CRM limitation and the errors within the process of decision-making in the context of CRM.

Hypothesis 5: There is a positive relation between the procedure limitation and the errors within the process of decision-making in the context of CRM.

Hypothesis 6: There is a positive relation between the management limitation and the errors within the process of decision-making in the context of CRM.

3. Method

3.1. Sample

The sample of the study consists of 222 pilots working in public and private organizations in Turkey. The percentages of pilots participating the study in terms of flight years and flight hours were as follows: 16% had less than 10 flight years and 1500 and less flight hours, 33% had 10-15 flight years and 1500-3000 flight hours, 36% had 15-20 flight years and 3000-6000 flight hours, 15% had 20 and more flight years and 6000 and more flight hours.

3.2. Scales

One questionnaire was used to gather data in scope of the study. The questionnaire consisted of three separate sections. First section was related to flight hours and years of the pilots; the other two sections used scales related to their wrong decisions and perceived organizational limitations.

Decision-Making Process and Wrong Decisions: Wrong decisions of pilots were measured using a scale of 24 items which was developed by us based on the definition of 43 fatal decisions generally made by pilots from Jensen and Chappel (1983). In the scale, pilots were asked to mark the frequency of the statements related to their wrong decisions on a 5 point Likert Scale (1=Always, 5= Never). The low scores obtained from the four-dimension scale (training, personal, CRM, experience) indicates a high rate concerning wrong decision-making of pilots. The reliability coefficient (cronbach's alpha) of the scale has been found to be .815

Organizational Limitations: Organizational limitations were measured on a scale of 24 items developed by us. In the scale, pilots were asked to mark the rate they agree with the statements related to their perception of organizational limitations on a 5 point Likert Scale (1=Strongly Disagree, 5= Strongly Agree). The high scores obtained from the six-dimension scale (performance, time, CRM, procedures, management, experience) indicates a high rate concerning pilots' organizational limitation perceptions. The reliability coefficient (cronbach's alpha) of the scale has been found to be .814

3.3. Validation of the Scales

To ensure the validity and reliability of the study variables, explanatory factor analysis was conducted by using SPSS software.

The Decision-Making Process and Wrong Decisions measure produced four factors upon factor analysis. The first factor named "Training Errors", explained 27.33% of the total variance. The second factor was named "Individual Errors", and it explained 18,8% of the variance. "CRM Errors", the third factor with a variance of 13.52 %, was followed by "Experience Errors" (12.97%). The factors all together explained 72.20% of the variance. KMO Bartlett's Test of Sphericity was .750.

The Organizational Limitations measure yielded six factors upon factor analysis. The first factor named "Performance", explained 15.06 % of the total variance. The second factor was named "Time", and it explained 14.03% of the variance. The third factor was named "past event", and it explained 13.91 % of the variance. The fourth factor was named "CRM", and it explained 13.98% of the variance. The fifth factor was named "Procedure", and it explained 13.98 % of the variance. The sixth factor was named "Management", and it explained 13,52% of the variance. The factors all together explained 83.97% of the variance. KMO Bartlett's Test of Sphericity was .751.

4. Findings

When the frequency distributions of the questionnaire items related to the measurement of the errors committed by the pilots in the process of decision-making are analyzed, the errors with the lowest scores and the highest frequency of being committed were observed to be "the exception of written rules for any reason," "flying unwillingly," "flying under the influence of medication or not informing the flight surgeon" and "ignoring any one of the checklist items."

Table 1: Mean, Standard Deviation and Correlations

Variable	Mean	SD.	1	2	3	4	5	6	7	8	9	10	
1.Total Errors	3,7	0,44	(.81).										
2.Training errors	3,55	0,78	0.78**	(,92)									
3.Individual errors	3,38	0,79	0.5**	0,1	(,91)								
4.CRM errors	4,07	0,65	0,43**	-0,01	,16*	(,75)							
5.Experience errors	4	0,71	0,42**	,19*	-0,09	,18**	(,81)						
6.Perf. limitation	3,22	0,91	0,46**	0,13	,68**	,29**	-0,01	(.96)					
7.Time limitation	3,38	0,85	0,25**	23**	,13**	-0,04	,20**	0,07	(.91)				
8.Past event limitation	3,48	0,93	0,18**	,23**	0,11	-0,11	0,07	0	,18**	(.92)			
9.CRM limitation	3,54	0,91	0,73**	,97**	0,03	-0,04	,20**	0,1	,23**	,24**	(.93))		
10.Procedure limitation	2,73	0,88	0,156*	,17*	0,12	-0,03	0,01	,18*	0,01	-13*	,17**	(.91)	
11.Management limitation	3,31	1,01	0,38	,15*	-,25**	-,22**	0,12	-0,06	-0,02	-0,03	,19**	0,05	(.91)

Note: Cronbach alpha reliability coefficients are given within brackets.
** p< .01, *p<.05
(N=222)

Table-1 shows the factor means and standard deviations as well as findings of correlation analysis regarding the study's variables. The mean of the errors of pilots due to training was 3,55 (sd=0,78), the mean of the errors due to individual was 3,38 (sd=0,79), the mean of the errors due to CRM originated training was 4,07 (sd=0,65), the mean of the errors due to experience was 4,00 (sd=0,71), the mean of the errors due to performance was 3,22(sd=0,91), the mean of the errors due to time limitation was 3,38(sd=0,85), the mean of the errors due to experience limitation was 3,48(sd=0,93), the mean of the errors due to CRM limitation was 3,54(sd=0,91), the mean of the errors due to procedure limitation was 2,73(sd=0,88), the mean of the errors due to management was 3,31(sd=1,01). When the error score and means of the pilots participating the study are analyzed, the mean of the error total is observed to be 3,7 (sd=0,44), the mean of the training error score is observed to be 3,55 (sd=0,78),

the mean of the individual error score is observed to be 3,38(ss=0,79), the mean of the CRM error score is observed to be 4,07(sd=0,65) and the mean of the experience error score is observed to be 4,00(sd=0,71). When the organizational limitation score and means are analyzed, the mean of the performance limitation is observed to be 3,22 (sd=0,91), the mean of the time limitation is observed to be 3,38 (sd=0,85), the mean of the past event is observed to be 3,48(ss=0,93), the mean of the CRM limitation is observed to be 3,54(sd=0,91), the mean of the procedure limitation is observed to be 2,73 (sd=0,88) and the mean of management limitation is observed to be 3,31(sd=1,01). The errors of the pilots participating to the study had a medium level relation with limitations of performance, time, past event, CRM; a low level relation with the limitation of procedure, and a nonsense relation with the limitation of management. Especially CRM and training relation is observed to be very much high compared to the other factors.

Total faulty decisions of the pilots participating the study have been evaluated in terms of sub-error factors: total errors of the pilots had a medium level relation with all the sub-error factors (training errors, individual errors, CRM errors and experience errors); but especially the relation with training errors was seen to be higher than all the other factors. When total errors have been evaluated in terms of organizational limitations; The total errors of the pilots had a medium level relation with limitations of performance, time, past event, the CRM; a low level relation with the limitation of procedure, and a nonsense relation with the limitation of management; but especially the relation with CRM limitations was seen to be higher than all the other limitations.

When wrong decisions have been evaluated in terms of training errors which is one of the sub-error factors, pilots' training errors have been seen to have a low level relation with experience errors; and they had no relation with individual errors and CRM errors. When training errors have been evaluated in terms of organizational limitations; the training errors of the pilots had a medium level relation with limitations of time, past event, the CRM; a low level relation with the limitations of procedure and management, and no relation with performance limitation; but especially the relation with CRM limitations was seen to be higher than all the other limitations.

When wrong decisions have been evaluated in terms of individual errors which is one of the sub-error factors, pilots' individual errors have been seen to have a low level relation with CRM errors; and they had no relation with training errors and experience errors. When individual errors have been evaluated in terms of organizational limitations; the individual errors of the pilots had a medium level relation with limitations of performance and management; a low level relation with the limitations of time and no relation with past event, CRM and procedure limitation; but especially the relation with performance limitations was seen to be higher than all the other limitations.

When wrong decisions have been evaluated in terms of CRM errors which is one of the sub-error factors, pilots' CRM errors have been seen to have a medium level relation with experience errors; and they had no relation with training errors and individual errors. When CRM errors have been evaluated in terms of organizational limitations; the CRM errors of the pilots had a medium level relation with limitations of performance and management, and no relation with time, past event, CRM and procedure limitations.

When experience errors have been evaluated in terms of organizational limitations; the experience errors of the pilots had a medium level relation with time and CRM limitations; no relation with past event, procedure, performance and management limitations.

Table 3: Findings of Regression Analysis Concerning the Limitations Which Predict Errors

Dependent Variable	Training errors		Individual errors		CRM errors		Experience errors		Total Errors	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
	B	**β**	**B**	**B**	**β**	**β**	**β**	**B**	**β**	**β**
Total flight time	0,02	0,02	0,08	-0,01	-0,03	-0,08	-,15*	-0,13	-0,03	-0,49
Performance limitation		0,02		,66***		,31***		0		,38***
Time limitation		0,01		0,07		-0,06		,15*		0,52
Past events limitation		-0,01		,11*		-14*		0		-0,01
CRM limitation		,98***		-0,05		0,03		,15*		,71***
Procedure limitation		-0,01		0,03		-0,11		-0,02		-0,34
Management limitation		-,03*		-,20***		-,21**		0,1		-,15***
ΔR^2	0,001	0,959	0,008	0,531	0,001	0,162	0,023	0,96	0,00	0,716
ΔF	0,161	743,877***	1,708	34,547***	0,184	5,927***	5,145*	3,245**	0,03	77,214***

*p<0,05 **p<0,01 ***p<0,001

When total flight duration variable's effects are taken in regard, a hierarchical regression analysis has been conducted to see how meaningfully effective organizational limitations are on the wrong decisions of the pilots. In the regression analysis, first step consisted of analyzing the independent effects of total flight time while in the second step organizational limitations were included in the equation and error factors were evaluated separately one by one and the resulting variance was analyzed. The results obtained are shown in Table-2.

In the regression analysis, total flight time had a meaningful effect on experience errors while it didn't have meaningful effects on other error factors. When regression equation included organizational limitations in the second step, CRM and management limitations were observed to be effective on training errors; performance, management and experience limitations were effective on individual errors; performance, management and past events limitations were effective on CRM errors; time and CRM limitations were effective on experience errors; performance, CRM and management limitations were effective on total errors. According to these results: CRM, performance and management limitations had more effects on total errors than time, past events and procedure limitations. In addition, the most important factor on the declaration of wrong decisions in the process of decision-making was CRM limitation. This result is parallel to the results of the studies conducted by Musson, Helmreich, (2004) and Salas et al. (2002) in this field.

The reasons for CRM limitation to be the most effective limitation are assumed to be various. Mainly the reasons could be listed as follows: inadequate and discontinuous CRM training within the organization or even if the training is adequate, lack in practice; copilots having trouble in communicating conditions that could indicate abnormal situations to the pilot in command due to cockpit hierarchy; crew not examining the attitudes of pilot in command unless the flight safety in at stake, and inadequate and improper flight trainings during the basic trainings.

Performance limitation, on the other hand, could be explained as risk taking of pilots in order to adapt themselves to the strategies and policies determined by the management, occasional compromise of the flight safety not to damage their image against the managers etc., not reporting an error since it could be considered as a negative influence on one's career.

Management limitation could be explained as management's pressure on pilots to make them fly in improper conditions in order to make benefit; economic factors occasionally taking precedence over flight safety; managements demanding actions that do not necessarily conform to the written rules.

The findings, as a result, show that organizational limitations effect the decision-making process of the pilots and cause the pilots to make poor decisions before, during and after the flight.

As seen in Table-2, total flight time (β=.15, $p<.05$) has a meaningful effect on experience related errors while it does not meaningfully effect other error factors. When organizational limitations are included in the regression equation in the second step, CRM limitation(β=.98, $p<.001$) and management limitation(β=.03, $p<.05$) are seen as effective factors on training related errors; performance limitation(β=.66, $p<.001$), management limitation(β=.20, $p<.001$) and experience limitation are seen as effective factors on individual errors; performance limitation(β=.31, $p<.001$), management limitation(β=.21, $p<.001$), past event limitation(β=-.14, $p<.005$) are seen as effective factors on CRM errors; time limitation(β=.15, $p<.005$), CRM limitation(β=.15, $p<.005$) are seen as effective factors on experience errors; performance limitation(β=.38, $p<.001$), CRM limitation(β=.71, $p<.001$), management limitation(β=-.15, $p<.001$) are seen as effective factors on total errors. When the findings obtained are evaluated from the perspective of total errors; Hypothesis 1(There is a positive relation between performance limitation and errors committed during the decision-making process in the context of CRM), Hypothesis 4 (There is a positive relation between CRM limitation and errors committed during the decision-making process in the context of CRM) and Hypothesis 6 (There is a positive relation between management limitation and errors committed during the decision-making process in the context of CRM) are accepted while Hypothesis 2(There is a positive relation between time limitation and errors committed during the decision-making process in the context of CRM), Hypothesis 3 (There is a positive relation between past event limitation and errors committed during the decision-making process in the context of CRM) and Hypothesis 5 (There is a positive relation between procedure limitation and errors committed during the decision-making process in the context of CRM) are denied.

5. Conclusion

The purpose of the present study is to determine how organizational limitations effect the wrong decision-making process of the pilots in the context of CRM. The findings obtained show that organizational limitations effect pilots' decision-making process. When the answers to the items of the scale prepared to determine the errors of pilots are analyzed, the most frequent errors pilots commit are observed to be “exception to the written rules for any reason (mean=3,25,sd=0,96)”, “flying unwillingly (mean=3,32,sd=0,91)”, “flying under the influence of medication or without informing the flight surgeon(mean=3,40,sd=0,85)” and “ignoring any one of

the checklist items(mean=3,41,sd=0,84)".

According to the total error scores in the findings of correlation analysis, the decision-making errors of the pilots had a medium level relation with limitations of performance, time, past event, CRM; a low level relation with the limitation of procedure, and a nonsense relation with the limitation of management. Especially CRM and training relation is observed to be very much high compared to the other factors.

When regression analysis findings are considered together with flight hours, management limitation is added to the performance limitation and CRM limitation and the effects of these three limitations on the total errors are weighing more than the limitations of time, past events and procedure. According to that, the most important factor on the declaration of wrong decisions in the process of decision-making is observed to be CRM. In this case, we can assume that pilots who have been inadequate in CRM training and its practice tend to make wrong decisions in the decision-making process.

All these findings aside, we have to indicate that our study had some limitations in itself as well. The first one of these limitations is an issue that could arise in the generalization of the findings obtained. Since the sample used in the present study majorly consists of public and private sector pilots flying in general aviation industry. Therefore, the studies that could bear healthier results would be the studies with wider sample groups with a separation of public and private sector pilots. Another limitation is that the data reflects only people's own assessments. The following studies could especially address the effects of fatigue of pilots on the decision-making process before, during and after the flight. This kind of study could have a different perspective on the subject. Additionally, CRM and communication effects on decision-making process in the errors committed within the cockpit especially for airline pilots could be studied.

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