# The Effects Of Demographic Factors On CRM Perception On Pilots: Turkey Example

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*Abstract*— Aviation industry has become aware of the significance of human errors and human factor in the accidents 30 years ago and developed programs known as CRM intended for the diminution of the known errors and increase of effectiveness [1]. The aim of this research is to understand the relationship between the demographical factors and perception of CRM on pilots. In order to reach this aim we conducted a survey on pilots at government and airline. We reached totally 1000 pilots but only 301 of them filled the survey but due to missed items and filling failures we could use 225 of them. We used SPSS 21.0 statistical package program for analysis. We made reliability analysis, factor analysis for structural validity, correlation and linear regression analyses for hypothesis tests. After the reliability analysis we found that overall Cronbach alpha coefficient was 0.701. Also we found that scale established 4 factors structure. After the regression analyses we found that age, tenure had a negative impact on CRM perception, total flight year, total flight hours, tenure, position and statue had a positive impact on CRM perception.

*Keywords— CRM, Demographics, Aviation*

## Introduction

John K. Lauber (1984), a psychologist member of the National Transportation Safety Board (NTSB), has defined CRM as ''using all available resources and information, equipment, and peopled to achieve safe and efficient flight operations'' [1]. CRM includes optimizing not only the person–machine interface and the attainment of timely, suitable information, but also interpersonal actions including leadership, effective team formation and maintenance, problem-solving, decision-making, and maintaining situation awareness [2]. Here is the definition of CRM from FAA: "*CRM can be broadly defined as the utilization of all available human, informational, and equipment resources toward the goal of safe and efficient flight. CRM is an active process by crewmembers to identify significant threats, to communicate them, and to develop, communicate, and carry out a plan and actions to avoid or mitigate each threat. CRM also deals directly with the avoidance of human errors and the management and mitigation of those errors that occur. CRM reflects the application of human factor knowledge to the special case of flight crews and their interactions with each other, with other groups and with the technology in the system*"[3]. Main goal is not getting people to 'work together better' but to reduce 'the frequency and severity of errors that are crew based'. This is achieved by training crews to 'avoid, trap or alleviate the cost of error by making better use of human resources.

## LITERATURE REVIEW

### A. CRM

The purpose of CRM (Crew Resource Management) is enabling the best possible utilization of the available resources [4]. CRM is found at the implementation stage of decision-making process of multiple team flights. 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 [5]. 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 [6].

CRM has gone in the course of a number of evolutions. The first generation focused on enhancing the effectiveness of managerial staff and correcting shortcomings in pilot behavior, tyranny by captains. In 1986, CRM training shifted to focal point of cockpit group dynamics. Training became more aviation-based with regard to flight operations and focused on team-based concepts such as team decision making. Third-generation CRM training broadened to reflect the environment in which crewmembers function, which included organizational culture and groups. By 1994, the fourth generation of CRM had come about, and its focus was on the addition of specific CRM behaviors to checklists, specialization of curriculum, and special training for those who instruct, certify, and evaluate crews in full mission simulations. The fifth generation CRM evolved to error management. The foundation of this generation is the fact that human error is unavoidable. Whereas previous CRM programs trained

crewmembers to avoid errors, they are now being trained to recover from errors and to manage those errors that are inevitable [4].

So how will we use CRM as a tool for flight safety? Many researchers investigate the issue and established a training program regarding CRM. 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 [7]. 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. Effectively 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 [8].

CRM training programs allow the trainers to focus mainly on human- human dealings as well as to emphasize the concepts such as communication, leadership, team work and coordination [9]. These programs include a lot of modules that aim at improving skills such as leadership, team spirit, decision-making and situational awareness; ensuring coordination among team members; more effective stress, workload and conflict management; and establishing a human-automation harmony [10]. Consequently, it will be likely to reduce the human errors and their negative effects by using the resources such as human, hardware and knowledge more efficiently thanks to CRM training programs [11].

Although many airline companies established training programs they could not achieved as they desired. Later on, a new research topic emerged. Why the training programs had functioned well? Researchers focused on culture and personal differences. In 1970s, the research conducted by NASA reported the significance of human-human communication in aviation. The interviews done with an airline named Pan AM pilots exposed that they received high quality training on aircraft systems and operations; though, they reported that they face problems in definite issues such as leadership, communication and decision-making [9]. Cooper, White and Lauber, in their detailed study on aircraft accidents that occurred between 1968 and 1976, concluded that most of those accidents were due to the problems in "giving orders", "communication" and "coordination" among the crew. Likewise, the simulator studies done by Ruffell-Smith discovered the magnitude of management skills in cockpit [12]. Under the light of these findings, CRM training programs were considered to extend non-technical skills such as communication, leadership, team work, decision making, situational awareness, work load and stress management. Even though CRM training programs are extensively used by airlines all over the world, they are not as thriving as those applied in the USA. Helmreich and Merritt, in their studies, argue that the factor which accounts for this difference in achievement is the existence of different cultural contexts [9].Helmreich and Merritt, in their study on determining the attitudes of pilots in certain scales, found out that their attitudes are influenced, to a great extent, by national culture. Also Salas et.al conducted a research about individual differences such as, personal selection and national culture. According to this work, when selecting pilots, CRM tests should be conducted to the candidates to measure their tendency to work as team. Also they had taken into account the culture factor [13].

Researchers explained the situation with the hypotheses proposing that CRM implementations could be effected by various factors and they continued their research by including different factors in their studies [11]. Besides the cultural differences, we tried to investigate the demographical differences among the flight crew. The scope of our work was narrowed by the aim. The researches could be found in the literature regarding culture [3][11], behavior markings [14] and Non-technical skills [15]. But we could not find any specific work emphasizing the demographics. Some of the researches mentioned the demographics but not as a sole topic. We investigate demographics such as: age, tenure, education, total flight time, total flight year, aircraft experience, position, and statue. Our main objective was to seek a relation between these factors and CRM understanding.

## II. METHODOLOHY

### A. Research Goal

The aim of this research is to understand the relationship between the demographical factors and perception of CRM on pilots. In order to achieve this aim we developed these hypotheses:

H1: There is a correlation between demographic factors and CRM factors.

H2: Demographic factor had an impact on CRM factors.

### B. Sample and Data Collection

The subjects of this study are Turkish pilots working for both government and commercial airline companies operating in Turkey. According the data obtained from Turkish Airline Pilots Association (TALPA) and government pilots who working for them, the number being 3000 in 2015. Within the scope of this study, a sample of 1000 pilots was taken from this population by using "basic random sampling" method. 300 of them returned, due to failed filling and missing answers 225 of them analyzed.

Table 1 Demographics

| Demographics | | |
|---|---|---|
| Age | 20-24 | 10.7% |
| | 25-34 | 63.6% |
| | 35-44 | 25.8% |
| Education | University | 88% |
| | Master | 12% |
| Tenure | Less than 1 year | 6.2% |
| | 1-3 | 6.2% |
| | 3-10 | 46.2% |
| | Less than 10 | 41.3% |
| Aircraft experience | Less than 1 year | 7.6 % |
| | 1-3 | 16.4% |
| | 3-8 | 36.9% |
| | 8+ | 39.1% |
| Total Flight year | Less than 10 year | 59.6% |
| | 10-15 | 26.2% |
| | 15-20 | 13.8% |
| | 20+ | 0.4% |
| Pozition | Captain | 65.8% |
| | First Officer | 34.2 % |
| Statue | Pilot | 75.6% |
| | Instructor | 18.2% |
| | Examiner | 6.2% |
| Total Flight Hour | Less than 1500 hr | 49.8% |
| | 1500-3000 | 39.6% |
| | 3000-6000 | 10.7% |

According to Table-1 most of the pilots were 25-34 years old (63.7%) and 88% of them graduated from a university. Nearly 60 percent of the sample was a flyer less than 10 year and half of them had 1500 flight hours and less.

*C. Analyses and Results*

The Data produced in this study were collected by survey. The survey consisted of two measures. In the first part questions about the demographic characteristics of pilots; in the other part questions designed to measure CRM perception were asked.

The CRM perception was measured by a scale taken from Helmreich and Merritt, but we update the scale to fit our country. We use previous researches conducted in Turkey. The measure included 20 items, each item was answered through a five-point Likert scale ranging from "1=strongly disagree" to "5=strongly agree." In the present study, the Cronbach's α coefficient for the scale was 0.70.

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

The CRM perception measure produced four factors upon factor analysis. The first factor named "CRM Training", explained 21.78% of the total variance (We received numbers of CRM training) . The second factor was named "Decision Making" and it explained 13.47% of the variance (My decision making ability as good as in emergencies as in routine flying conditions, A truly professional crewmember can leave his/her personal problems behind when flying). "Stress" the third factor with a variance of 10.37 % (I am less effective when stressed or fatigued), was followed by "Command" (8.94%) (Except for total incapacitation of the captain, the first officer should never assume command of the aircraft). The factors all

together explained 68.80% of the variance. KMO Bartlett's Test of Sphericity was 0.747.

| Table-2: Factor analysis results for CRM | | | | |
|---|---|---|---|---|
| CRM | CRM Training | DM | Stress | Command |
| Q1 | 0.812 | | | |
| Q4 | 0.746 | | | |
| Q5 | 0.729 | | | |
| Q3 | 0.715 | | | |
| Q7 | 0.678 | | | |
| Q9 | 0.645 | | | |
| Q11 | | 0.703 | | |
| Q13 | | 0.618 | | |
| Q14 | | | 0.779 | |
| Q15 | | | 0.750 | |
| Q17 | | | | 0.712 |
| Q19 | | | | 0.661 |
| Total Explained Variance for CRM  54,58 % | | | | |

DM: Decision Making, OR: Obeying the Rules

As a result of correlation analyses we found that, there were a negative correlation between "CRM Training" and tenure (r=-0.17, p<0.01), age (r=-0.14, p<0.05), aircraft experience (r=-0.23, p<0.01), total flight year (r=-0.16, p<0.05) and positive correlation with position (r=0.18, p<0.05). Also we found that there were a positive correlation between "Decision making" and tenure (r=0.13, p<0.05), aircraft experience (r=0.14, p<0.05), total flight year (r=0.15, p<0.05), total flight time (r=0.17, p<0.01) and statue (r=0.15, p<0.05). According to these results H1 partially accepted.

Table 3 Regression Analyses

| | CRM training | DM | Stress | Command |
|---|---|---|---|---|
| | β | β | β | β |
| Age | -,049 | ,109 | -,158 | -,130 |
| Education | ,118 | -,050 | ,085 | -,030 |
| Tenure | ,054 | **-,305*** | ,054 | ,066 |
| Aircraft experience | -,251 | ,143 | ,076 | -,167 |
| Total Flight year | ,089 | ,043 | ,101 | ,108 |
| Total Flight Hour | -,081 | -,017 | ,075 | -,057 |
| Statue | ,070 | -,041 | -,063 | -,003 |
| Position | ,018 | -,089 | ,066 | **-,287**\*\* |
| ΔR² | 0.077 | 0.029 | 0,065 | 0,046 |
| ΔF | 1.999 | 0.717 | 1,652 | 1,140 |

To explore whether the independent variables had a significant impact on the dependent variables, hierarchical regression analyzes were conducted. Table-3 shows the regression analysis results for each CRM dimension. Results

showed that tenure had a negative impact on decision making and position had a negative impact on command factor. In the regression analysis, demographic variables: age, education, aircraft experience, total flight year, total flight hour and position had no significant impact on CRM factors. According to these results H2 partially accepted.

## III. CONCLUSION

Human error in Aviation was the subject of researchers for many years. After the quantum leaps in the aviation human could not catch the technology as desired. At the beginning of the aviation history, pilots had tolerated the aircraft errors but after the 1960's the current turned to opposite way. Even though the technology has helped to human, it is not enough to prevent accidents. We mentioned the evolution of the CRM above. CRM turned to be most used technique within the airlines. CRM training helped the airlines to educate their crew for cooperation in the aircraft.

The aim of this research is to investigate the relation between demographic differences on CRM perception among the pilots. Most of the academic researches focused on cultural differences on CRM but demographics were not the focus of them.

In order to achieve this aim we cunducted a survey on pilots in Turkey. We use SPSS program to evaluate the results of survey. The results showed that the reliability of the scale was 0.701. We cunducted factor analyses for structural validity. The scale gave us four factor structure. The factors named as follows: the first factor "CRM training", second one "Decision making", third one "Stress" and the last one named "Obeying the rules". This structure was shown similarities between Helmreichs', Flinn and Şekerlis' works. As a result of correlation analyses we found that, there were a negative correlation between "CRM Training" and tenure (r=-0.17, p<0.01), age (r=-0.14, p<0.05), aircraft experience (r=-0.23, p<0.01), total flight year (r=-0.16, p<0.05) and positive correlation with position (r=0.18, p<0.05). These results may indicate that, younger and inexperienced pilots could not understand the importance of CRM training or they did not pay enough attention to the issue. Only the captains approached the training positively. Also we found that there were a positive correlation between "Decision making" and tenure (r=0.13, p<0.05), aircraft experience (r=0.14, p<0.05), total flight year (r=0.15, p<0.05), total flight time (r=0.17, p<0.01) and statue (r=0.15, p<0.05). These results tell us that, experienced pilots had more healthy decision making process.

As a result of the regression analyses, we found that that tenure had a negative impact on decision making and position had a negative impact on command factor. These results indicated that decision making affected by experience. When the experience level increased the decision making effectiveness increased as well. Above the 10 years or more experienced pilots showed more attention to decision process, they were aware of fatigue could decrease their level of attention and also they were well aware of personal problems could impair their decision making process. Another finding of our research is the position factor had a negative effect on command factor. Command factor (or we can say as Obeying the rules) as the Helmreich argued before, was one of the

critical point of cooperation within the cockpit. First officers did not question the orders of captain but they obey them. FO's accepts captain's decisions without doubt and they think that unless the captain became incapacitated, they have to obey. But in aviation history there were many accidents caused by the captain's individual mistakes. The main reason behind the CRM is that. According to Helmreich and Hostefede this problem pops up mainly in the eastern cultures or societies which had high power distance.

We suggest that airline companies or the government agencies should pay attention to composition of flight crew. And especially the captain and FO relations regarding flight safety, also they may highlight the importance of cooperation within the flight deck. Captains' decisions should not be unquestionable but of course this should not led harm the chain of command. Another suggestion regarding the results, companies or the government agencies should train the pilots whose experience were 3 years or less about the dangers of fatigue and conditions which could impair their ability to decide well. To achieve these objectives companies could revise their CRM training programs or they can highlight the importance of the training. Also training managers should be careful about the cultural differences and should adopt the program to avoid this kind of situations.

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 cultural differences among the flight crew and how to avoid from that.

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