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Pilot Selection in Airline Organizations with the Analytical Hierarchy Process

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Abstract

In the aviation sector, where intense rules and competition prevail, safe flight operations are possible with the employment of qualified human resources who can adapt to technology. The aim of this research is to investigate how the most suitable candidate can be recruited by evaluating many criteria together in the pilot recruitment processes, which are of critical importance for aviation enterprises. In this context, the opinions of senior pilots working in the world's top 10 airline organizations were consulted in the study carried out with the Analytical Hierarchy Process (AHP), which is one of the multi-criteria decision support methods. As a result of the literature research, the recruitment criteria for pilot candidates, which are actively used in the sector, have been listed in the context of the suggestions of experienced captains who also take part in various management positions in the aviation sector. A total of 17 criteria, 3 of which are upper and 14 are sub-criteria determined were weighted with the AHP method. As a result of the analysis, "technical", "non-technical" and "occupational criteria" were listed as the upper criteria according to the degree of importance in terms of local weights.

1. Introduction

The fact that competition has become much more fierce than in the past has created new challenges in business life. The aviation industry, which has a global economic potential of 2.7 trillion dollars (Allianz, 2019), needs qualified human resources, which is the only permanent weapon of competition (Česynienė, 2008). Because the aviation sector, which has grown under the control of strong organizations in terms of technology, business development and diplomacy, leads the technological transformation, which is reflected in other industrial areas, especially in the economic systems of developed countries, with its role as a locomotive, thus supporting the creation of qualified added value (Ministry of Development, 2018). Therefore, it is possible to adapt to innovation quickly and effectively with technological adaptation, by investing in human resources, which is the main pillar of success. Managers who are aware of this use a number of carefully prepared criteria to determine the most suitable candidate for the relevant position in the selection of human resources that reflect the identity of the business. Because the main purpose of personnel selection, which is one of the human resources functions, is not only optimizing personnel expenses, which is one of the items that will keep costs at low levels. The main goal is to carry out all activities with minimum cost and maximum benefit, and thus to keep the business afloat in challenging competitive conditions in constant change.

A person who steps into aviation with the dream of becoming a pilot goes through a number of difficult processes, including theoretical, practical and flight stages (Carretta and Ree, 2000; Bates, Colwell, 1997; Howse and Damos, 2011). Successfully overcoming these processes requires above-average competencies from analytical thinking to verbal and applied sciences. Compared to other occupational groups, it is known that even the slightest mistake in the piloting profession can cause irreparable results in terms of both financial and human life. This puts heavy responsibilities on businesses in the selection of pilots (Olaganathan and Amihan, 2021) who ensure that operations are carried out safely and successfully.

While evaluating the competencies of the pilots they employ, aviation organizations take into account non-technical characteristics as well as technical competence. There are many studies on what these criteria are. The common points that these studies focus on are; pilots' flight ability and experience, as well as individual abilities such as decision making, communication, stress management and teamwork, and psychomotor skills such as spatial, visual and auditory memory ability (Carretta and Ree, 1994; Yazgan et al., 2017; Bates et al., 1997; Howse and Damos, 2011). Making the most accurate assessments will benefit businesses both in terms of reputation and finances in the long run and will permanently support growth.

Multi-criteria decision making (MCDM) methods, which have been used in many sectors from past to present, allow the selection of the most suitable personnel among the candidates. However, as a result of the literature review, it is seen that MCDM methods are not used much in the aviation sector. Yazgan and Üstün (2011) who are researchers working on this subject used the MCDM method in weighting the criteria they determined. In this context, the determination of the recruitment criteria applied in the selection of personnel for pilots from human resources management functions and their importance levels were emphasized in the research. The determined criteria were first ranked according to their importance with the survey method, within the framework of the opinions of experienced captains who have worked in airlines for many years, both in pilot and manager positions. These criteria were then weighted with the help of the Analytical Hierarchy Process (AHP), one of the MCDM's, and it was determined which criteria would correspond to how many points. Thanks to the weighting process made with the AHP method, the evaluation criteria used in recruitment are scored without subjective tendencies.

2. Conceptual Framework

As of the end of 2019, a total of 295 thousand 547 people, 11 thousand 840 of whom are pilots, are employed in the Turkish civil aviation sector (SHGM, 2020). In this respect, it is possible to say that aviation is a very large and developing sector. The fact that today's aircraft consists of highly developed safe systems brings the human factor to the fore in accidents (Gopal, 2000). Studies show that 70 to 80% of all aviation accidents are related to human factors (Shappell and Wiegmann, 2003). Similarly, Li et al. (2001) revealed in their study that 80% of aviation accidents and 50% of aviation incidents are related to pilot errors. The fact that human errors are so high has increased the importance of pilot selection, which is a function of human resources management.

Errors that develop independently of environmental factors are called pilot error (Plant and Stanton, 2012; Shappell and Wiegmann, 2001; Shappell et al., 2007). In addition, factors such as excessive fatigue, workload and poor communication are also known to be effective in increasing pilot errors (Helmreich, 1997; Helmreich, 2000). Factors underlying errors also develop depending on decision-making, skill-based and perceptual factors (Shappell and Wiegmann, 2000; Shappel et al., 2017). Decision-making errors are stated as errors that occur because of the wrong choices of the pilot who is in the decision-making situation. Errors that develop due to factors such as carelessness and forgetting are skill-based errors. Perceptual errors can also prevent the healthy fulfillment of professional requirements. The common point of all these errors is that they affect flight safety negatively.

Goeterset et al. (1993) explained the professional success of pilots with their abilities in reasoning, situational awareness, perceptual speed, memorization, psychomotor coordination, reaction orientation, time-sharing, selective attention, spatial orientation, divided attention, control sensitivity, and visualization. Similarly, Hilton and Dolgin (1991) pointed out three important factors in pilot selection: intelligence, psychomotor skills and personality. Griffin and Koonce (1996), on the other hand, stated that psychomotor, perceptual-cognitive, paper-pencil and computer tests were performed during the selection process of military pilot candidates who will serve in the United States, which is the leader in aviation (Martinussen and Torjussen, 1998; Bailey and Woodhead, 1996; Burke et al. 1997).

Yazgan and Üstün (2011) conducted their studies for pilot candidates using the ANP method with 3 upper and 15 sub-criteria. The upper criteria are listed as technical, non-technical and occupational criteria. Sub-criteria are university exam score, basic mathematics, physics, aviation knowledge, english proficieny, personality traits, communication ability, teamwork skills, decision making and problem solving, intelligence, spatial orientation, visual memory, auditory memory, psychomotor skills and determined as an interview. Yazgan and Erol (2016) used binary logistic regression and multiple linear regression analyzes to determine the selection criteria for civilian pilot candidates. As the selection criteria, the scores obtained from the tests measuring the psychomotor, cognitive, and numerical abilities of the candidate, the numerical score of the university exam, the school achievement and the score obtained from the oral exam were used. Oktal and Onrat (2020) used the AHP method in the selection of airline pilot candidates in their study. Grade point average, English, mathematics and physics proficiency, individual characteristics, operational abilities, and basic and integrated mental abilities were used as criteria.

As can be seen, although it varies according to the sector, enterprises can benefit from many criteria in the personnel selection processes. The common goal of all these criteria determined for the sector and the task is to select the most suitable candidate in terms of efficiency. MCDA is used for different sectors and positions as well as aviation. In this context, Bedir and Eren (2015) used a total of 5 criteria to select personnel in their study in the retail sector with the integration of AHP-Promethee ranking methods. Liang and Wang (1994) carried out the personnel selection with the multi-criteria decision-making method in their study. Bali et al. (2013) used delphi technique and heuristic fuzzy sets methods in staff selection. Özgörmüş et al. (2005) conducted a supply planning engineer personnel selection study with fuzzy AHP. Güdük and Önder (2017) used the AHP method in the selection of data entry personnel in health services. In their study, Temiz and Cingöz (2015) used the AHP technique in the recruitment process of a fast-food business manager candidate. Doğan and Önder (2014) used AHP and TOPSIS methods for sales representative personnel selection in their study. Koyuncu and Özcan (2014) carried out their studies by using AHP and TOPSIS methods in the selection of production supervisors. Turan and Turan (2016) carried out their studies with the AHP method in the selection of nurses in the health sector. Türeli and Davraz (2016) carried out their studies by using AHP and VIKOR methods in the selection of personnel in the health sector. Weingarten et al. (1997) used the AHP for the selection of surgical assistants. Wang et al. (2017) performed physiological and psychological selection for a high-performance fighter pilot based on the AHP.

3. Methodology

3.1. Criteria Selection

In the research methodology, first, the criteria required for the weighting process with AHP were determined. The criteria determined as a result of the literature review were collected in a common pool and each criterion was handled separately in the context of air transport. Considering the difficulties experienced in personnel selection processes (Sackett et al. 2008), operating a fair and effective process in terms of results will positively affect the justice perceptions of the candidates and minimize possible objections (Ryan and Ployhart, 2000; Truxillo et al. 2009).

During the evaluation and prioritization of the criteria, the opinions of experts who worked in different units, especially in teacher piloting and human resources management, were consulted. The demographic characteristics of these people in decision-making positions were determined based on the demographic variables included in the study on flight crew resource management conducted by Aktaş and Tekarslan (2013). Information about the experts is presented in the table below.

Table 1. Demographic Characteristics of Experts

	Education	Age	Status	Flight Year	Flight Hours
Participant 1	Bachelor's Degree	43	Exeminer Pilot	18	14860
Participant 2	Bachelor's Degree	48	Exeminer Pilot	19	15600
Participant 3	Master's Degree	46	Exeminer Pilot	18	15320
Participant 4	PhD	51	Exeminer Pilot	24	16800
Participant 5	Master's Degree	48	Exeminer Pilot	20	15900
Participant 6	PhD	52	Exeminer Pilot	27	17190
Participant 7	Bachelor's Degree	39	Exeminer Pilot	16	13940
Participant 8	Bachelor's Degree	40	Exeminer Pilot	15	13370
Participant 9	PhD	50	Exeminer Pilot	25	16480
Participant 10	Bachelor's Degree	38	Exeminer Pilot	15	13090

When the demographic characteristics and professional experiences of the experts, all of whom have higher education levels, are examined it is seen that the average age is 45.5, the average flight year is 19.7, and the average flight time is 15200 hours. In addition to their administrative and technical duties, it is evaluated that the experts, all of whom are teacher pilots, have a high level of competence in terms of pilot employment.

In this context, 3 basic and 14 sub-criteria based on Yazgan and Üstün (2011)'s work with the contribution of its experts are presented in the table below (Hilton and Dolgin, 1991; Griffin and Koonce, 1996; Yazgan and Erol, 2016; Oktal and Onrat, 2020).

Table 2. Criteria and Explanations

Code	Criteria	Description
C_1	***Technical Criteria***	***Express their professional skills and experience.***
C_{1a}	Flight Year Experience	Time spent actively in the piloting profession.
C_{1b}	Total Flight Hours (Todd and Thomas, 2012; Carretta and Ree, 2000)	Total flight time with the aircraft as a pilot.
C_{1c}	Type Rating	The type of aircraft authorized to fly.
C_{1d}	English Language Proficiency (Yazgan and Üstün, 2011)	English language proficiency, which is the international aviation language.
C_{1e}	Simulator Test Results (Bolstad et al. 2002; Carretta and Ree, 2000)	Virtual reality system data that can simulate flight conditions for the pilot.
C_2	***Non-Technical Criteria***	***Criteria not directly related to the aircraft and the work performed***
C_{2a}	Decision Making and Problem Solving (Yazgan and Üstün, 2011)	Usually, the ability to deal with abnormal situations or solve a problem.
C_{2b}	Stress Management (CAA, 2014)	Ability to act correctly and make right choices when under stress
C_{2c}	Communication Skills (CAA, 2014; Yazgan and Üstün, 2011)	Ability to use language
C_{2d}	Teamwork Skill (CAA, 2014; Yazgan ve Üstün, 2011)	Ability to work as a member of a group.
C_{2a}	Personal Characteristics (Carretta and Malcolm, 1996; Yazgan and Üstün, 2011)	Personality traits that characterize an individual
C_3	***Occupational Criteria***	***Express the criteria related to the piloting profession.***
C_{3a}	Interview (Yazgan and Üstün, 2011; Carretta and Ree, 2000)	Interview for candidates for evaluation
C_{3b}	Spatial Orientation (Endsley, 1999; CAA, 2014; Yazgan and Üstün, 2011)	The ability to orient the body and postural position according to the physical environment in a static position or movement.
C_{3c}	Visual Memory (Endsley, 1999; CAA, 2014; Yazgan and Üstün, 2011)	The ability to accurately remember an object and then associate its properties with others.
C_{3d}	Auditory Memory Ability (Endsley, 1999; CAA, 2014; Yazgan and Üstün, 2011)	Ability to store and remember auditory information.

3.2. Analytical Hierarchy Process (AHP)

The Analytical Hierarchy Process (AHP), developed by Saaty in 1977, is one of the most frequently used (Zietsman and Verschuren, 2014) multi-criteria decision-making methods. A predefined comparison scale is used in AHP, where the systems approach is adopted. For this, with the help of expert opinions, the importance levels of the criteria affecting decision making are determined and one-to-one comparisons are made. In the hierarchical structure setup, there is the purpose at the top, the sub-criteria at the middle level, and the alternatives at the bottom. In this system, which is different from the traditional decision tree, each level represents a different segment. AHP, which should theoretically include homogeneity, reciprocity, meeting expectations and independence (Saaty, 1980, 1990, 2004, 2008), helps to make the best decision and make the right choice with clear justifications by synthesizing the results of criterion comparisons. The steps to be followed while applying AHP are given below:

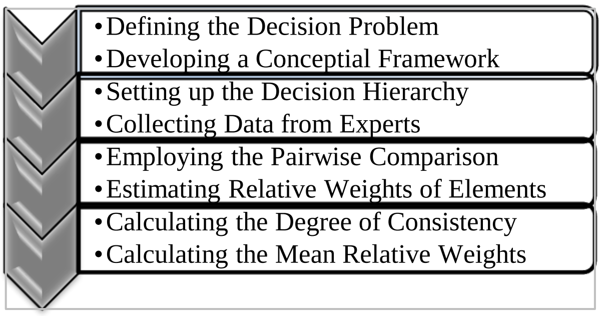

Figure 1. AHP Process
Source: Saaty, R.W. (1987).

First of all, as a result of defining the problem, the purpose, criteria and alternatives are determined, and a hierarchical structure is created. During this step, surveys and face-to-face interviews can be conducted with experts. There should be no significant differences between the experience and knowledge levels of the experts whose opinions are sought. The importance degrees to be used for weighting the criteria selected or determined during the multi-criteria scoring process are given in Table 3.

Table 3. The AHP Pairwise Comparison Scale

Intensity of importance	Definition	Explanation
1	Equal importance	Two factors contribute equally to the objective
3	Moderate importance of one over another	Experience and judgment strongly favor one factor over another
5	Essential or strong importance	Experience and judgment strongly favor one fctor over another
7	Very strong importance	A factor is strongly favored and is dominance demonstrated in practice
9	Extreme importance	The evidence favoring one factor over another is of the highest possible order of affirmation
2,4,6,8	Intermediate values between the two adjacent judgments	When compromise is needed

Source: Saaty, R.W. (1987).

In the First step, the pairwise comparison matrix is created as shown in formula (1).

$$A = \begin{vmatrix} 1 & a_{12} & a_{1n} \\ 1/a_{12} & 1 & a_{2n} \\ 1/a_{1m} & 1/a_{2m} & 1 \end{vmatrix} \quad (1)$$

In the next step, the normalization of the pairwise comparison matrix is performed by normalizing the values of the matrix. The normalized matrix is obtained by using the formula (2) as a result of dividing the value in each column in the matrix by the column sum.

$$b_{ij} = \frac{a_{ij}}{\sum_{i=1}^{a} a_{ij}} \quad (2)$$

Then, the average of the sum of each row of the normalized matrix is taken and the criteria weights are found using formula (3).

$$W_i = \frac{\sum_{j=1}^{a} b_{ji}}{n} \quad (3)$$

The next step is to check whether the criteria weights are consistent or not. In the meantime, formula (4) is used to find the consistency ratio (CR). As a result of the process, the consistency ratio (CR) is expected to be lower than 0.10. If it is otherwise high, it is defined as inconsistency and requires reconsideration of expert opinions.

$$\mathrm{CR} = \frac{CI}{RI} \quad (4)$$

Formula (5) is used to calculate the required consistency index value (CI).

$$\mathrm{CI} = \frac{(\lambda max - n)}{(n-1)} \quad (5)$$

The random index (RI) table is used for the random index value. In this context, the value that is suitable for the number of criteria used is selected.

Table 4. Random Consistency Index (RI) Values by Matrix Dimensions

n	1	2	3	4	5	6	7	8	9
R.I.	0	0	0,58	0,9	1,12	1,24	1,32	1,41	1,45

Source: Saaty, R.W. (1987).

Finally, the consistency of the matrix is tested by comparing the selected value with the consistency index value (Saaty, 1987).

3.3. Implementation

In this study, the importance degrees of the criteria used in the pilot recruitment processes in the aviation sector are emphasized. In order to determine and weight the criteria, the opinions of the expert participants were used, and the weight of each criterion was found. Within the framework of literature review and expert opinions, 3 upper and 14 sub-criteria were determined in a hierarchical structure, and experts were asked to make pairwise comparisons for the criteria. The research model created is shown in the figure below.

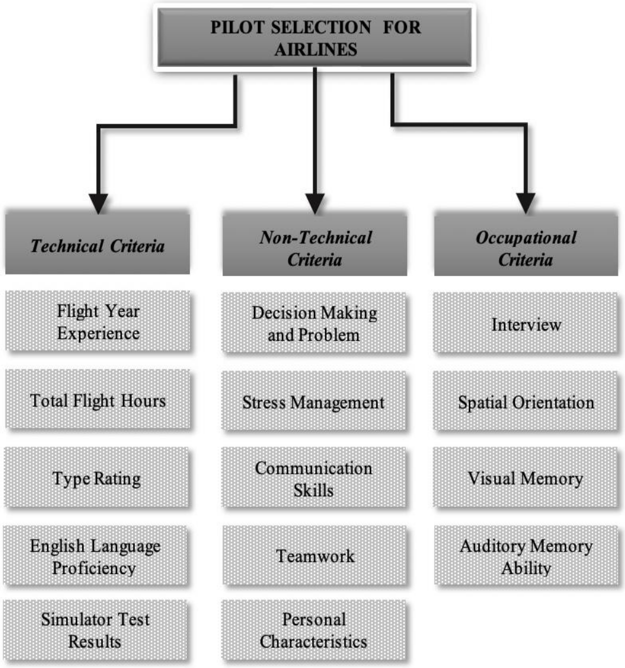

Figure 2. Research Model

The weighting processes made based on upper and sub-criteria with AHP were carried out with the following steps. With the help of the created matrix, the local and global weights of each criterion were calculated. For this, first, pairwise comparison matrix was formed based on upper and then sub-criteria and normalized. Afterwards, the relative importance values of the criteria were determined, and their consistency was checked.

The pairwise comparison matrix for the upper criteria determined within the framework of the literature review and expert opinions is presented in Table 5.

Table 5. Pairwise Comparison Matrix for the Upper Criteria

	C_1	C_2	C_3
C_1	1,00	5,00	9,00
C_2	0,20	1,00	5,00
C_3	0,11	0,20	1,00
Total	1,31	6,20	15,00

In the second step, criteria weights are calculated by normalizing each value in the pairwise comparison matrix. For this process, the value in each column is divided by the column total and the arithmetic average is taken. The matrix formed as a result of the process is presented in Table 6.

Table 6. Normalized Matrix and Criterion Weights for the Upper Criteria

	C_1	C_2	C_3	Weights
C_1	0,76	0,81	0,60	0,72327
C_2	0,15	0,16	0,33	0,215765
C_3	0,08	0,03	0,07	0,060965

After obtaining the normalized matrix, it is necessary to find the relative importance values (weights of the criteria) that enable the criteria to be placed in order of importance within themselves. The procedure here is to calculate the arithmetic mean for each row of the normalized comparison matrix. Thus, the most important decision criterion is determined with criterion weights (wi).

Table 7. Relative Importance Values for the Upper Criteria

	C_1	C_2	C_3	Total	Total / C
C_1	0,72	1,08	0,55	2,35	3,250208
C_2	0,14	0,22	0,30	0,67	3,083180
C_3	0,08	0,04	0,06	0,18	3,012848

In the next step, the consistency of the criterion weights was checked. Consistency ratio (CR) should be less than 0,10 [56]. In this context, the consistency index (CI) was calculated, and the consistency of the matrix was tested, and the results are presented in Table 8. Since the value found with 0,09 is less than 0,10, the consistency tests were successful. 0,58 was used for the RI value of 3.

Table 8. Consistency Test Results for the Upper Criteria

Total	Weights	Total / C	Landa Max	Consistency Index	Random CI CI/RI	
2,350778	0,72327	3,250208				
0,665243	0,215765	3,08318	3,115412	0,057706	0,099493	<0,10
0,183677	0,060965	3,012848				

After the processes related to technical, non-technical and professional upper criteria, pairwise comparison matrix was formed for each of them based on sub-criteria, and then the consistency of the sub-criteria, whose relative importance values were determined, was checked. Sub- of technical criteria; flight years' experience, total flight hours, type ratings, English language proficiency and simulator test results are divided into 5 groups. The pairwise comparison matrix created is shown in Table 9.

Table 9. Pairwise Comparison Matrix for the Sub-Criteria of Technical Criteria

	$C1_a$	$C1_b$	$C1_c$	$C1_d$	$C1_e$
$C1_a$	1,00	1,00	5,00	7,00	9,00
$C1_b$	1,00	1,00	5,00	3,00	5,00
$C1_c$	0,20	0,20	1,00	1,00	1,00
$C1_d$	0,14	0,33	1,00	1,00	1,00
$C1_e$	0,11	0,20	1,00	1,00	1,00
Total	2,45	2,73	13,00	13,00	17,00

The normalized matrix and criterion weights created for the sub-criteria of the technical criteria following the pairwise comparison matrix is shown in Table 10.

Table 10. Normalization of the Pairwise Comparison Matrix Created for the Sub-Criteria of the Technical Criteria

	$C1_a$	$C1_b$	$C1_c$	$C1_d$	$C1_e$	Weights
$C1_a$	0,4082	0,3663	0,3846	0,5385	0,5294	0,445390
$C1_b$	0,4082	0,3663	0,3846	0,2308	0,2941	0,336793
$C1_c$	0,0816	0,0733	0,0769	0,0769	0,0588	0,073512
$C1_d$	0,0571	0,1209	0,0769	0,0769	0,0588	0,078138
$C1_e$	0,0449	0,0733	0,0769	0,0769	0,0588	0,066166

The relative importance values calculated for the sub-criteria of the technical criteria following the normalization process are shown in Table 11.

Table 11. Relative Importance Values for the Sub-Criteria of the Technical Criteria

	$C1_a$	$C1_b$	$C1_c$	$C1_d$	$C1_e$	Total	Total / C
$C1_a$	0,4454	0,3368	0,3676	0,5470	0,5955	2,2922	5,146505
$C1_b$	0,4454	0,3368	0,3676	0,2344	0,3308	1,7150	5,092113
$C1_c$	0,0891	0,0674	0,0735	0,0781	0,0662	0,3743	5,091014
$C1_d$	0,0624	0,1111	0,0735	0,0781	0,0662	0,3913	5,007949
$C1_e$	0,0490	0,0674	0,0735	0,0781	0,0662	0,3342	5,050483

After calculating the relative importance values, the consistency of the criteria weights was checked. In this context, the consistency index (CI) was calculated, and the consistency of the matrix was tested, and the results are presented in Table 12. Since the value found with 0,01740 is less than 0,10, the consistency tests were successful. 1,12 was used for the RI value of 5 (Table 4).

Table 12. Relative Importance Values Determined for the Sub-Criteria of the Technical Criteria

Total	Weights	Total / C	Landa Max	Consistency Index	Random CI	CI/RI
2,292204	0,44539	5,146505	5,077613	0,019403	0,01740	<0,10
1,714989	0,336793	5,092113				
0,374253	0,073512	5,091014				
0,391313	0,078138	5,007949				
0,334168	0,066166	5,050483				

Sub-criteria of non-technical criteria; decision making and problem solving, stress management, communication ability, teamwork ability and personal characteristics. The pairwise comparison matrix created is shown in Table 13.

Table 13. Pairwise Comparison Matrix for the Sub-Criteria of the Non-Technical Criteria

	$C2_a$	$C2_b$	$C2_c$	$C2_d$	$C2_e$
$C2_a$	1,00	1,00	5,00	7,00	9,00
$C2_b$	1,00	1,00	5,00	3,00	3,00
$C2_c$	0,20	0,20	1,00	3,00	1,00
$C2_d$	0,14	0,33	0,33	1,00	1,00
C2e	0,11	0,33	1,00	1,00	1,00
Total	2,45	2,86	12,33	15,00	15,00

The normalized matrix and criterion weights created for the sub-criteria of the technical criteria following the pairwise comparison matrix is shown in Table 14.

Table 14. Normalization of the Pairwise Comparison Matrix Created for the Sub-Criteria of the Non-Technical Criteria

	$C2_a$	$C2_b$	$C2_c$	$C2_d$	$C2_e$	Weights
$C2_a$	0,4082	0,3497	0,4055	0,4667	0,6000	0,445999
$C2_b$	0,4082	0,3497	0,4055	0,2000	0,2000	0,312666
$C2_c$	0,0816	0,0699	0,0811	0,2000	0,0667	0,099866
$C2_d$	0,0571	0,1154	0,0268	0,0667	0,0667	0,066525
C2e	0,0449	0,1154	0,0811	0,0667	0,0667	0,074944

The relative importance values calculated for the sub-criteria of the non-technical criteria following the normalization process are shown in Table 15.

Table 15. Relative Importance Values Created for the Sub-Criteria of the Non-Technical Criteria

	$C2_a$	$C2_b$	$C2_c$	$C2_d$	$C2_e$	Total	Total / C
$C2_a$	0,4460	0,3127	0,4993	0,4657	0,6745	2,3982	5,377065
$C2_b$	0,4460	0,3127	0,4993	0,1996	0,2248	1,6824	5,380837
$C2_c$	0,0892	0,0625	0,0999	0,1996	0,0749	0,5261	5,268215
$C2_d$	0,0624	0,1032	0,0330	0,0665	0,0749	0,3400	5,111529
C2e	0,0491	0,1032	0,0999	0,0665	0,0749	0,3936	5,251601

After calculating the relative importance values, the consistency of the criteria weights was checked. In this context, the consistency index (CI) was calculated, and the consistency of the matrix was tested, and the results are presented in Table 16. Since the value found with 0,06229 is less than 0,10, the consistency tests were successful. 1,12 was used for the RI value of 5 (Table 4).

Table 16. Relative Importance Values Determined for the Sub-Criteria of the Non-Technical Criteria

Total	Weights	Total / C	Landa Max	Consistency Index	Random CI	CI/RI
2,398166	0,445999	5,377065	5,277849	0,069462	0,06229	<0,10
1,682403	0,312666	5,380837				
0,526118	0,099866	5,268215				
0,340044	0,066525	5,111529				
0,393575	0,074944	5,251601				

The sub-criteria of the criteria related to the profession are divided into 4 groups. These are interview, spatial ability, visual memory ability and auditory memory ability. The pairwise comparison matrix created is shown in Table 17.

Table 17. Pairwise Comparison Matrix for the Sub-Criteria of the Occupation-Related Criteria

	$C3_a$	$C3_b$	$C3_c$	$C3_d$
$C3_a$	1,00	3,00	5,00	7,00
$C3_b$	0,33	1,00	1,00	1,00
$C3_c$	0,20	1,00	1,00	1,00
$C3_d$	0,14	1,00	1,00	1,00
Total	1,67	6,00	8,00	10,00

The normalized matrix and criterion weights created for the sub-criteria of the criteria related to the occupation following the pairwise comparison matrix is shown in Table 18.

Table 18. Normalization of the Pairwise Comparison Matrix Created for the Sub-Criteria of the Occupational Criteria

	$C3_a$	$C3_b$	$C3_c$	$C3_d$	Weights
$C3_a$	0,60	0,50	0,63	0,70	0,605951
$C3_b$	0,20	0,17	0,13	0,10	0,147318
$C3_c$	0,12	0,17	0,13	0,10	0,127857
$C3_d$	0,08	0,17	0,13	0,10	0,118875

The relative importance values calculated for the sub-criteria of the occupational criteria following the normalization process are shown in Table 19.

Table 19. Relative Importance Values Created for the Sub-Criteria of the Occupational Criteria

	$C2_a$	$C2_b$	$C2_c$	$C2_d$	Total	Total / C
$C2_a$	0,61	0,44	0,64	0,83	2,52	4,157618
$C2_b$	0,20	0,15	0,13	0,12	0,59	4,032186
$C2_c$	0,12	0,15	0,13	0,12	0,52	4,029818
$C2_d$	0,08	0,15	0,13	0,12	0,48	4,028463

After calculating the relative importance values, the consistency of the criteria weights was checked. In this context, the consistency index (CI) was calculated, and the consistency of the matrix was tested, and the results are presented in Table 20. Since the value found with 0,02344 is less than 0,10, the consistency tests were successful. 0,89 was used for the RI value of 4 (Table 4).

Table 20. Relative Importance Values Determined for the Sub-Criteria of the Occupational Criteria

Total	Weights	Total / C	Landa Max	Consistency Index	Random CI	
					CI/RI	
2,519311	0,605951	4,157618	4,062021	0,020674	0,02344	<0,10
0,594013	0,147318	4,032186				
0,515240	0,127857	4,029818				
0,478882	0,118875	4,028463				

As a result of the calculations made with AHP, the local and global weights of the criteria to be used for pilot recruitment were determined. Local weights were calculated for the upper criteria, and both local and global weights were calculated for the lower criteria.

Table 21. Local and Global Weights of all Criteria

Upper Criteria	Local Weights	Lower Criteria	Local Weights	Global Weights
Technical Criteria	0,723270131	Flight Year Experience	0,445390464	0,321
		Total Flight Hours	0,336793179	0,243
		Type Rating	0,073512482	0,053
		English Language Proficiency	0,078138332	0,056
		Simulator Test Results	0,066165543	0,047
Non-Technical Criteria	0,215765137	Decision Making and Problem Solving	0,445999057	0,096
		Stress Management	0,312665724	0,067
		Communication Skills	0,099866478	0,021
		Teamwork Ability	0,066524959	0,014
		Personal Characteristics	0,074943782	0,016
Occupational Criteria	0,060964732	Interview	0,605950599	0,036
		Spatial Orientation	0,147317864	0,008
		Visual Memory	0,127856786	0,007
		Auditory Memory Ability	0,11887475	0,007

According to the calculations the global weights of technical criteria are 0,723270131, non-technical criteria are 0,215765137, and occupational criteria are 0,060964732.

Among the technical criteria, the local weight of the flight year experience is 0,445390464, and the global weight is 0,321; the local weight of the total flight hours is 0,336793179, and the global weight is 0,243; the local weight of the type trainings received was 0,073512482, and the global weight was 0,053; English language proficiency has a local weight of 0,078138332 and a global weight of 0,056; the local weight of the simulator test results was found to be 0,066165543 and the global weight to be 0,047. As a result of these calculations, it is possible to say that the criterion with the highest local and global weight under the technical criteria is the experience of the flight year.

Among non-technical criteria, decision making and problem solving has a local weight of 0,445999057 and a global weight of 0,096; stress management has a local weight of 0,312665724 and a global weight of 0,67; the local weight of the communication ability is 0,099866478, and the global weight is 0,021; The local weight of teamwork ability is 0.066524959, its global weight is 0,014, the local weight of personal characteristics is 0,074943782, and its global weight is 0,016. As a result of these calculations, it is possible to say that the criteria with the highest local and global weights under non-technical criteria are decision making and problem solving.

Among the criteria related to the profession, the local weight of the interview is 0,605950599 and its global weight is 0,036; the local weight of spatial ability is 0,147317864, and the global weight is 0,008; visual memory ability has a local weight of 0,127856786 and a global weight of 0,007; The local weight of the auditory memory ability was found to be 0,1887475, and the global weight was 0,007. As a result of these calculations, it is possible to say that the criterion with the highest local and global weight under the criteria related to the profession is the interview.

Finally, all the sub-factors were ranked according to their global weights obtained by AHP. The most important criteria are flight years' experience (0,321), total flight hours (0,243) and decision making and problem solving (0,096), while the least important criteria are visual memory ability (0,007) and auditory memory ability (0,007).

Table 22. The Order of Importance of the Sub-Factor

Sub-Criteria	**Global Weights**	**Sub-Criteria**	**Global Weights**
Flight Year Experience	**0,321**	Interview	**0,036**
Total Flight Hours	**0,243**	Communication Skills	**0,021**
Decision Making and Problem Solving	**0,096**	Personal Characteristics	**0,016**
Stress Management	**0,067**	Teamwork Ability	**0,014**
English Language Proficiency	**0,056**	Spatial Orientation	**0,008**
Type Rating	**0,053**	Visual Memory	**0,007**
Simulator Test Results	**0,047**	Auditory Memory Ability	**0,007**

4. Results and Discussions

Personnel selection process, which is one of the human resources management functions, is of vital importance for businesses. Each business determines various criteria to select the most suitable candidate for the working conditions. These criteria vary according to the sector. Determining recruitment criteria is very important for the long-term success of businesses. Because a correct procurement procedure also means efficient work outputs and lower labor turnover. When it comes to aviation, recruitment processes become much more critical. Because the aviation industry is one of the most risky and competitive industries. The fact that even the slightest mistake can cause irreparable results is another factor that distinguishes the aviation industry from others. This makes it necessary to carry out all activities with a preventive approach. Within the aviation sector, the area where commercial and reputational pressure is at the forefront is air transportation. In this context, the study focuses on the pilot selection criteria in the air transport sector.

The criteria determined as a result of the literature review were expanded with expert opinions. A total of 17 criteria, including 3 upper and 14 lower criteria, were determined. These criteria were put in order of importance within the framework of the opinions of 10 participants, who were determined among the most experienced captain pilots of the airline transport sector. All criteria were weighted at local and global level by using pairwise comparison matrix with the AHP method. According to the results of the research, it was seen that the most important recruitment criterion was flight experience with a global weight index of 0,321. Flight year experience is followed by total flight hours (0,243) and decision making and problem solving (0,096) criteria. It was seen that the criteria with the least importance are visual memory and auditory memory ability (0,007). In general, the criteria used in the air transport sector are similar to those in this research. However, it is the superior side of the research that these criteria have been expanded within the framework of expert opinions. However, it is seen that the determination of pilot selection criteria has been done in military aviation. It is known that the dynamics of civil aviation differ from military aviation by being partially similar. In this context, the fact that the research was conducted on civil air transportation sector can be considered as another advantage. In this respect, the study is not only a useful resource for the literature, but also for the sector. Finally, it is possible to mention some limitations of the research. The first of these is the study of the Turkish sample, even though the industry is dependent on international dynamics. The second is that it has been studied specifically for air transport. Finally, experts are limited to 10 people. As a result, although these limitations negatively affect the generalizability of the research results, this study is a resource for other researchers on the subject.

Ethical Approval

Not applicable

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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