STATISTIC ANALYSIS OF THE AERONAUTICAL AND AIR TRAFFIC STUDENTS EDUCATION AT THE FACULTY OF TRANSPORT AND TRAFFIC ENGINEERING, UNIVERSITY OF ZAGREB

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ABSTRACT

This paper deals with analysis and characteristics of human factor training. Its objective is to show that human factors in aviation are the most important factor in air traffic safety. It will also show how human factors affect air traffic safety. The structure of two aviation courses (air traffic course and aeronautical course) at the Faculty of Transport and Traffic Engineering will be presented. Several statistic analyses will be used to show the benefits of the education. The analysis will include the ratio of the number of students enrolling in the course and the students completing the course. The success of finding employment in the national firms dealing with air traffic will be analysed. The analysis will include every generation of students enrolled at the Faculty since 1992. During the years of aviation the unwritten rule was that aviation was in the standard manner a male profession. In this paper this rule will be checked using the data of students enrolled at the Faculty. The number and success according to the gender of students will be analysed.

1. INTRODUCTION

Air traffic is a complex branch of traffic whose primary task is to reach the defined high level of standards of air traffic safety.

The complexity of air traffic is defined as a system of human–machine interfaces. Although air traffic tries to reach full automation with minimal human share, human factor will certainly remain the most important factor of air traffic safety as direct (pilots, air traffic controllers, mechanics) and indirect factor (aeronautical engineers, technicians). Seamless co-ordination, qualifications, high responsibility and professionalism as well as clarity and understanding of speech and data communication between pilots and controllers are the major conditions for the safe flow of air traffic. Therefore, it is extremely important that selection, education and training of aviation personnel – especially pilots and air traffic controllers, are prepared and performed at the highest level in compliance with the international standards and recommendations.

2. CHARACTERISTICS OF EDUCATION

The Faculty of Transport and Traffic Engineering, University of Zagreb, took the main role in establishing the first aviation education centre after Croatia had gained independence. Until 1992 there had been only general air traffic course at the Faculty which lasted for 9 semesters plus a period for diploma thesis.

In 1992 the Department of Aeronautics was founded including three different courses – military pilot, civil pilot and air traffic control course. The civil pilot and the air traffic controller course lasted and still last for 5 semesters, plus the time needed for the diploma thesis. In this period civil pilot and air traffic controller students have to attend a number of different theoretical general and professional subjects. Also, within this education, the civil pilot students have practical training (flight simulator training and flight training) within the Faculty's Croatian Aviation Training Centre. This course is organised in co-ordination with the Ministry of Maritime Affairs, Transport and Communications. The military pilot course lasts for 9 semesters plus a period for diploma thesis. This course is organised in co-ordination with the Ministry of Defence in such a way that after five theoretical semesters the students continue their practical training at the Aviation Military Training Centre. Until 2002 air traffic control course offered only theoretical subjects but since last year in co-ordination with the Croatian Air Navigation Services Ltd. a plan has been developed to include practical (ATC simulator) training in this course.

The new model of study for air traffic controllers at the Faculty of Transport and Traffic Engineering should be planned and brought to the professional benefit and interest of both the Faculty and the Croatian Air Navigation Services [1].

The civil pilot theoretical training syllabus that had been valid for students up to the academic year 2001/2002 was at the level of CPL/IR. The requirements of the biggest "user" of pilots in Croatia, Croatia Airlines, were increased to the "frozen" ATPL level with the introduction of JAR–OPS 1 in Croatia[2]. The Faculty and its Department of Aeronautics responded to these new requirements by a decision to modify the syllabus in a way in which it would fully comply with the "frozen" ATPL requirements, as outlined in JAR–FCL 1, AMC FCL 1.470(a) [2].

Since the civil pilot training course is not a purely professional training course, but also an academic one and since the students who graduate do not only receive their flight crew license but also an academic diploma, the syllabus as outlined in AMC FCL 1.470(a) is only a starting point and represents the minimum of knowledge required [2]. On the other hand, the lectures at the Faculty are more academic than is required by AMC FCL 1.470(a) and not sufficiently operations-oriented. That is the main reason why the syllabus and its subjects should be balanced with theoretical and practical training [2].

3. ANALYSIS OF THE NUMBER OF GRADUATED VS. ENROLLED STUDENTS

3.1. Analysis of Air Traffic Course

General air traffic course at the Faculty of Transport and Traffic engineering is a course with the longest tradition of aviation courses. After graduating the students acquire an academic degree - B.Sc. (after 9 semesters or five years) or Air Traffic Engineer (after 5 semesters or 3 years).

After graduating the students get a job at Croatia Airlines, business aviation, Croatian CAA, Crocontrol, at airports etc.

Figure 1 presents 6 generations of students enrolled in the air traffic course (9 semesters) from 1998 until 2002/2003 [4]. If we take into consideration the fact that an average student needs 6 years to finish the course, we could assume that most of these graduated students enrolled in the course between 1992 and 1996.

It can be noticed that every year approx. 80 students enrolled in the air traffic course and that the number of graduated students exceeds the number of enrolled students only in the year 2002.

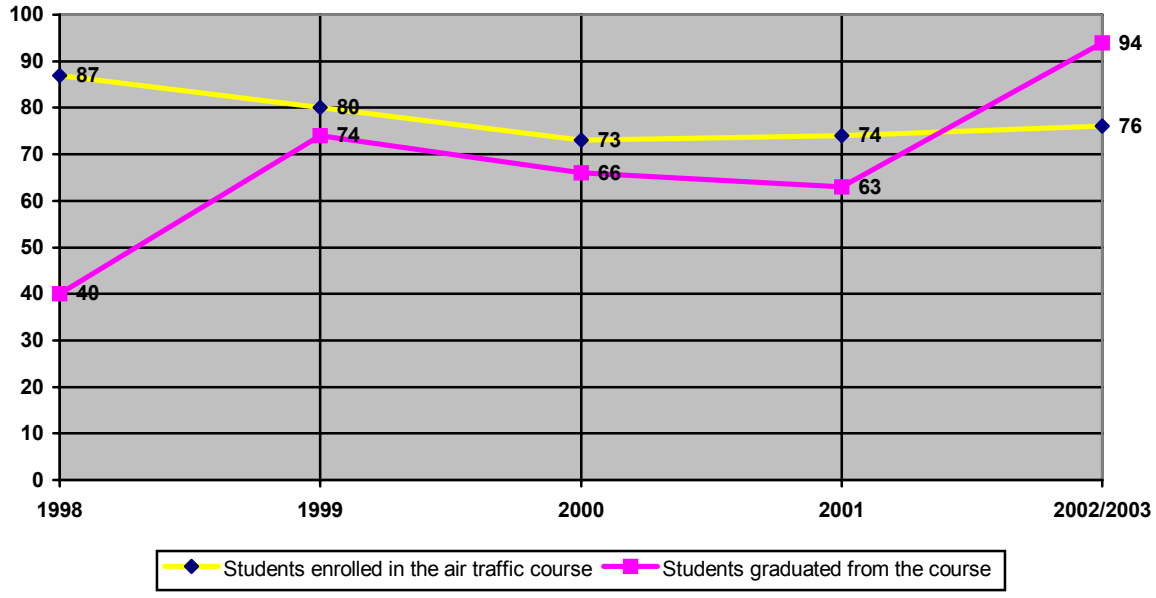

Figure 1: Number of students enrolled in air traffic course and those graduated

Figure 2 shows progression of the 1998 generation [4]. The number of students regularly enrolling in the higher academic years is presented.

We can notice that the number of students has decreased over the years, which was to be expected.

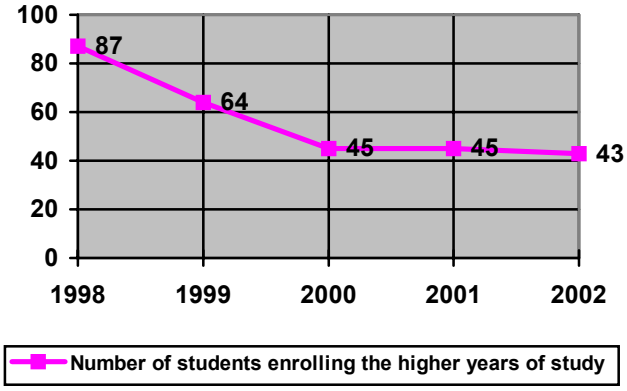

Figure 2: Decrease of the number of students for the 9-semester air traffic course

According to this analysis ca 50 % (43/87) of the enrolled students complete the course at the end of their education. Similar result is obtained for the other 5-semester air traffic course (Figure 3).

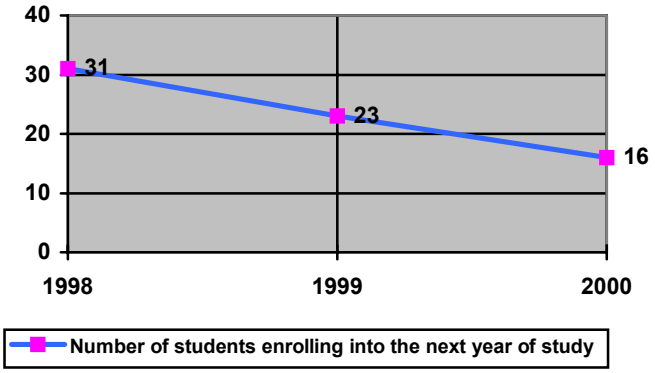

Figure 3: Decrease of the number of students for the 5-semester air traffic course

According to data from Figure 3, the number of students at the end of the study is half as much as at the beginning of the study (16/31). This means that the rate of success of passing into the next year is around 50 %.

When analysing these data we have to take into consideration that the number of students contains the number of students regularly enrolling into the higher year, the number of failed students from previous generations and the number of students changing the primary course or the faculty.

3.2. Analysis of Aeronautical – Military Pilot Course

The military pilot course was also established at the Faculty of Transport and Traffic Engineering in 1992. It lasts for 9 semesters and is organised in co-ordination with the Croatian Ministry of Defence in such a way that after five theoretical semesters the students continue their education and practical training at the Military Aviation Training Center.

The military pilot course data are not available in detail. At the beginning, there were approx. 60 students and the number has decreased substantially over the last few years.

After graduating, the military pilots get employment at the Croatian Air Force.

3.3. Analysis of Aeronautical – Civil Pilot Course

Since 1992 nine generations of students have enrolled in the civil pilot training course at the Faculty. Since there are no available complete data for the three generations of students [4], it is impossible to calculate the percentage of graduated students compared to the number of those enrolled in the course (Table 1).

Table 1: Years of enrolment in the civil pilot course

Year of enrolment	Number of students
1992	24
1993	36
1994	23
1995	not available
1996	not available
1997	not available
1998	13
1999	7
2000	11

We can see that the last enrolled generation of students was the generation of the year 2000. Since we have information that students from the last two generations could not complete their practical training, it is possible to calculate the total number of graduated civil pilots at the Faculty for the first 7 generations. The first civil pilot graduated in the independent Croatia at the end of 1995. Since then, 114 civil pilots have graduated at the Faculty.

3.4. Analysis of Aeronautical – Air Traffic Control Course

Like the two other courses above, the air traffic control course was also established in 1992 and since then 8 generation [4] of students have enrolled in the course (Table 2).

Table 2: Total number of students at the ATC course

Year of enrolment	Number of students
1992 – 1st generation of	44
1993 – 2nd generation	21
1995 – 3rd generation	31
1998 – 4th generation	17
1999 – 5th generation	31
2000 – 6th generation	26
2001 – 7th generation	22
2002 – 8th generation	22
Total	214

The first air traffic control students graduated at the Faculty of Transport and Traffic Engineering in the year 1995 and since then the total number of graduated ATC students is 86.

Since the last two generations still have lectures we can subtract the 44 students from the total number and calculate the percentage of the graduated ones for the first 6 generations: 214 – 44 = 170 →86/170 = 0.505 or approximately 51% which was to be expected.

4. ANALYSIS OF ATC AND CIVIL PILOT STUDENTS ACCORDING TO GENDER

During the years of aviation there was an unwritten rule that aviation and then ATC as part of the aviation system was as a rule a male profession. In the year 2000 an interesting analysis was made [8] at the Faculty of Transport and Traffic Engineering. The task was to show how many female students participate in the ATC course. Also, we tried to show the success of female students using three different criteria.

The analysis was made for the first 5 generations of students.

The first criterion included psychological and medical capabilities of students as preliminary conditions for enrolling in the course. There were more male candidates than female ones interested in enrolling in the course over the years. 77% of male candidates passed the medical and psychological tests. At the same time 70% of female candidates successfully enrolled in the course during these five generations.

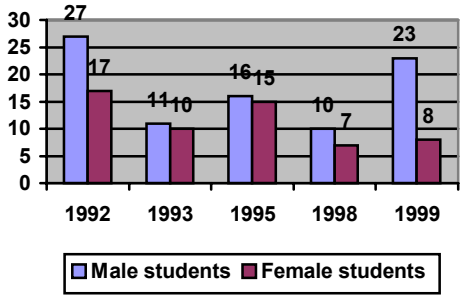

Figure 4: Number of students enrolled in the ATC course according to gender

We can see, as we expected, that in every generation there are more male students.

The second criterion included the average grades in 21 professional subjects. Female students were better students and acquired better grades in 19 subjects or 90% of all subjects. This could be a fine indicator of the future highly qualified professional. However, it cannot represent a condition for that. Good grades can "speak" for some qualities of the candidates necessary for the ATC profession: responsible, hard-working, serious, diligent. Naturally, these qualities are not the only qualities

that an air traffic controller should have. Good co-ordination, intelligence, independence, self-confidence, consistency are even more important and cannot be developed through theoretical subjects.

Until the beginning of the year 2001, 74 ATC students graduated from the Faculty and among them there were 37 female students or exactly 50%.

The third criterion that was used to show how female students participate in the ATC course was the number of graduated students employed at the Croatia Control till 2000. 27 candidates were employed at that time and among them 12 were female or 44%.

These analyses show that more male than female ATC students successfully reached the medical and psychological standards necessary for enrolling in the ATC course. On the other hand, female students are more successful in the theoretical knowledge and the average grades obtained during education. Nevertheless, male graduated students are still slightly better in getting employed at the Croatia Control. This is no surprise, since the total number of graduated male students is higher than in the case of female students.

All of this leads to the conclusion that female students, according to the above criteria, are equal to their male colleagues and that air traffic control is still, but less than before, a male profession.

5. ANALYSIS OF EMPLOYMENT AT AVIATION INSTITUTIONS AND FIRMS

5.1. Croatia Airlines

Croatia Airlines is the national carrier of Croatia. Approx. 70% of the pilots graduated at the civil pilot course at the Faculty in Zagreb (44 as well as 8 at the B.Sc. Air Traffic Engineering) [7]. The rest of the pilots (23) validated their documents or upgraded them at the Faculty. There are 70 air traffic engineers and 65 BSc in air traffic Engineering who are employed at the Croatia Airlines. Practically two hundred (almost one fifth of the total employments – 1051) of Croatia Airlines' employees are former students of the Faculty.

5.2. Croatian Air Navigation Services Ltd.

Croatian Air Navigation Services or Croatia Control has 88 employees graduated at the Faculty, 70 air traffic engineers and 18 air traffic controllers. We assume that rest of the controllers have two different backgrounds. Some of them got the job at the Croatia Control after finishing different ATC courses in several European ATC centres (for example in Bailbrook College or DFS). The rest of the employed controllers finished ATC courses yet in ex-Yougoslavia.

5.3. Croatian major airports

The analysis of the number of the employees at the Croatian airports shows that up to 4% are the former students of the Faculty employed at Zagreb Airport accommodating half of the Croatian air traffic (number of passengers).

Table 3: Number of airport employees who graduated at the Faculty

Croatian major airports	Number of airport employees who graduated at the Faculty
ZAGREB AIRPORT	49
SPLIT AIRPORT	10
PULA AIRPORT	8
DUBROVNIK AIRPORT	4
OSIJEK AIRPORT	5
ZADAR AIRPORT	4
RIJEKA AIRPORT	3
LOSINJ AIRPORT	1
BRAC AIRPORT	0
TOTAL	84

As may be seen, the total number of employees graduated at the Faculty vary from zero up to 10 and in the percentage between 0 and 12%. Compared to Croatia Airlines, it can be concluded that the number of the graduated employees at the airports are far less.

5.4. Croatian Air Force

The Croatian Air Force is considering and planning the necessary number of military pilots for their existence and future needs.

5.5. Other aviation institutions

There is a certain number of aviation institutions such as the Croatian CAA [3], the Faculty of Transport and Traffic Engineering, business aviation and others, with approx. 40 employed persons. A certain number of the graduated students are employed abroad.

5.6. Other non-aviation institutions

The lack of balance between the graduated students and the available working positions result in that a certain number of graduated students get a job in the non-aviation firms or in some self-employment

(freelance) activities. It is very difficult to collect such information.

5.7. Public employment office

The report from the Croatian Public Employment Office shows that there are 35 BSc and 65 air traffic engineers listed as unemployed. There are 31 unemployed civil pilots, as well as 5 air traffic controllers [5].

6. POSTGRADUATE STUDY

The postgraduate study was established in 1997 at the Faculty of Transport and Traffic Engineering. The major field is the technical science and one field is the transport and traffic technology. When enrolling, the candidates can choose among different branches including the aeronautical and the air traffic branch.

Since 1997 six generations of postgraduate students were enrolled [6] (Table 4).

Table 4: Generations of the postgraduate students

Generation of postgraduate study	**Aeronautical branch**	**Air Traffic branch**
I generation - 1997	14	6
II generation – 1998	11	6
III generation – 1999	9	4
IV generation – 2000	5	7
V generation – 2001	16	7
VI generation – 2002	5	9
Total	60	39

During this period, from 1997, only 4 postgraduate students completed the study (3 at the aeronautical branch and 1 at air traffic branch and acquired the degree of Master of Science - M.Sc.).

The Faculty of Transport and Traffic Engineering is not only an important research and development institution within the Croatian borders but also within the whole region. There is also a certain number of postgraduate students from abroad, especially from Bosnia & Herzegovina.

7. CONCLUSION

With the independence of Croatia in 1991 it became necessary to establish a centre for aviation education. The Faculty of Transport and Traffic Engineering organised courses for air traffic engineers with and without the diploma as well as aeronautical courses for military pilots, civil pilots and air traffic controllers. This analysis shows that the graduated students mainly got a job in aviation or in non-aviation activities and a minor number is recorded at the public employment office. We assume that, because of certain stagnation in the development of aviation in Croatia, there will be fewer working positions in the future. Therefore, the number of students enrolling in the aviation courses at the Faculty has to be planned very carefully.

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KEY WORDS

Human factors, air traffic, air traffic control, education, students, employment, pilots, air traffic controllers, air traffic engineers, faculty

BIOGRAPHIES

Biljana Juricic was born in Osijek, Republic of Croatia on 27th January 1972. In 1991 she enrolled the air traffic engineering course and graduated after five years and achieved the BSc diploma. In 1997 she continued higher education enrolling the aeronautical course at the postgraduate study at the same Faculty. In 2002 she achieved her MSc with master thesis “Runway capacity models”. From 1998 she is employed at the Faculty of Transport and Traffic Engineering as an assistant lecturer. The main scope of her work is air traffic conrol.

Jelena Bistrica was born on June 25th 1979 in the Republic of Slovenia.

In 1998 she joined the course for Air Traffic Controllers at the Faculty of Transport and Traffic Engineering at the University of Zagreb, where she graduated in 2001. After her graduation, she completed the Radar course at the DFS Academy, Langen – Germany and shortly after that started working as an Air Traffic Controller at the Zagreb ACC.

Stanislav Pavlin was born in 1949 in Zagreb. He graduated in 1973 at the Faculty of Transport and Traffic Engineering, University of Zagreb. He worked at Zagreb Airport as airport planner and Head of the Organisation, Development and Investment Department. He acquired his M.Sc. in 1980 with the master thesis entitled "Computer Modelling and Simulation of Airport Traffic at Zagreb Airport Airside". He acquired the Ph.D. in 1989 with the doctoral thesis "Improvement of Airport Passenger and Baggage Handling Technology". He was Deputy Minister for Civil Aviation from 1991 till 1993. Since 1994 he has worked at the Faculty of Transport and Traffic Engineering. He is Professor and Head of the Aerodrome Department.