

Industry and Aeronautical Engineering Education at ETSID

E. Ballester Sarrias

Director

School of Design Engineering ETSID

Valencia, Spain

E-mail: eballest@isa.upv.es

L.M. Sánchez Ruiz¹

Vice Dean

School of Design Engineering ETSID

Valencia, Spain

E-mail: lmsr@mat.upv.es

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INTRODUCTION

This paper presents the experience of the School of Design Engineering ETSID, at Universitat Politècnica de València (Spain), to create a strong collaboration between university and industry, within the degree of Aeronautical Engineering.

With this in mind, when ETSID implemented the BEng in Aeronautical Engineering, we planned a number of actions to incorporate the industry's knowledge into the curriculum of this degree.

One of the first actions taken was to include a subject called "Fundamentals of Aeronautical Engineering", in which professionals gave weekly presentations to the students in order to share their knowledge and expertise.

Another, more classical way of closing the gap between education and industry is by means of industry internships. In this regard, ETSID has established a number of agreements with companies to allow its students to take part in internships. These companies include Air Nostrum, AENA, Airports, etc.

A key point in the creation of the curriculum was the advice and support given by the Association of Aeronautical Engineers of the Valencian Region, which has

¹ Corresponding Author
L.M. Sánchez-Ruiz
LMSR@mat.upv.es

approximately 100 members. From the very beginning, this association has offered us its expertise, and some of its members have even given lectures on subjects such as “Airports”, while they were actually in charge of managing specific airports.

Clearly, all these activities require proper financial support. With this in mind, we have been looking for companies related to the aeronautical field that can provide funding through the programme “Cátedras de Empresa” (Company Chairs). This programme allows to cover expenses such as travel costs to attend conferences, as well as travel costs for students and professors to visit companies, often located within a of 100 km range, but also other companies located further away (Toulouse). The companies with which we collaborate through the “Company Chair” programme also provided us aeronautical equipment, industrial placements, lectures and annual awards to outstanding students.

1. Subject: Introduction to Aeronautical Engineering

The main goal of the subject “Introduction to Aeronautical Engineering” [1] is to offer first-year students an overview of the different fields included under Aeronautical Engineering, that is, the many different situations and jobs where students can apply knowledge that they will be acquiring at the University throughout their study plan. A large part of this information is offered through lectures given by different R&D professionals who are members of companies, Institutes or Universities devoted to Aeronautics, or which work with Aeronautical Engineers.

In order to introduce students to the different branches of the industry, this subject is divided into four main blocks or units: Aircraft and Aerospace Vehicles; Aerospace Propulsion; Airports and Aerial Navigation, and Aeronautical Engineering Applications for the general industry (automobile, energy, marine, railways, etc).

The first block addresses aircraft design, certification tests, etc. Students are introduced to the concept of aerodynamics and to the forces involved in flying, through lectures provided by companies that work in this field, such as Rolls Royce, Boeing, Eurocopter, VKI (aircraft).

The Propulsion block provides a description of the main Aeronautical Engineering propulsion plants, including an explanation of their architecture and operating principles. Maintenance and certification topics are also addressed. The companies Rolls Royce, ITP and VKI (propulsion) are highlighted.

The block on Airports and Aerial Navigation defines the main characteristics of airports and airfields: their design, organisation and exploitation. This unit also presents the basic principles of aerial navigation, and the organisation and management of the air space. Here we can mention the contributions made by ESA (European Space Agency) and AENA.

The last block provides information on aeronautics and its relationship to different industries, not specifically aeronautical, such as the automobile industry, renewable energies, etc. In this area we must highlight the contribution made by lecturers from Comet S.A, the Universidad Politécnica de Madrid (UPM) and Thermal Engines Centre at UPV.

To reinforce the basic knowledge of the students, before each lecture, classes are taught on the basic concepts of aircraft flight, and on how to manage and organise organisation aerial navigation.

Finally, it should be noted that, during this course, the students visit aeronautical facilities to provide them with a first hands-on contact with aircraft and their propulsion, so as to establish a link between what is being studied and its corresponding profession (the career future) [2].

1.1. Lectures and events

Here is a list of the lecturers and the companies they work for, as well as the topics of the lectures.

- Air Force; Colonel Felipe Ramajo (Aero. Eng.) “Skills of Aeronautical Engineers within the Military”.
- ITP; Alfredo López Díez (Aero. Eng.); “Aircraft Propulsion Design”.
- Cessna, Sergio López (Aero. Eng.); “Maintenance and Characteristics of Executive Aircraft”.
- Air Europa; Miguel Puig Prohens (Aero. Eng.); “Organising Fleet Maintenance”.
- Boeing; Eduardo Carrillo de Albornoz-Braojos (Director, Boeing Europe); “Boeing in the Aeronautical Industry and Europe”.
- Air Nostrum; Juan Diaz Palacios (Aero. Eng.); “Maintenance in Civilian Aviation”.
- Comet S.A.; José María Nieto (Industrial Eng.) “Research and Development in the Field of Aeronautics”.
- AENA, Juaquin Llop (Aero. Eng.); “Aerial Navigation and Airport Operation”.
- UPM, Gregorio López Juste (PhD., Aero. Eng.); “Introduction to Aeronautical Engineering”.
- ESA (European Space Agency), Julián Santiago Prowald (PhD., Aero. Eng.); “Solar Sails and the Organisation of Satellite Communication”.
- Aeronautical Engineers Association, Fermín Tirado (Aero. Eng.); “Professional Skills of Aeronautical Engineers”.
- Rolls Royce, Antonio Guijarro Valencia (Aero. Eng.); “Gas Turbine Design”.
- Inaer, Jorge Arnas and Aurelio González; “Design and Explanation of Helicopter Operation”.
- Defence (Air Force), Colonel Felipe Ramajo, (Aero. Eng.); “Military Aviation”.
- VKI (Von Karman Institute), Guillermo Paniagua (Industrial Eng.), “The Future of Propulsion in Aeronautics”.
- UPM, Álvaro Cuerva (PhD., Aero. Eng.), “Wind Energy”.

We also had the following lecturers:

- Pedro Duque: Aeronautical Engineer and first Spanish astronaut. In October of 2011, Mr. Duque returned to the European Space Agency after taking a special leave. He has resumed his position as an astronaut, and is currently Head of the Flight Operations Office, with responsibilities over European activities in the International Space Station.

- Angel Villalba: Aeronautical Engineer and Representative of the Maestranza Airbase for implementing the Maintenance of the EF2000 (Eurofighter); he is a member of the work group that obtained the ISO 9002 Certificate (PECAL 120) for the Maestranza Airbase.
- Aurelio Martínez: Aeronautical Engineer and Manager of INAER Maintenance, a position he combines with that of Technical Director of INAER Helicópteros
- Ivan Tejada: Aeronautical Engineer and Master's in Airport Systems and in Business Management. He joined Aena as Director of the Madrid/Cuatro Vientos airport, and has been Director of the Valencia Airport since September, 2001. He was awarded the Cross of the Order of Merit of the Guardia Civil, with White Distinction.
- Marcelo Casenove: Degrees in Physics and Mathematics, Manager of the CESSNA project in Valencia.
- Eduardo Carrillo De Albornoz Braojos: Degree in Business, Director of Resources and Technology of BOEING ESPAÑA.
- Francisco Manuel Martínez Fadrique: Aeronautical Engineer, currently Director of Technical Integration, trying to provide a generic integral solution to land control systems. Its most immediate client is the National Plan for the Observation of Earth, which implements the Spanish satellites Ingenio and Paz.

1.2. Visits made during the course

Maestranza Airbase, Albacete. Here the students become acquainted with different types of aircraft, including the famous autogyro, several helicopters, and seaplanes. They also get a first-hand overview of the maintenance of the most modern combat aircraft. Thanks to the diversity of craft, this visit sets an important differential basis on the design of each plane with regard to its requirements. At the airbase, students are explained the uses for each aircraft and how the maintenance is conducted.

Air Nostrum Maintenance Facilities (Valencia). With this visit, students are exposed to a type of airplane and maintenance which is not available in Albacete. Here they observe medium-range commercial airplanes, and they analyse how maintenance is conducted for this type of fleet, which normally differs from a military fleet, due to the different uses and requirements.

2. Relationships with companies from the Aeronautical Industry

The programme in Aeronautical Engineering started eight years ago at the Universitat Politècnica de Valencia, and the School of Design Engineering (ETSID), was put in charge of implementing it.

Since then, various actions have been taken to approach an industry sector with which there were no professional ties, in order to facilitate our graduates' employability.

The actions developed to establish and consolidate these ties are:

- **Company internships**

The school has entered agreements with several entities, both inside and outside the Valencian Region. All internships imply a salary averaging 740 €/month. The

collaborating companies include Aena, Air Nostrum, Airbus, Airbus Military, Cassidian, Comet Ingeniería, Eads, Eurocopter España, Indra Sistemas, and Urjato, among others. Internships are not mandatory, and during their work experience with the companies, students apply to real situations the knowledge they have acquired throughout their studies. After this internship period, at least 70% of the students are hired by the company.

- **Company Chairs**

The company Chairs [3] were created to establish a wide and well-qualified collaboration with companies to develop objectives in the areas of teaching, research, and transfer of technology and knowledge.

The companies we collaborate with through “company chairs” also provided us with aeronautical materials, stays at their institutions, personnel who collaborate with the instructional activities, and awards to the top students in each graduating class.

The Chairs are endowed with 30,000 euros a year, and to insure a proper monitoring of their activities, a Monitoring Committee has been established, formed by University and company members.

Two chairs have been established with companies from the aeronautical sector:

Air Nostrum Chair

The objective of the Air Nostrum Chair is to carry out joint activities that focus on the field of Aeronautics, such as training activities, graduating projects, encouraging scientific research activities, exchange of experts and social promotion through ETSID.

The Air Nostrum company started collaborating in 2005, and the activities financed by the Chair's endowment [4] of 30,000 euros/year, over 4 years, include the Air Nostrum Classroom, lectures by professionals in the sector, student visits to aeronautical facilities such as airports (AENA), companies such as IBERIA, institutions like INTA (National Institute of Aerospace Technology), and travel abroad (Aeronautics Trade Fairs like Le Bourget and ILA Berlin).

This Chair has financed attendance to the Employment Forum and has granted Academic Excellence Awards.

It has also sponsored some lectures given by professors from the Universidad Politécnica de Madrid.

Eurocopter Chair

The goal of the Eurocopter Chair is to promote and develop collaboration activities between Eurocopter and the Universidad Politécnica de Valencia, in order to encourage privileged relationships with the Schools that train young professionals who are attractive to Eurocopter on account of their knowledge and potential, and to establish Research and Development partnerships.

The Eurocopter company, which is part of the helicopter manufacturing division of the EADS group, has maintained a chair with ETSID since 2008. Through this chair, the Eurocopter Classroom has been fitted with computer equipment, and the Chair has also collaborated with the Academic Excellence Award to the outstanding student, with the Employment Forum, and it has endowed an incentive programme for internships at the Eurocopter Company.

In addition to the collaboration of private companies, ETSID entered a “partnership” with the Spanish Army and Air Force, which has made available to students materials that are difficult to access, such as a Mirage F1, a BO 105 helicopter, and an Atar 9K, to study them in different laboratories belonging or linked to ETSID. We have also had opportunities to visit military facilities, where students get direct access to materials and projects developed by Aeronautical Engineers within the Armed Forces.

- **Academic Excellence Awards**

Every year since the first Aeronautical Engineering graduating class, outstanding students have been given awards. These awards are presented by companies such as Boeing, Eads, Airbus, Eurocopter, Iberia, Aena, Itp, Ineco, Gmv, and Air Nostrum. In most cases, the awards carry a purse ranging from 1,000 to 2,000 euros.

- **Employment Forum**

The Employment Forum of the Universitat Politècnica has been taking place for the past 13 years. At this event the participating companies have stands where they can collect the CVs of interested students. The participating companies also provide technical lectures and presentations. The companies which have participated in the different editions are Eurocopter, Air Nostrum, Eads, Ineco, Gmv, Avialsa, and Inaer.

- **Lectures**

Various lectures have been organised during these years, delivered by leading professionals in the field.

ETSID's relationship with the aeronautical industry does not solely involve receiving, but also providing quality aeronautical education and research, both nationally and internationally. Our standards have been recognised by prestigious entities such as PEGASUS [5] (Partnership of a European Group of Aeronautics and Space UniversitieS), which allows establishing partnerships with leading companies to carry out internships and projects. As an example, AIRBUS offers approximately 50 jobs per year to students from the PEGASUS universities, after their fourth year of studies.

- **Student Travel**

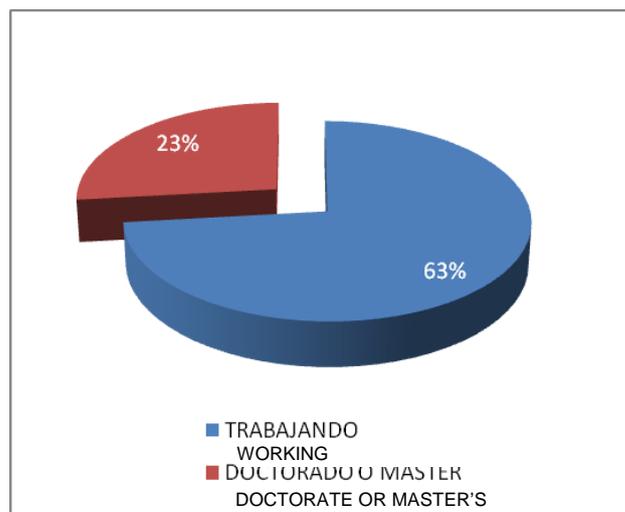
Students have been given the opportunity to visit aeronautical companies such as AIRBUS in Toulouse, Eurocopter or Aernnova, Eads in Getafe, Air Nostrum in Valencia, as well as attend International Trade Fairs such as Le Bourget in Paris and ILA in Berlín, and visit different airport facilities in Valencia, Castellón and Alicante, the airbase in Torrejón (Madrid), Maestranza in Albacete, and Ala 12 of the Air Force (Madrid) [6], all of which has meant for ETSID a cost of approximately 16,000 euros.

- **Access to the Job Market**

Thanks to all the activities detailed above [7], the employability results for the first three graduating classes are as follows:

First graduating class: 25 graduates

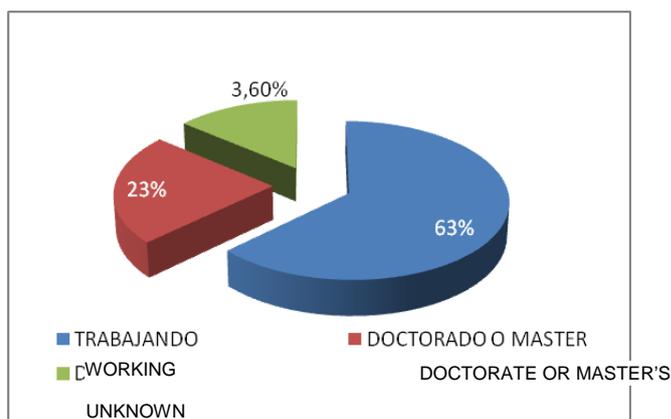
Of which 22 are working and 3 are pursuing Master's programmes. None of them are unemployed. 80% of recent graduates are carrying out their professional activity in Spain and 20% abroad (France, Italy, Belgium, Germany, etc.).



The companies where they are carrying out their professional activity are: Air Nostrum, Eurocopter, Islair, Elitecnica, Altran, Airbus, Airbus Military, Augusta Wesland, Airtech Levante, Hispasat, Accenture, Eads, Alten, Cesna, Inaer, Airtech Levante, and Consellería (the Valencian Regional Government).

Second graduating class: 55 graduates.

Of which 42 are working, 20 are pursuing Master's or Doctoral programmes, and 2 are unemployed. 50% are carrying out their professional activity in Spain, and the other 50% in countries such as: United Kingdom, United States, France, Germany and Belgium.

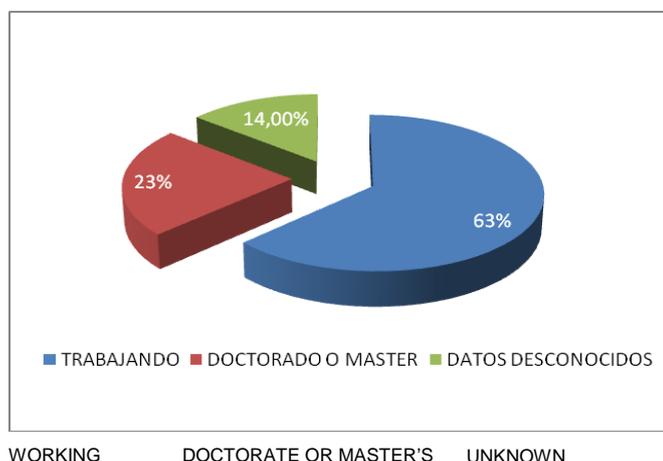


The companies where they are carrying out their professional activity are: Airbus, Aka, Rolls Royce, Altran Belux, Grupo Santander, Asisten, Safran Engineering Services, Aeronova, Aertec Ingeniería Y Desarrollo, Aertec Ingeniería Y Desarrollo, F. Iniciativas, Airbus Military, Eads, Sogeti High Tech, Tisat, Airnova, Aribus Military, Latecis, Bertrandt, Alestis, Cesa, Grupo Tam, Ta Espejo, Iberia, Gmv Aerospace And Defence, Inocsa (Aecom), Aertec, and Fligtech.

The Universities or Technology Institutes where they are broadening their studies include: Oxford University, Cranfield University, Von Karman Institute-Belgium, Brunel University (London), and Montana State University (United States).

Third graduating class: 77 graduates

In this case, less data is available than for the previous classes because this is the last graduating class. The available data shows that 48 graduates are working, 18 are pursuing doctoral or Master's studies, and no data is available for 11 graduates, who may be looking for employment. The geographical distribution of graduates who are working is as follows: 50% are working in Spain, and 50% are working abroad, in countries such as France, United States, United Kingdom, and Germany.



The companies where these recent graduates are working are: Airbus, Aernova, Cemes, Ekes, Airbus Military, Alten, Air Nostrum, Altran, Heathrow Airport, Eurocopter, Cluster Aeronáutico Comunidad Valenciana, Privium. S.L., Real Aero Club Leon, Eads, Iberia, Simon-Kucher & Partners, Rolls Royce, Cesna, Airbus Operation S.L., and Geci Levante.

The universities where they are furthering their studies are: U. of Maryland College Park, Universidad Autónoma de Barcelona, Universitat Politècnica de Valencia, Cranfield University, and Von Karman Institute (Belgium).

Within the framework of the current economic situation and the increase of unemployment in Spain, the level of employment obtained by our students can be considered a success. This is thanks to the actions undertaken over these past eight years [8], and to the students' high level of training, as it is proven by the fact that multinational corporations such as EADS are conducting personnel selection campaigns at our School.

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