

FRENCH-GERMAN INTEGRATED STUDIES AT THE DEPARTMENT OF AEROSPACE ENGINEERING OF THE UNIVERSITY OF STUTTGART, GERMANY

Jan Osburg
osburg@irs.uni-stuttgart.de
Institute of Space Systems,
Department of Aerospace Engineering,
University of Stuttgart, Germany

Manfred Zippel
zippel@ila.uni-stuttgart.de
Institute of Propulsion,
Department of Aerospace Engineering,
University of Stuttgart, Germany

Prof. Dr. Ernst Messerschmid
Ernst.Messerschmid@esa.int
Head,
European Astronaut Centre,
Cologne, Germany

Structural change in the European aerospace industry is causing an increase in European cooperation projects. Young engineers are therefore more and more expected to have international experience. At the same time, most companies prefer graduates that have finished their studies in minimum time. This paper describes how these conflicting requirements were integrated into an innovative "French-German Integrated Studies" programme between the Department of Aerospace Engineering of the University of Stuttgart, Germany, and the elite French aerospace engineering schools "Ecole Nationale Supérieure de l'Aéronautique et de l'Espace" (ENSAE) and "Ecole Nationale Supérieure d'Ingénieurs de Constructions Aéronautiques" (ENSICA), located in Toulouse. This programme permits participating French and German students of aerospace engineering to gain experience abroad without delaying their graduation, and it has been in successful operation since its inception in 1990. The Integrated Studies programme is based on this straightforward concept: French and German students spend their last year of graduate studies at one of the participating universities, and the academic credits they obtain during this year – including their thesis – are applied towards the degree of their home institution. Tight organizational cooperation and a thorough preparation of each individual stay provide the foundation for this unbureaucratic approach.

INTRODUCTION

Structural change in the European aerospace industry is leading to more and more multinational mergers, partnerships, and European cooperation projects. Young engineers are therefore increasingly expected to have international experience. At the same time, most companies prefer graduates that

have finished their studies in minimum time – of course, while maintaining the highest standards of education.

This paper describes how these conflicting requirements for European engineers of the 21st century were integrated into an innovative "French-German Integrated Studies" programme between the Department of Aerospace Engineering of the University of Stuttgart, Germany, and the elite French aerospace engineering schools "Ecole Nationale Supérieure de l'Aéronautique et de l'Espace" (ENSAE) and "Ecole Nationale Supérieure d'Ingénieurs de Constructions Aéronautiques" (ENSICA), located in Toulouse (Figure 1).

Copyright Notice:

Copyright © 2001 by the authors. Published by the American Institute of Aeronautics and Astronautics, Inc., with permission. Released to IAF/IAA/AIAA to publish in all forms.



Figure 1: The French-German Integrated Studies programme in the European environment

This programme permits participating French and German students of aerospace engineering to gain experience abroad without delaying their graduation, and it has been in operation since 1990. Its success paved the way for study-abroad plans like the new “European Credit Transfer System¹” (ECTS), assuring students studying abroad that their efforts will be endorsed by their home university and can be applied towards their degree studies there.

Equivalence vs. Double Degrees

Frequently, in the context of study-abroad programmes, the issue is raised whether awarding two degrees, e.g. a German engineering degree along with a French one, is necessary or even desirable for an international career. In general, the answer is “no” to both questions, as mutual recognition of university degrees has already been codified in Europe through the Treaties of Rome, as early as 1957². Quality of education is assured – and recognized – by mutual accord, as the freedom of education and of migration of workers has been prioritised in Europe from the beginning.

The concept of an open job market also plays an important role when discussing European economic development, thus enabling French and German engineers to work in either country without additional educational or licensing requirements.

Fulfilling requirements for a entire second degree thus only serves to increase the duration of studies.

Different Approaches to Engineering Education in France and Germany

On the other hand, international cooperation in industry, research and science demands that university graduates have already spent some time abroad during their studies, to experience different cultures, educational systems, and ways of cooperation in companies and universities.

Engineering education in France presents an interesting alternative to the German system. French engineering students start their academic career with two years of laborious basic courses in mathematics and physics, leading to a rigorous nationwide competitive test that determines further placement. The following three years are spent at one of the “Grandes Ecoles”, national engineering schools with a tightly regulated, demanding curriculum that are completely separate from the French university system. This approach combines a thorough education in the basics with custom-tailored education in engineering specializations.

German universities implement a different concept. While engineering students traditionally have a more structured plan of lectures than e.g. students of humanities or of

science, compared to their French colleagues they are much more autonomous in the long- and mid-term arranging of their studies as well as in selecting lectures and examinations.

Interestingly, these different approaches are perceived as positive by exchange students of each respective other country. French students often have initial difficulties adjusting to the large amount of information gathering and decision-making required by the relative freedom of the German university system, but appreciate the resulting autonomy. German students in France must deal with the short-term challenge of high class loads and frequent examinations, but appreciate the resulting efficiency and intensity of education. First-hand experience of a different educational system therefore has a high value in building intercultural understanding as well as in professional education.

Close cooperation within the European aerospace industry (which ultimately led to the mergers of national companies in the late 1990's), as well as suppliers being active in different countries, demands engineers that can work and communicate on an international level. As early as the 1970's, the Department of Aerospace Engineering of the University of Stuttgart had therefore instituted a first study-abroad programme that consisted of students working on their Masters' thesis at French institutions like the "Office National d'Etudes et de Recherches Aérospatiales" (ONERA), the "Grandes Ecoles" mentioned above, or industry. However, in order to really get to know a host country, a longer stay was considered desirable. This was one of the reasons why the "French-German Integrated Studies" programme that will subsequently be presented was developed.

INTEGRATED STUDIES: CONCEPT

Objectives

Students participating in the Integrated Studies programme spend one year at the French or German host institution, respectively. Academic credits acquired abroad

– including examinations, project work, and their Masters' thesis – are accepted by their home institution.

Participants are awarded the regular degree of their home institution, along with a certificate of participation in the Integrated Studies programme. To assure adequate academic performance of participants, applicants are selected according to the number of their exams completed and grades achieved, their motivation, and their language as well as social skills.

Educational Schedule in Germany and France

The educational schedule in Germany and France is different. Any standardized exchange programme must therefore adapt in order to enable efficient studies (Figure 2).

French students of aerospace engineering, after obtaining their high school diploma equivalent ("Baccalaureat"), spend two years in so-called preparatory classes, and study for the subsequent three years until their graduation at a so-called National School. Participants of the Integrated Studies programme only spend the first two of those three years there, receiving a basic education in engineering, and then deepen their knowledge in an area of specialization at the Aerospace Department of the University of Stuttgart, where they also work on their Masters' thesis. They receive a transcript stating the examinations they have taken along with the associated results, and return to their home institution (ENSAE or ENSICA) for graduation.

Participants from Stuttgart, after finishing college-preparatory high school with the "Abitur", study aerospace-specific engineering basics for two years, after which period they usually receive the "Vordiplom", a certificate of having successfully completed the first part of the academic curriculum. They subsequently spend five months with an aerospace company during their mandatory internship. This rather long internship, as compared to the usual one- or two-month programmes provided for in other engineering

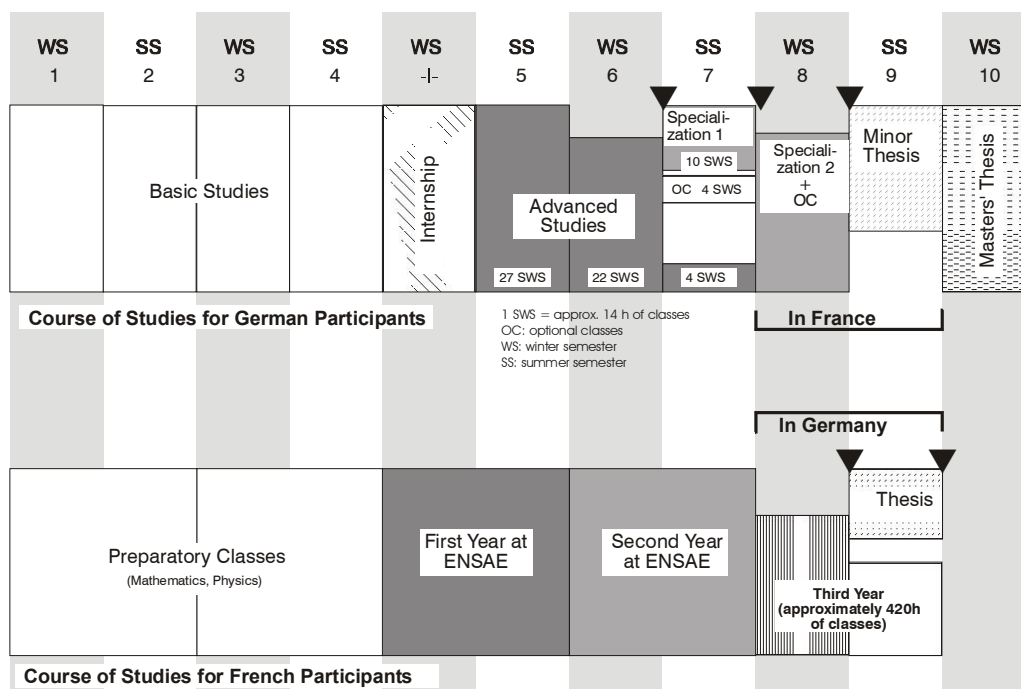


Figure 2: Academic schedule and curriculum structure in French and German engineering studies

curricula, enables students to get first – supervised – work experience as an employed aerospace engineer, domestically or abroad. It also offers better planning efficiency for hosting companies when compared with a sequence of short internships wedged in between regular classes.

The second part of the curriculum, after the return from the internship, continues with one year of lectures on the theoretical foundations and practical applications of aerospace-related science and technology. This lays the groundwork for the subsequent year of specialisation in one theoretical and one applied field (Table 1).

The first specialisation is taken in Stuttgart, the second one – including the first of the two required theses – at one of the host institutions in France. After their return from France, participants complete their Masters' thesis ("Diplomarbeit") and then receive their

engineering degree (Master-of-Science equivalent).

Comparison With Other Exchange Programmes

The Integrated Studies programme has been instituted in 1990, and has been in successful operation ever since. Its main advantage is that it leaves the specific structures of national academic systems intact for the participating students to experience, and does not affect the duration of studies, i.e. the participating students' graduation date.

Compared to an exchange duration of six months, as with the regular SOCRATES/ERASMUS-funded "thesis abroad" scheme, a full one-year stay abroad allows participants to experience the host country to a much higher degree, to get to know more of their host-nation colleagues, and to perform both research for their thesis and take classes. Participants also improve their options when

choosing specializations, as they can take classes that are not offered at their home institution.

Table 1: Specializations offered by the Department of Aerospace Engineering of the University of Stuttgart

Foundations	Applications
Structures	Aircraft Design
Fluid Dynamics	Propulsion
Thermodynamics	Space Systems
Flight Mechanics and Control	Information Technologies

The “double degrees” offered by some other exchange programmes lead to a significant delay in graduation – often by more than a year – and create the erroneous impression among less informed students and recruiters that national degrees are not recognized throughout Europe, thus necessitating a second (or third, or ...) degree. This is in direct contradiction of the spirit of European unification.

DESCRIPTION OF PARTICIPATING UNIVERSITIES/SCHOOLS

ENSAE

The “Ecole Nationale Supérieure de l’Aéronautique et de l’Espace¹” (ENSAE) was founded in Paris in 1909 as an elite educational institution for aircraft design. It was transformed into a national school in 1930, and transferred to Toulouse in 1968 along with many other aerospace-related institutions and activities of French government and industry.

In 1972, its space research and education component was officially acknowledged by changing the name to its current form. Unofficially, ENSAE is also known as “SupAero”.

ENSAE today offers a three-year aerospace engineering curriculum to approximately 150

students annually. Together with Masters’ and PhD students, ENSAE’s student body comprises approximately 600 French and foreign students, some of them active-duty military officers. The school cooperates closely with the associated ENSAE Research Centre (“Centre des Etudes et de Recherches de l’ENSAE à Toulouse”, CERT), located in close proximity to its campus.

ENSICA

The “Ecole Nationale Supérieure d’Ingénieurs de Constructions Aéronautiques⁴” (ENSICA) was founded in Paris in 1945 and moved to Toulouse in 1961. Since 1979, it is a member of the prestigious circle of national schools. More than 60 ENSICA professors and lecturers from industry provide engineering education to approximately 400 students, 340 of which follow a three-year curriculum.

The school is located close to the downtown area of Toulouse, and cooperates closely in research and education with the adjacent “Centre d’Essais Aéronautiques de Toulouse” (CEAT).

University of Stuttgart (Department of Aerospace Engineering)

The University of Stuttgart⁵ is one of the largest scientific and engineering universities in Germany. Its almost 16 000 students are enrolled in the following 14 departments, where 5000 employees in 140 institutes work on research and education:

- ✧ Architecture and City Planning
- ✧ Civil Engineering and Geodesy
- ✧ Chemistry
- ✧ Electrical Engineering and Information Technology
- ✧ Power Technology
- ✧ Design and Manufacturing
- ✧ Earth Sciences and Biology
- ✧ History, Social Sciences and Economics
- ✧ Aerospace Engineering

- ✧ Mathematics
- ✧ Philosophy
- ✧ Physics
- ✧ Process Engineering and Cybernetics
- ✧ Computer Science

One of the departments is the only Department of Aerospace Engineering in the German university system. Over 1000 students go through a five-year curriculum leading to the academic degree of "Diplom-Ingenieur Luft- und Raumfahrttechnik" (equivalent to a Master of Science degree in Aerospace Engineering), and approximately 30 doctoral dissertations are submitted per year.

The department is composed of the following institutes:

- ✧ Institute of Fluid Dynamics
- ✧ Institute of Flight Mechanics and Control
- ✧ Institute of Aircraft Design
- ✧ Institute of Aircraft Propulsion
- ✧ Institute of Space Systems
- ✧ Institute of Aerospace Structures
- ✧ Institute of Aerospace Thermodynamics

Each institute offers in-depth specialisation for final-year students (cf. Table 1). It also performs extensive research in its area of specialization and is therefore fully equipped with laboratory facilities, workshops, wind tunnels, and other installations.

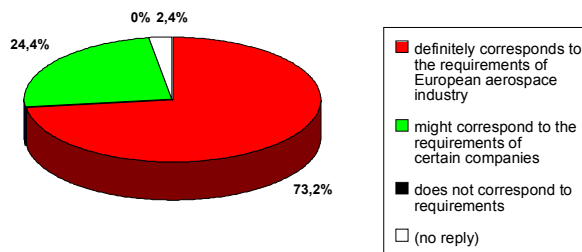
FEEDBACK FROM PARTICIPANTS AND INDUSTRY

Since its inception in 1990, the number of German students participating in the programme has stabilised at around five per year. The vast majority of returning participants gave very positive feedback, stating that their one-year study-abroad experience had been extremely valuable to them. Academic performance of participants abroad was above average, even when compared to their host-nation colleagues. One student even ranked at the top of his class. This validates the high standards for participant selection mentioned above.

On the French side, however, participation has been varying and generally less numerous. Most French students at the participating schools frequently prefer to spend their study-abroad time in the USA. One reason for that – apart from the language issue – seems to be that the structure and organization of US curricula, especially in aerospace engineering, is quite similar to that of the French schools. Non-academic issues present another reason for giving preference to participating in a study-abroad programme with the USA.

To evaluate actual job-market advantages of graduates having participated in the Integrated Studies programme, an acceptance study among corporate members of the German Association of Aerospace Companies

The French-German Integrated Studies Programme ...



Compared to a "regular" graduate, we would hire a French graduate who participated in the French-German Integrated Study Programme for a position with the...

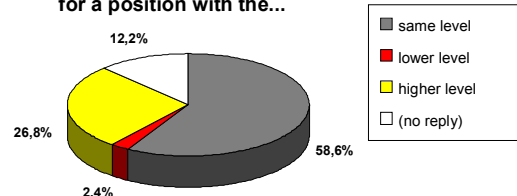


Figure 3: Results of a survey among German aerospace companies regarding the Integrated Studies programme

was performed soon after the programme was started. Responses solicited from over 80 company representatives confirmed the validity of the chosen approach (Figure 3).

OUTLOOK

The French-German Integrated Studies programme has been very successful throughout its more than ten years of existence with respect to academic results, successful participation, and participant satisfaction. However, some aspects must adapt to the dynamic development of structures and boundary conditions in the European (and global) aerospace industry. This issue is also of importance for universities that want to start similar programmes today.

An important issue in this context is the acceptance of an Integrated Studies programme. While German participants reported that industry as well as academia recognize the value of such a programme, some French graduates mentioned that their interviewers did not know about it. This experience shows the necessity of increasing the awareness about – and also the number of – programmes that do not require students to spend significant extra time to acquire a second degree.

Increased attractiveness of the programme could also be achieved through a stronger integration of potential employers of participants. A German aerospace company has already organized a one-week workshop for DFIS participants and alumni at one of their facilities on Lake Constance in 1999, offering lectures and practical exercises that demonstrated the challenges and rewards of working in an international environment. This provided first-hand experience with a potential future employer to the participating students. Hopefully, other aerospace companies will step forward with similar offers in the future.

An area in definite need of improvement concerns the amount of paperwork, forms, and legal documents to be tackled by

participants. While the amount of such bureaucracy is deliberately held at an absolute minimum within the “protected area” of the French-German Integrated Studies programme organization itself, the host universities’ general academic administrations as well as municipal and state offices still require a plethora of paperwork to be prepared and submitted by the students, a state which is seemingly unaffected by the notion of unlimited intra-European academic mobility.

Another area offering improvement is the expansion of the programme to include other European aerospace universities. Here, preference should be given to true partnerships between equally-rated academic programmes, while preserving the individual strengths of the host institutions’ academic systems.

SPACE STATION DESIGN WORKSHOP

In addition to the one-year “French-German Integrated Studies” programme presented above, the participating universities are cooperating in a second area in order to provide an opportunity for international experience to their students.

Every year, the Institute of Space Systems of the University of Stuttgart and the ENSAE offer one-week, hands-on design workshops where participating students from Germany and France can experience the conceptual design process of a space system. While ENSAE’s focus is on the design of a satellite, the Institute of Space Systems’ “Space Station Design Workshop” tasks the student design teams with conceptualizing a space station, starting with the proverbial blank sheet of paper, with subtopics ranging from overall configuration to launch an assembly to human integration issues.

Special emphasis is put on the latter issue. Therefore every year some of the participating students have a background in (terrestrial)



Figure 4: French and German students experiencing multinational teamwork at a “Space Station Design Workshop”, hosted by the Institute of Space Systems, Department of Aerospace Engineering, University of Stuttgart

architecture, thus making the workshop a truly interdisciplinary endeavour.

Main focus of the workshops is to teach important aspects of conceptual design and systems engineering through learning-by-doing. The workshop experience also offers insight into project-oriented cooperation in multinational and interdisciplinary design teams, as it is common practice in the European aerospace industry (Figure 4).

Additional experience gained by the participating students includes systems-level thinking, creativity, and social skills. English is used exclusively throughout the workshop. Participant feedback, which is systematically collected after each workshop, indicates that students consider participation in these workshops as being exceptionally beneficial.

SUMMARY

The “French-German Integrated Studies” programme between the French elite aerospace schools ENSAE and ENSICA, both located in Toulouse, and the Aerospace Department of the University of Stuttgart in Germany offers a one-year study-abroad experience to participating students, while avoiding delayed graduation.

A stable number of participants as well as a positive evaluation by industry on the German side confirm the validity of the chosen

approach, which deliberately steers clear of awarding a “double degree”.

Additional systems design workshops expand the opportunities for French-German student exchange and hands-on multinational experience.

REFERENCES

- 1 ECTS homepage, <http://europa.eu.int/comm/education/socrates/ects.html>
- 2 Treaty Establishing the European Community, Rome, Italy, 1957, http://europa.eu.int/eur-lex/en/treaties/dat/ec_cons_treaty_en.pdf (Consolidated Version, 1997)
- 3 ENSAE website, <http://www.supaero.fr/>
- 4 ENSICA website, <http://www.ensica.fr/>
- 5 University of Stuttgart website, <http://www.uni-stuttgart.de>
- 6 Department of Aerospace Engineering website, <http://www.uni-stuttgart.de/organisation/fakultaeten/lrt/institute/>
- 7 Space Station Design Workshop website, <http://www.irs.uni-stuttgart.de/SSDW>