ACARE Education Study
"What changes are needed in European Aerospace Engineering Education to assure the Quality of the Future Engineering Workforce?"
Editor: J.L. van Ingen, Study Coordinator, August 2004

Summary
An "Education Study" was performed on behalf of ACARE under the responsibility of the ASTERA consortium. The study provides the European Aeronautics sector with a view on the future educational needs of the stakeholders and the ways in which the education community could and should respond to these needs in order to meet the goals of Vision 2020. The present report summarizes the results of this study. The last chapter contains some concrete recommendations to ACARE for actions to be included in the Second Strategic Research Agenda.

Some statistics on the distribution of the questionnaire and the responses.

	Universities					Industry	Grand total
	Central Europe	Western Europe	Southern Europe	Northern Europe	Total Univ.		
Number sent out	21	29	14	25	89	50	139
Response rate (nr)	11	13	9	9	42	20	62
Response rate (%)	52	45	64	36	47	40	45

Recommendations to ACARE for subjects to be included in the Second Strategic Research Agenda The following recommendations are made by the Study Group in close co-operation with Drs.Adrian de Graaff who, in addition to being a member of the Study Group, is also rapporteur for ACARE Working Team 5 on "Research Infrastructure and Education".

Education
• Ensure that the demands for university graduates (both in qualitative and quantitative terms) are met by universities by creating a platform to address the issue.
• Improve life-long learning mechanisms.
• Implement mechanisms to measure the quality of the education through accreditation and student qualification. (At present I would put most emphasis on "quality assurance and reputation building" and avoid the word "accreditation" as much as possible)
• Improve the image of a career in the air transport sector by e.g.:
- Innovative teaching.
- Regional Science labs at universities, in museums and industry to serve schools in their region.
- Open days at universities, research labs and industry.
- Advocating aerospace education as exciting and giving access to a great variety of jobs, also in other non-aerospace industrial sectors.
- Greater visibility of the industry and its exciting projects in the media.
- Ensuring access to emerging technologies and to large-scale validation facilities.
- Improving mobility by exploiting the existing EU mobility programmes.

The focus of the first study was on academic education. It is recommended to perform a similar study on education at technical schools.

The most important stakeholder reactions to the future needs in education contents can be summarized as follows:

- **University education** and its alignment to the technology supply chain requirements is generally good but the depth of course contents needs to increase. However it should be realized that the universities are restricted in the number of years their curricula are allowed to take. Therefore there is always the problem: if subject "x" comes in, some subject "y" should go out.

- Particular emphasis is placed on **general skills** such as physics, engineering mechanics, materials and manufacturing, engineering fluid mechanics and control theory.

- The airframe, engine and equipment sectors see high relevance for certain subjects, which ultimately may lead to **curricula specialized towards sector requirements**. (But then the question is how many jobs industry would guarantee for graduates from these specialized curricula. If the number would be small, it is always possible to compose a special curriculum for individual students that then could be sponsored by the company that requested this specialist. The responsibility of the university is to provide the curriculum that best suits the majority of their students).

- There will be an increasing requirement for **computer literacy** combined with sound engineering judgment among graduates.

- There is a trend to hire **general engineers** in multinational aerospace firms, which can transfer to other sectors easily.

- Good knowledge of **English** - and increasingly **Russian** - is important.

- From the responses by private stakeholders to the information gathering exercise, it became also apparent that more emphasis is needed in the curricula on design, maintenance, repair and overhaul knowledge (MRO). (Is an inventory available of the required number?)

- The sector also demands more multi-discipline oriented people that are solution (result) oriented, are well acquainted with IT-technologies, have excellent communication skills and experience in working in a (virtual) environment with a multicultural team, are flexible, have a knowledge sharing and a knowledge "teleshopping" mentality. The future staff is expected to have knowledge of management skills, has creative and conceptual capabilities and is capable of adapting changes in the (working) environment.

- It should also be stressed that curricula should contain the latest (??) knowledge gained in research. A positive feedback from research into education should always be accomplished. (Yes, but this latest knowledge has to be filtered by the universities and only gradually be included in the curriculum. Also here it is always possible to let a Master student do his thesis in close cooperation with the researcher that provided this "latest knowledge").

- Some universities have already reacted on these developments by providing students practical design team experience and courses in management and economics.

• The analysis shows that concrete action should be taken:

- Create a (**permanent) platform** where university representatives (e.g. PEGASUS) and a representation of universities not involved in PEGASUS but part of EASN) and the demand side (e.g. AECMA (name changed later), EREA) should meet at regular intervals to exchange views on the requested developments of the curricula at universities. Such a platform could be supported through an accompanying measure of the European Commission.

- Stimulate the improved **relationship and interaction between the market and education** by:

- Improving **mobility** of staff and recruits.

- Providing multicultural **team experience** during the post initial study period, for example through design team exercises at universities. A possible solution could be to set up a **"European design academy"** as a joint partnership between the demand side and education

to give students design experience and stimulate creativity as a team process. (At least industry should provide and help in tutoring design projects for students).

In order to provide young students with some experience in the sector, the "**ECATA junior**" programme should be revitalized and should receive some funding from public sources in order to guarantee continuity of the programme.

- Ensure **exchange of students** and promote networking by providing public financial support to student's societies (EUROAVIA) (Much to my regret I have the impression that EUROAVIA is not very much alive anymore. What happened?).

- Ensure that education can benefit from **advanced IT-means**, like virtual reality design.

Life-long learning

• Improve life-long learning opportunities.

• Create opportunities for **young employees** with a limited working experience to gain knowledge about business management (ECATA - European Aerospace Business Integration Programme), by providing multinational team projects in industry and research centers. ECATA is depending on the willingness of industries for contributions: a system of public/private partnership on training should be introduced to guarantee continuity.

• Better advertise the opportunities created by the European Commission in the Framework Programmes to stimulate personal professional training and create a **central point of contact** to promote these opportunities for the aeronautical sector, for instance at the

AECMA office. (The co-location of the AECMA-, EREA-, and EASN offices in Brussels would be beneficial). Funding for such an activity could come from the Commission, industry and EREA. The European Commission promotes via its Marie Curie programme both individual driven actions, company driven actions, research team promotion, etc.

• Current training in industry is by 50% undertaken internally and 50% externally. Training is by a vast majority of a technical nature.

• Promote life-long learning by creating **distant education opportunities**. It is recommended to closely analyze the US experience as could be shown in a benchmark activity. (At present there is much attention for e-learning. If not yet done so, PEGASUS should be involved in this. Let the best European teacher for a given subject develop such a course. In my opinion such an internet course should always be followed by a face-to-face meeting between students and teacher, e.g. in a week during the summer. Where relevant this could include lab work at the university with the best equipment for that subject.)

• Create opportunities for business management training.

• Provide European Community grants to **professional development** programs at private schools in the aerospace industry, like EURESAS.

Quality issues of education

The quality issues of the education and **accreditation of universities** has been a long debated issue. Numerous initiatives, like those within PEGASUS and the European Credit Transfer System (ECTS) have been taken to compare education standards in different places. It may still take a long time to reach a European education accreditation system, that would have a legal status. It is recommended to implement a **voluntary accreditation system** for aeronautical education recognizing the diversity of the national education systems. The specific criteria for such a voluntary accreditation could be developed in co-operation between universities and aeronautical societies and organizations (CEAS members, AECMA, EREA, PEGASUS, etc.). The set-up of such a system − that could serve as a European pilot project for accreditation − could be sponsored by the European Commission.

(For quite some time the European aerospace community should avoid to become involved in a legal struggle about a Europe wide accreditation system. European countries are too diverse to reach an agreement in a reasonable time. Let us mind our own business and concentrate on

Student qualification

It is envisaged that university education will be highly **individualized**. In continental Europe, this could lead to a system of "dossier diplomas", showing the type of courses and activities the graduate has followed during his education. However, such a "dossier" approach may not be compatible with the UK-system of "chartered engineers". Further study in this domain seems therefore needed.

The aeronautical image

Currently, the overall number of graduates recruited to the industry is going down. There is an increasing number of recruits that are hired from outside the EU. The vast majority of new recruits are male.

The demographic development in Europe, the reduced interest of young people in science and technology and the competition between the aeronautical sector and other technological sectors in Europe, may severely reduce the number of young European university graduates that will **choose a career in aeronautics**. Aeronautics is still regarded as a challenge in some European countries like France, but in others (including the UK) aeronautics has no special interest. Therefor a number of actions are needed:

- To create the interest for aeronautics of **young people** at primary and secondary school. This could be done e.g. by advertising on TV focused on young people, by creating interesting documentaries, by using air shows to advertise the benefits of aeronautical education, by creating **regional science labs** as done by DLR, etc.

- To create **AWARDS** for excellence in education and to give them adequate press coverage.

- To improve the image of an aeronautical career by displaying the **advantages** in professional life.

In the different countries, experience has been gained in promoting aeronautics but **no best practice mechanism exists**. The European Commission funds a programme on Science and Society that should be used as a mechanism to perform best practice studies. It is proposed to take action along this line. It is recommended that the Commission services of DG Research responsible for the aeronautics programme should also be more supportive in this respect.

ACARE Study Support in the frame of ASTERA2
Developing a voluntary European accreditation system
for higher education in aerospace engineering
Final Report WP210_5
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<u>**Executive Summary**</u>
Based on the earlier ASTERA "Education Study" the ACARE Strategic Research Agenda 2 (SRA-2, 2004) recommended performing an "Accreditation Study" that should lead to a voluntary accreditation system for higher education in Aerospace Engineering in Europe. This recommendation has been followed up with the present study, which has been carried out within the frame of the ASTERA-2 Specific Support Action, "Aeronautical Stakeholders' Tool for the European Research Agenda".

The main conclusions and recommendations are presented in this Executive Summary Report. Further actions by ACARE on these recommendations are urgently requested. It is believed that these will make an essential contribution to the realization of Vision 2020.

<u>The main conclusions are:</u>
1. The EU countries have at present their own, sometimes quite different, legal accreditation systems.

2. The European governments have in their declarations in Bologna and Lisbon agreed to increase their inputs into the "knowledge society" and as a result of that also to strive for a "European Higher Education Area" (EHEA).

3. The EHEA should, among others, work on quality assurance in all its forms, including accreditation. Various "Communiqués" of the European Ministers of Education have been issued after Bologna and Lisbon (Berlin, Bergen) It should be emphasized that the Working Group, when using the term "quality", always refers to "increasing excellence", excellence being the basis (whether for institutions or programmes) for further consideration.

4. The ministers have asked the ENQA (European Network (now Association) for Quality Assurance; devoted to higher education in general) to develop a harmonized set of criteria and procedures for quality assurance in Europe. An overwhelming number of reports by ENQA are already available. The first conclusion to be drawn however is that this process of European harmonization will be "long and arduous" because it is to be expected that several countries will not easily give up their own systems (often having a long history). (YES!!)

5. The Working Group therefore is of the opinion that stakeholders in the European Aerospace community should not wait for such a harmonized official European system but should fulfil an "avant-garde" role by taking the initiative for a voluntary system for quality improvement, quality control (note that already here we avoided the word "accreditation") and thus playing an active role in the European accreditation system to come. (At present I would not have used the words "active role").

6. The European aerospace community should refrain from interfering with the various national legal systems and the coming European legal debates on future developments. These should be closely followed and the results used where possible, but otherwise the initiative should be left to ENQA.

<u>The Working Group therefore recommends:</u>
1. To start immediately a follow-up study as a three year EU project under a Specific Support Action in FP7. This project should have three main objectives.
a) To follow the various European developments on quality control and accreditation and advise on further actions to be taken towards a voluntary system for accreditation in due

time, eventually leading to a full-fledged European system.(Again: refrain from accreditation. The following point b) might be taken up first)

b) To organize (e.g.) three yearly conferences on the subject of quality assurance in a broad sense, covering the vocational-, bachelor- and master level, reviewing best practices etc.

c) To lay the foundation for a "European Society for Quality Assurance in Aerospace Engineering Education".

2. One of the tasks of this Society should be to establish an entity for developing and later issuing a quality/excellence label to (European) universities that would be recognized by the organizations that would want to employ the graduates of these universities. The quality label should, as far as possible, be based on present and future regional, national and European requirements for quality assurance and accreditation. In the end this label should have such a reputation that it is accepted as equivalent to the future European and national accreditation systems. It is assumed that "peer reviews" and "site visits" that may be needed in these future procedures would be organized by the Society.

3. In this activity of the Society the various European Aerospace Engineering stakeholders should be represented, such as industry (including SME's), research establishments, academia (including students, e.g. as represented by EUROAVIA), Professional Societies (working together in the Confederation of European Aerospace Societies (CEAS), ESA/ESTEC, etc. It should be noted that at least one of the members of CEAS, (the Royal Aeronautical Society), has a long lasting experience with accreditation-like activities in the UK and as a member of FEANI (European Federation of National Engineering Associations) also has European experience on the subject. The new Society might take
advantage of the fact that CEAS has an office in Brussels.

4. During the developments described above, PEGASUS (the "Partnership of a European Group of Aeronautics and Space Universities") might develop its present acceptance criteria in such a way that they be exploited in the frame of developing a quality assurance system.

5. It is recommended that there will be a strong cooperation between the Society and organizations of the European Aerospace Engineering faculties (such as PEGASUS and EASN) during the development of the quality label.

6. Universities not yet satisfying the criteria for such a quality label but wanting to apply for it should be supported by the Society and the Universities that already gained it.

7. ACARE's Working Group on Human Resources (AGHR) (one of the two groups of ACARE WT5) should be asked to support the proposal for the project as mentioned in recommendation number 1. The terms of reference of the AGHR are such that this Working Group is expected to prepare proposals for projects to be performed under the European FP7. A follow up of the present accreditation study might very well be performed under a "Specific Support Action"

<u>Avant-propos to answering the questions.</u>

Before answering the questions I would like to emphasize that due to personal circumstances I could not follow in detail the recent developments in the present subject. Therefore my apologies in advance in case I do not give sufficient credit to these developments. Nevertheless I have the impression (and in fact fear) that not much has been achieved in the meantime and hence that these earlier studies may still be useful as a starting point for further action.

It should be realized that the European aerospace community has a great advantage over other disciplines. The industry is already well integrated, the research institutes have a strong cooperation in CEAS and the educational institutes are working closely together in PEGASUS and EASN. This advantage should be exploited not waiting for the governments to take the lead in this process of cooperation and quality assurance.

In the following "industry" is understood to be used in the broad sense and also includes the research establishments.