bmvit

Bundesministerium
für Verkehr,
Innovation und Technologie

# TAKE OFF

## The Austrian Aeronautics Research and Technology Programme

## Latest Results in 2010


TAKE OFF

FFG

# Foreword

The first results of TAKE OFF, the Austrian aeronautics research and technology programme, were published in 2007. Since then 71 new research projects have been funded to the tune of around 28 million Euros. It became evident that there was an intensive need for more research as there was a high demand of the Austrian research community for the findings of TAKE OFF. I am delighted to report that the Austrian aeronautics sector has an enviable level of R&T investment, i.e. more than 13% of annual turnover. We want to ensure that the Austrian aeronautics industry is better supported in the long term and this is why we have undertaken a number of measures in oder to adapt TAKE OFF and reflect the needs of industry.

The global economic crisis has seen a significant drop in the number of airline passengers and a declining interest in purchasing new aircraft. In the period of 2007–2009 the first Austrian civil aeronautics strategy for research, technology and innovation was developed by the government and industry. This strategy has now started its implementation phase with the particular purpose to strengthen the industry over the long-term and improve its competitiveness and productivity.

There are about 30 members of the Austrian Aeronautics Industries Group which represent the core interests of the industry. They achieved a positive turnover of 3.5% in 2008 – in spite of a difficult second half of the year. This is equivalent to a turnover of 791 million Euros. However, this figure does not include the turnover of a further 200 companies that are active in the aeronautics industry. These companies were identified by a survey commissioned within the scope of the Research Technology and Innovation aeronautics strategy and show the true breadth of capabilities within Austria.

The Austrian aeronautics industry is strongly oriented towards exports and niche products. TAKE OFF has supported the industry in this endeavour by having joint calls with other countries, such as Germany and Great Britain. This demonstrates the programme's flexibility and ability to address the changing requirements of the aeronautics industry over the course of time.

Last year an interim evaluation of the TAKE OFF programme was undertaken. The outcome was very positive and the report showed that the target group genuinely appreciated TAKE OFF as the basis for Austrian aeronautics research funding. Essentially, the programme was seen as an international example of best-practice.

This brochure is intended to provide an overview of the most recent research activities that have been funded over the last three years within TAKE OFF.

**Doris Bures**
**Federal Minister of Transport,**
**Innovation and Technology**

# Table of Contents

# Visions of the Austrian Aeronautics Sector

## Aeronautical technology in Austria

As a result of the dynamic growth and changes within this sector in recent years, the field of Austrian aeronautics has assumed increasing significance. In 2008, the aeronautics (supplier) industry alone achieved a turnover of 791 million Euros and employed 4255 people. This corresponds to an annual growth in turnover of 20% as well as a 10% annual increase in the number of people employed. The export quota of the Austrian aeronautics (supplier) industry is nearly 100%. Austrian aeronautics company customers are not only located in Europe (50%); many are also in the USA (24%) and several other countries. In addition to OEM manufacturers such as EADS (Airbus, Eurocopter), Boeing, Embraer and Bombardier Aerospace, and supplier companies such as BAE Systems, Rolls Royce, MTU Aero Engines, General Electric, Pratt&Whitney and Snecma, the list of customers also include airports, airlines and air traffic control facilities.[1]

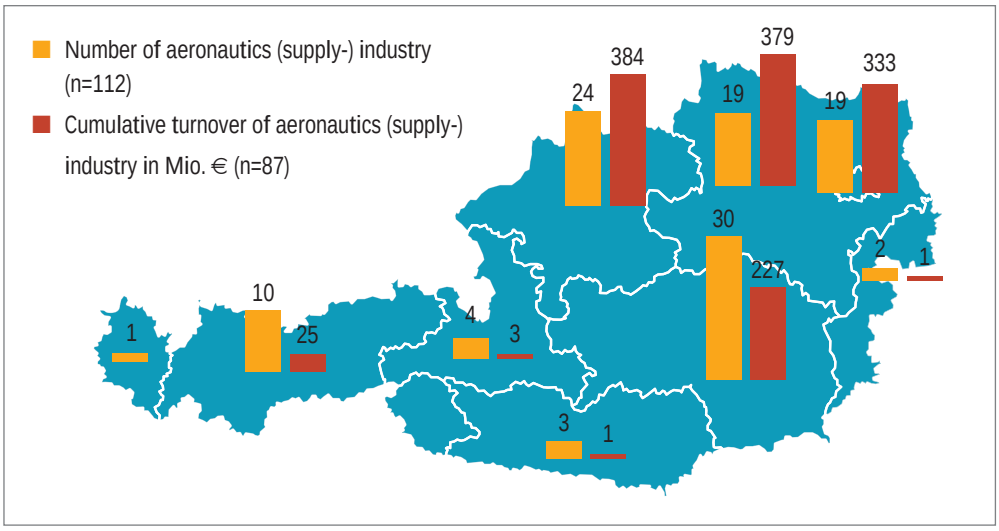



**Figure 1:** Regional allocation of the Austrian aeronautics (supply-)industry; source: Study Ö-Link, BRIMATECH on behalf of BMVIT

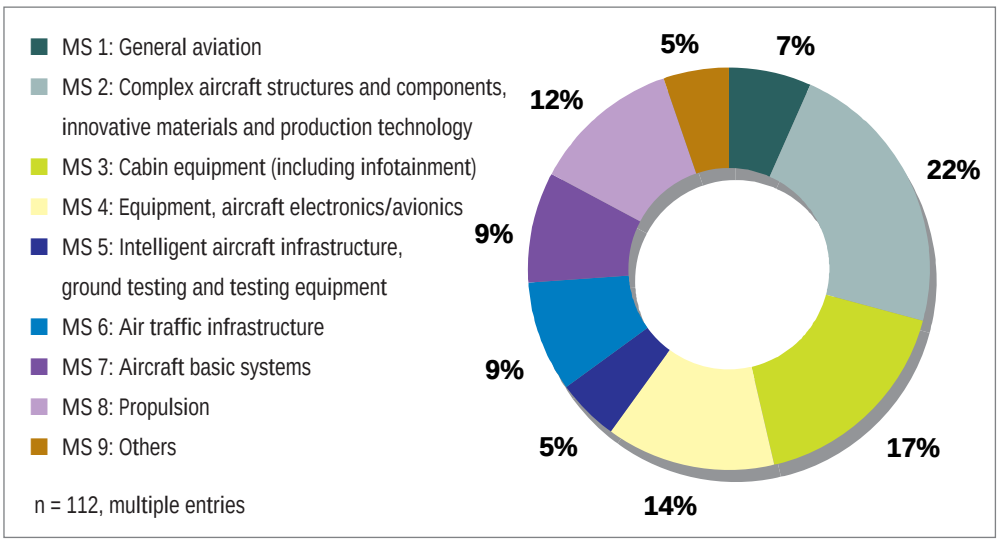



**Figure 2:** Allocation of companies to the market segments, source: Study Ö-Link, BRIMATECH on behalf of BMVIT

[1] Austrian Aeronautics Industries Group: URL: http: / / www.aaig.at

The Austrian aeronautics (supplier) industry and air transport sector exhibits several areas of expertise in the fields of general aviation, complex aircraft structures and components, innovative materials, production technology, cabin equipment (including infotainment), aircraft electronics/avionics, intelligent aircraft infrastructure, ground testing and other testing equipment, propulsion, air traffic infrastructure and air traffic control applications (ATM and airport technology, air- and landside). In addition to large companies which are important in this sector such as Diamond Aircraft Industries GmbH, FACC AG, Böhler Schmiedetechnik GmbH & CoKG, BRP Rotax GmbH & CoKG, Test-Fuchs GmbH, List Holding GmbH and Frequentis AG, in recent years new companies such as TTTech Computertechnik AG, Avibit Data Processing GmbH, Schiebel GmbH, Westcam Fertigungstechnik GmbH and Secar Technology GmbH have established themselves and gained a reputation far beyond the borders of Austria.

In Austria as well, the air transport sector has undergone marked growth in recent years. The number of passengers in Austria has virtually doubled since 1995 (96%)[2]). In 2007, Vienna airport, the largest airport in Austria, recorded 17 million passengers. This corresponds to nearly 80% of the total air traffic in all of Austria. The remainder was divided between the airports in Salzburg (8%), Graz (4%), Innsbruck (4%), Linz (3%) and Klagenfurt (2%).

The European Commission still expects a doubling in air traffic over the next 10 to 15 years; this growth will follow the temporary slump due to the economic and financial crisis. The amount could even grow to three times as much traffic within the next 20 years.

In order to deal with this growth in Europe, we must confront central issues. These include the impact on the environment, safety, customer satisfaction, affordability and expansion of air transportation capacity with Europe-wide harmonised and optimised air traffic management.[4]

This requires the application of new technologies and innovative advances in operational methodologies. These are the basis for higher performance, greater environmental compatibility, reduced air traffic noise, the aircraft used, air traffic management systems and airport technologies. Such advances are also in the interest of time and costs saving. Besides the requirements for technical development, the aeronautics industry is also confronted with such issues as the reduction in the number of tier 1 suppliers by the OEMs. Furthermore, extremely long development times require advanced financing. Constantly rising R&D quotas and the participation in risk financing required by the OEMs represent further hurdles for the aeronautics (supplier) industry. Likewise the very costly certification requirements and product liability issues do not allow the aeronautics (supplier) industry to rest on its laurels.

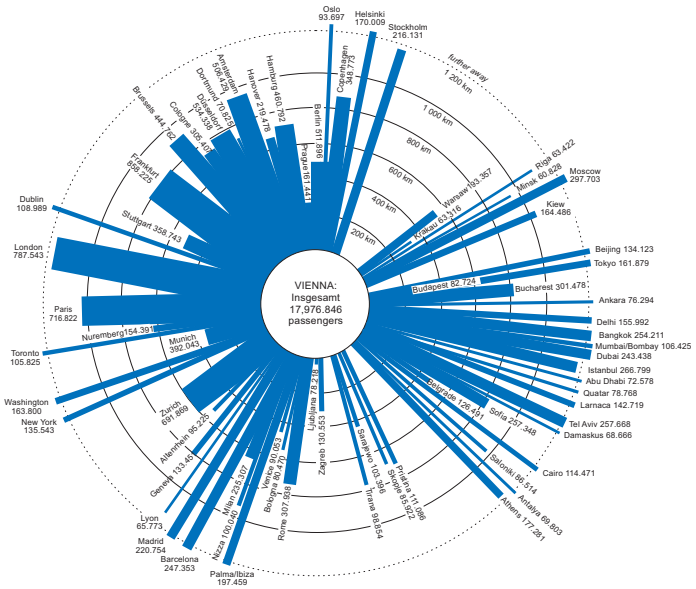



**Figure 3:** Number of scheduled air traffic passengers in 2007, (to and from Vienna, without transit)[3]

[2] Austrian statistics: URL: http: / / www.statistik.at / web_de / statistiken / verkehr / luftfahrt / personenverkehr / index.html (as of 01.09.2009)

[3] Austrian statistics: URL: http: / / www.statistik.at / web_de / statistiken / verkehr / luftfahrt / personenverkehr / index.html (as of 01.09.2009)

[4] European Commission: URL: http: / / ec.europa.eu / research / transport / transport_modes / aeronautics_en.cfm# (as of 01.09.2009)

# The Austrian Aeronautics Strategy for Research, Technology and Innovation

In order to meet these challenges, the Austrian Federal Ministry of Transport, Innovation and Technology has initiated the drafting of a national civil aeronautics strategy for research, technology and innovation (RTI aeronautics strategy). This RTI aeronautics strategy has been developed in close collaboration with 30 experts and representatives of the aeronautics (supplier) industry, air transport sector, supporting institutions and ministries. The objective of the process was to strengthen the position of this sector by supporting research, technology and innovation and, for the first time, also consider the air transport sector (airports, airlines and air traffic control).

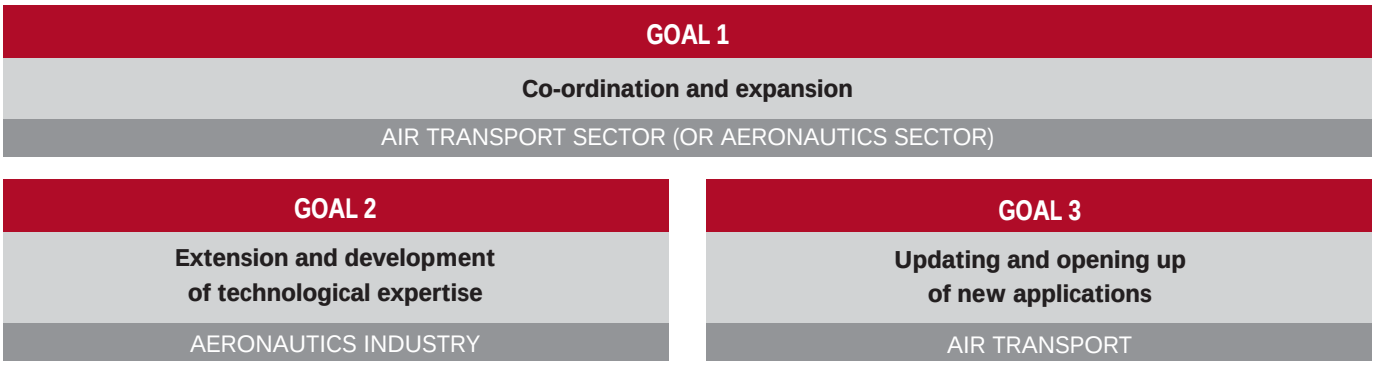



**Figure 4:** The three main goals of the RTI aeronautics strategy[5]

## Vision and goals

The results of trend analysis and global changes in aeronautics were analysed in relation to the Austrian air transport sector and the related challenges, and so-called "windows of opportunity" were identified. These are the areas which could open up opportunities for the civil air transport sector in Austria in the coming years. On this basis, in Vision 2020, the growth chances for the Austrian civil air transport sector have been identified. The factors which could support the already existing and highly competitive companies in this industry by advancing these activities have been outlined. At the same time the inclusion of other companies currently engaged in similar activities, although not directly working in the aeronautics industry, is viewed as generally in the best interest of reaching these goals. The realisation of critical masses via the improved consolidation of research institutions and suppliers has also been identified as an essential task. Simultaneously, the research activities and actions of those companies towards the end of the supplier chain should be better integrated in existing primary operations.

The heart of the RTI aeronautics strategy is the identification of six market segments within the Austrian business and research community in which Austria exhibits particular strengths. The goal is to network each of these market segments along the horizontal and vertical value added chain and thus contribute to the development and extension of the air transport sector. The following six market segments have been identified. This classification also serves as the framework for the TAKE OFF projects presented within the scope of this brochure:

1. **General aviation**
2. **Complex aircraft structures and components, innovative materials and production technology**
3. **Cabin equipment (including infotainment)**
4. **Equipment, aircraft electronics/avionics**
5. **Intelligent aeronautical infrastructure, ground testing and testing equipment**
6. **Networked air traffic infrastructure and air traffic control applications (ATM and airport technology, airside and landside)**

[5] BMVIT: URL: http: / / www.bmvit.gv.at / innovation / downloads / luftfahrtstrategie.pdf (as of 04.09.2009)

## Implementation

In order to realise these goals, four strategic areas have been defined in which adequate public support measures should be provided. Organisational measures for better structural networking among those involved and extending the measures for the support and financing of research activities are viewed as essential. In addition, all targeted educational and qualification measures at all levels of education, as well as accompanying measures for the strategic further development of the sector, are likewise viewed as essential. In all four areas, individual concrete measures have already been defined and, in part, already realised.

As a result, for example a SESAR Forum for current information within the European public/private partnership and a funding round table with representatives from a broad range of Austrian support institutions was organised. Calls for proposals for the support of co-operative research projects with Germany, Hungary and Great Britain were published along with the commissioning of strategic studies on the subject of networking and conducting innovative networking seminars.

Already existing activities will be continued where appropriate; these include the representation in the research-relevant committees of the ACARE (Advisory Council for Aeronautics Research in Europe) European technology platform for aviation, in the group of national representatives in the Joint European Technology Initiative Clean Sky, and in the transport programmes of the European Union by the Federal Ministry of Transport, Innovation and Technology. Further improved co-ordination with the aeronautics industry is also a high priority. For better co-ordination in respect to the realisation of the RTI aeronautics strategy, the already formed work group for strategy development will be maintained. This group discusses the implementation steps still required. According to need, this work group will be extended to include additional representatives.

The RTI aeronautics strategy brochure can be downloaded via the following link:
http://www.bmvit.gv.at/innovation/luftfahrt/index.html

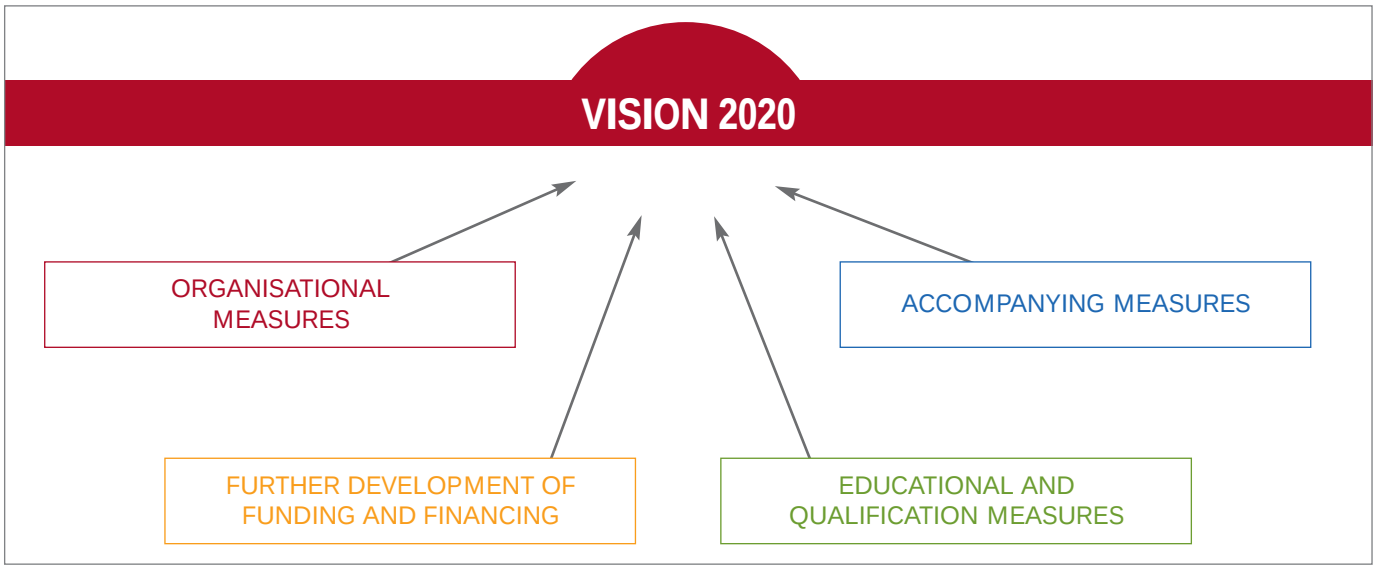



**Figure 5:** Strategic measures for the realisation of Vision 2020[6]

[6] BMVIT: URL: http: / / www.bmvit.gv.at / innovation / downloads / luftfahrtstrategie.pdf (as of 04.09.2009)

# The TAKE OFF Programme for Research and Technology in Aeronautics

TAKE OFF, the Austrian research and technology programme for aeronautics, was started in 2002 by the Federal Ministry of Transport, Innovation and Technology. Its objective is the provision of new stimulus for the Austrian aeronautics (supplier) industry by supporting targeted research and development activities. These are in the interest of improving competitiveness and thus strengthening the industry in terms of international co-operation and improving networking with the existing research institutions.

In the TAKE OFF programme, the research activities of companies and research institutions in the area of aeronautics technology are combined according to subjects of particular emphasis which were formulated in advance. By way of annual calls for proposals[7], project ideas from interested parties are sought in the form of proposals. These proposals are then evaluated, selected and monitored by international experts for quality and innovative content, ensuring the high quality of the projects ultimately supported. During the execution of the project, the specifically assigned programme management of the Research Promotion Agency (FFG) oversees the quality assurance of these projects and networking among the project participants. In this way, synergies between the different research projects can be better utilised.

## Orientation

Following the creation of the RTI aeronautics strategy, the goals and instruments of support for the TAKE OFF technology programme were oriented to the goals of this strategy. Important here was, above all, the extension of the programme to match the R&D requirements of the Austrian air transport sector, the realignment of the subject areas emphasised with focus on the six market segments, an extended portfolio of support instruments, and special consideration for small and medium-sized companies. At the same time, other goals are addressing new companies in the aeronautics industry, better targeting in the orientation of research co-operation between industry and research, supporting the expansion of human resources, and the integration of foreign research partners for better international networking as well as enhanced measures to disperse the results among our own research community.

With these goals, TAKE OFF addresses industrial and service companies, research establishments, university and non-university researchers as well as technical colleges in Austria or those having research facilities in Austria along with public and private users such as aviation companies, airports and air traffic control facilities which are related to this sector and actively pursuing research and development.

TAKE OFF is a technology and research programme and, as such, combines a number of activities. These measures are derived from the programme goals and define the orientation of the programme. On the one hand, it is concerned with the expansion and development of research and development in the six marketing sectors identified (see Section 1.2), including propulsion. At the same time, they also concern educational and qualification measures. These include the continuing education of employees and the loaning of personnel to small and middle-sized companies. In addition, they include requests for targeted programme-supported measures such as events dealing with future-oriented topics and surveys regarding aeronautics relevant topics.

**Focal points of TAKE OFF**

1) **Securing and enhancing the competitiveness of Austrian aeronautics research and the aeronautics industry by targeted networking over the six market segments (see Section 1.2)**
2) **Including the requirements of the air transport sector in research and development topics and therefore strengthening the orientation to the entire research, technology and development relevant aeronautics sector**
3) **Supporting a safe, efficient, climate protecting and comfort oriented air transport system**
4) **Educating qualified researchers and technicians and intensification of ambitious co-operative research projects**
5) **Improving the Europe-wide and international transparency and thus strengthening the external image of Austrian research and development**

[7] The term call for tender is used in a broad sense: here we refer to the awarding of public funding for submitted project proposals.

## Mechanisms of support and project types

Within the scope of the programme, over a number of years mechanisms and project types tailored to the requirements of the research and development activities of the target groups have been developed. These are oriented to the community guidelines on state aid of the European Union as well as to the Austrian guidelines for the support of economic/technical research and technology development (RTD guidelines).

Projects with a technology readiness level from 2 to 5 are supported.

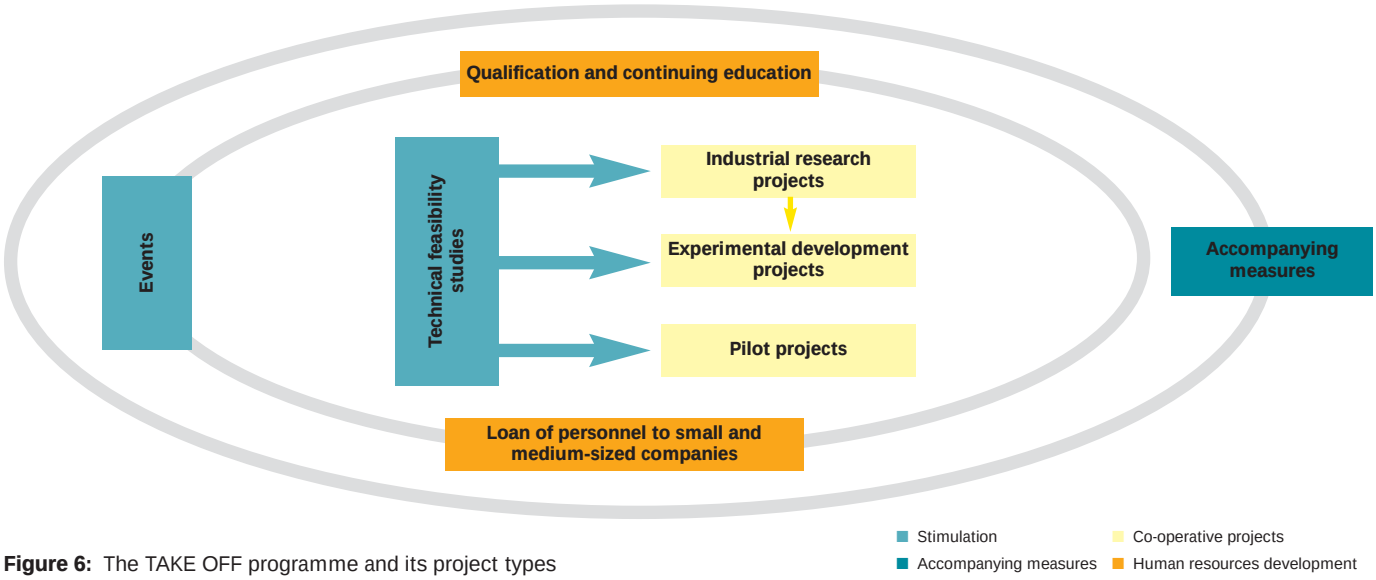



**Figure 6:** The TAKE OFF programme and its project types

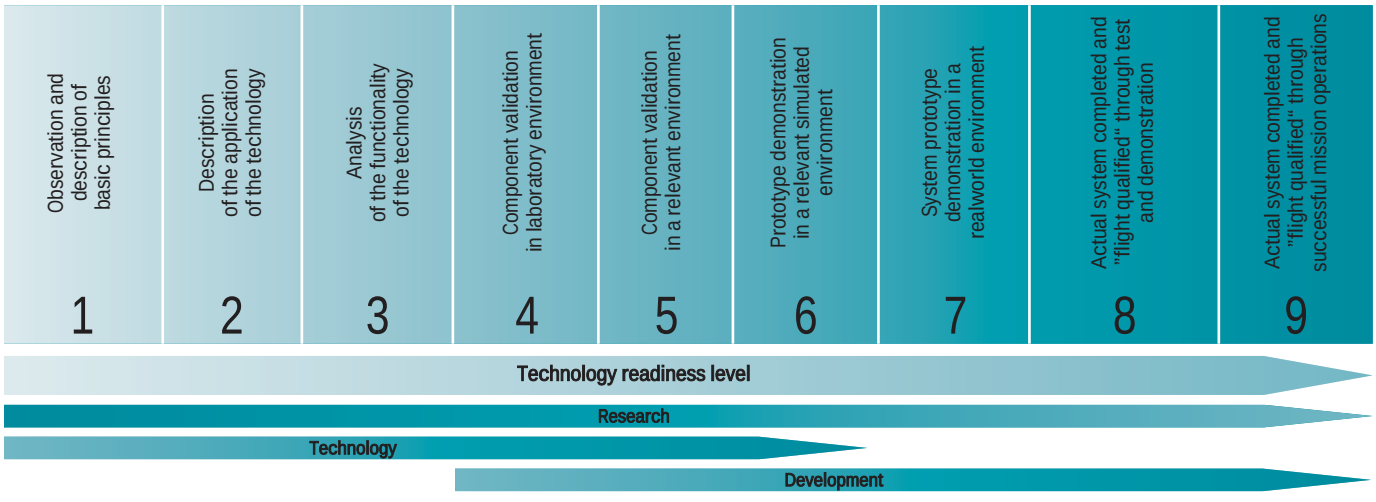



**Figure 7:** Technology readiness level (TRL)

# The TAKE OFF Programme for Research and Technology in Aeronautics

| Project type | Description |
|---|---|
| **Stimulation** | Proposals for stimulation projects must lay the foundation for later, more comprehensive co-operation. Such projects support industrial research or experimental development.<br>Support is given for technical feasibility studies for the clarification of the feasibility of particularly innovative ideas and concepts with a high risk and excellent potential for economically profitable application. Events and series of events for the further networking of the parties concerned are supported as well. |
| **Co-operative projects** | Co-operative projects represent the core of the programme. Innovative and ambitious research projects in which at least two partners take part are of interest here. Research and development proposals in the area of industrial research (TRL 2-4), experimental development (TRL 4-5) and pilot projects (TRL 2-5) are supported. Research and development in these project types is characterised by differing proximity to the market: |
| | The industrial research projects are concerned with systematic research activities or critical research for acquiring new knowledge and skills. These projects serve the goal of developing new products, processes or services or the utilisation of significant improvements with existing products, processes or services. |
| | Within the scope of experimental developments, plans and provisions or concepts for new modified or improved products, processes or services are developed. These make use of the newly acquired, combined and existing scientific, technical, economic as well as other relevant knowledge and skills. |
| | Pilot projects are strategic projects of particular importance in connection with Austria as an aeronautics site. These projects are comprised of industrial research, experimental development and a demonstration component. |
| **Human resources development** | These projects support the expansion and development of human resources for research and development in aeronautics. The continuing education of employees, computer-based training tools for the realisation of educational measures, loan of personnel to small and medium-sized companies, certification in accordance with AS/EN9100 and certifications based on this are supported as well as individual research projects. |
| **Accompanying measures** | In addition, within the scope of accompanying measures, experimental or theoretical projects are commissioned. Such measures aim to generate completely new or fundamental knowledge without immediately recognisable practical applications. This includes the financing of studies which are of interest to the public but are not of immediate commercial interest. |

## Interim evaluation of TAKE OFF

As is generally done with research support programmes, an interim evaluation of TAKE OFF was performed in 2008. The evaluation experts of Prognos AG in Berlin examined the quality of the realisation up to that time. The evaluation also examined the effectiveness and efficiency as well as the conceptual alignment to the Austrian RTI aeronautics strategy and new ideas for the future shaping and development of the programme for the period from 2002 to 2007.

In this interim evaluation, the thematic differentiation following alignment with the RTI aeronautics strategy was judged to be very positive. The evaluators also found the focus of support to be co-operative projects; this would smoothly pave the way for the national aeronautics industry. These projects embody important stimulus for access to national and international (knowledge) networks. In the future, pilot projects with this focus should be more intensively funded.

According to the evaluators, the target group sees TAKE OFF as the foundation of Austrian aeronautics support and as a central programme for supporting further technological development in the Austrian aeronautics industry. They see TAKE OFF as a catalyser for Austrian parties involved in aeronautics. Moreover, the programme exhibits a model character.

The interim evaluation clearly shows the high level of customer satisfaction with the quality of project support during the period of support on the part of all parties submitting proposals. Over the period examined, each Euro of public funding was matched with 1.1 Euros in private R&D investment.

Other recommendations based on the interim evaluation were the development and expansion of bilateral calls for proposals, the preparation of short and succinct report forms and also the optimisation of application forms and the generation of specimen consortium contracts.

These recommendations have been taken very seriously by the programme directors and, to a large extent, already implemented.

Those interested can download the detailed final report on the interim evaluation at:
www.bmvit.gv.at/innovation/luftfahrt/studien/index.html

# The TAKE OFF Programme for Research and Technology in Aeronautics

## Results to date

Since the beginning of the TAKE OFF programme, seven calls for proposals have taken place. A total of 109 projects with an R&T sum of around 39.5 million Euros have been approved for research institutions, (supplier) companies and companies active in the air transport sector. The focus of support has been in the financing of co-operative R&T projects (57%) followed by 16% in the area of human resources, 11% for accompanying measures, 8% for feasibility studies, 6% for events and 2% for concept initiatives.

Fortunately, the proposal budget has in the meantime increased from an initial amount of around 3 to 4 million Euros to around 7 million Euros annually. Indeed, with the significantly higher success rate of far more than 50% and a mean funding quota of 42% (2002-2009), which in recent years has risen to 53% (2009), planned research activities in the Austrian aeronautics industry can be supported under extremely attractive conditions.

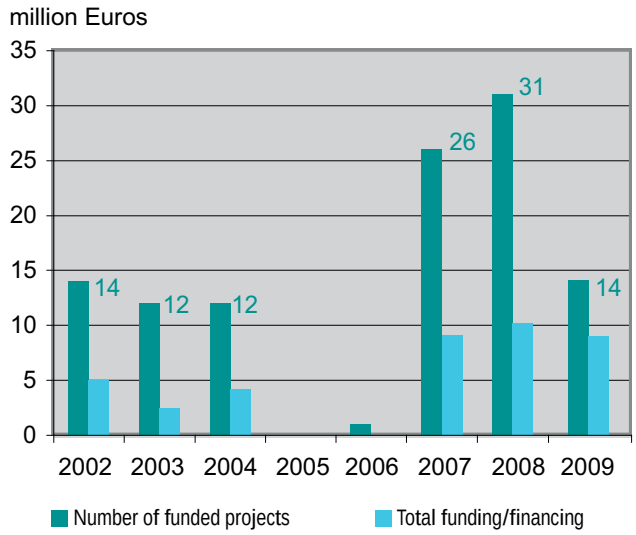



**Figure 8:** Total funding/financing in relation to number of funded projects within TAKE OFF

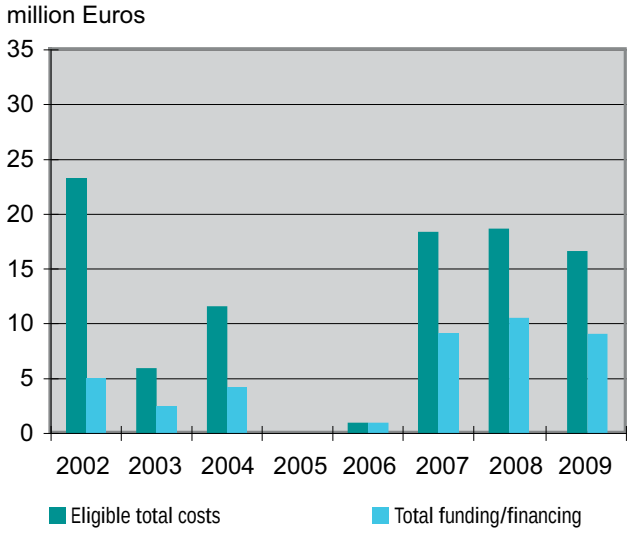



**Figure 9:** Eligible total costs in relation to total funding/financing, TAKE OFF 2002-2009

Over the period from the fourth to the seventh call for proposals, following alignment with the RTI aeronautics strategy in the years 2007 to 2009, a total of 71 projects were initiated. The funding amount was about 28 million Euros.

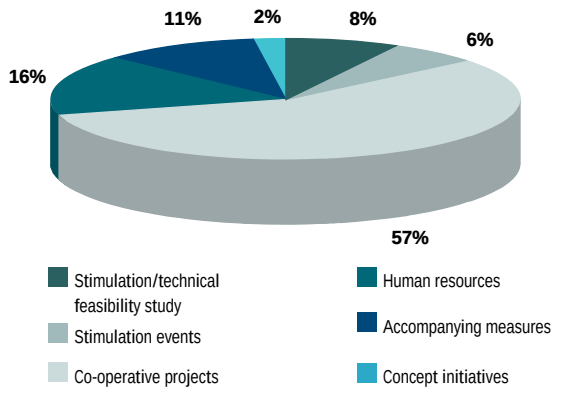



**Figure 10:** Number of projects per project type in relation to the total number of projects carried out, 4.-7. TAKE OFF call

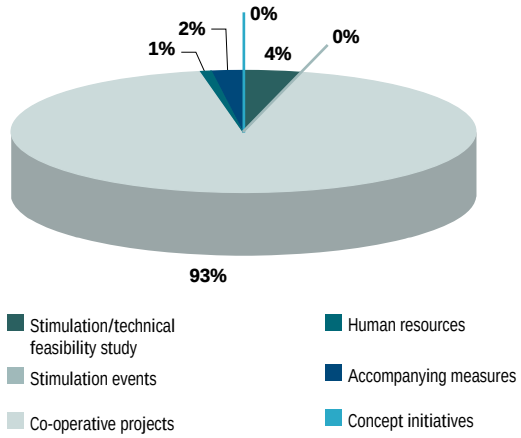



**Figure 11:** Distribution of financial support for each project type in relation to total financial support, 4.-7. TAKE OFF call

It can be seen that co-operative projects represent the focus of the TAKE OFF programme. This is true of both the number of projects and the amount budgeted.

The distribution of the projects supported from the fourth to the seventh call for proposals is oriented to the market segments identified in the RTI aeronautics strategy (including propulsion). This clearly shows that the complex aircraft structure and component sector as well as innovative materials and production technology currently represent the greatest number of projects. These projects also receive the greatest financial support. This is reflected in the number of companies active in this area in Austria.

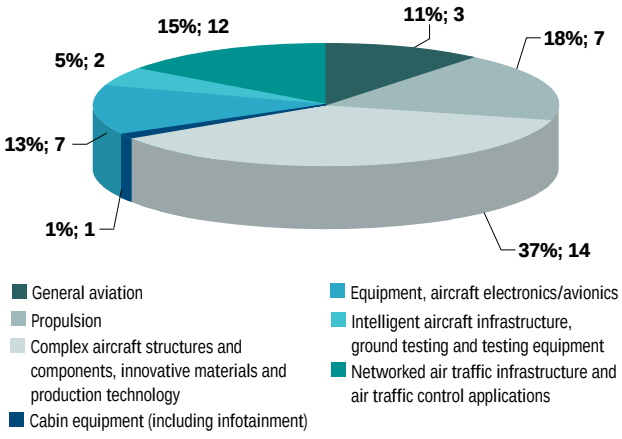



**Figure 12:** Funding budget for each market segment in relation to the total funding budget, 4.-7. TAKE OFF call

# The TAKE OFF Programme for Research and Technology in Aeronautics

## Establishment of an Austrian research community

Following the start phase of TAKE OFF, the availability of the first project results enabled work on networking within the Austrian aeronautics research community to begin. This included numerous events intended to promote the relation of experiences between the research parties in the aeronautics technology area. Following each call for proposals, shortly after the beginning of the different projects a workshop is conducted at which the project parties are networked and their proposals presented and discussed. This encourages the identification of possible synergies. Furthermore, events dealing with specialised aeronautics-related subjects such as fibre bundle materials, digital voice communication, lightweight constructions and unmanned aircraft are also organised within the scope of TAKE OFF. These are in part conceived of and conducted by the programme directors and partly by those involved in the projects.

### Networking workshops

Since the fourth call for proposals in 2007, a so-called start workshop with short presentations and discussions concerning the supported/financed projects accompanies the calls for proposals. This workshop is specially organised for those engaged in projects relating to the call for proposals and serves to promote networking as well as the identification of possible synergetic possibilities between different projects. The initial workshops for the last three calls for proposals in 2007 to 2009 were well received by those taking part. The exchange of experiences enabled the initiation of new co-operative work. This has already led to the submission of joint proposals within the scope of the European research framework programme.

The programme endeavours to present the results of projects to the public in order to make the project results more familiar. In March 2007, an interim presentation of the results was given in Vienna in which the public was invited to participate. The large number of participants was proof on the great interest shown by the expert public – so much so that this programme will be maintained and a second presentation of results was already given in October 2009. Besides a condensed overview of current research results, exciting evidence of new trends amongst aircraft manufacturers will be given in presentations by international guest speakers. Several pages about the uses, challenges and potential of co-operative research projects will be discussed from a number of sides as well.

### The future of fibre-reinforced composites in Austrian aeronautics industry and related research

On 1 December 2008 an event entitled "The Future of Fibre-Reinforced Composites in Austrian Aeronautics Industry and Research" was held which was attended by an invited audience. This event was organised and conducted co-operatively by the TAKE OFF programme leadership and the Technical University of Vienna.

At the event, which with more than 130 guests exceeded all expectations, technology trends and market assessments in the area of fibre-reinforced composites from EADS Innovation Works, FACC AG, the Joanneum Technical University, the Technical University of Vienna, the University of Leoben and AIT were featured.

The round-table discussion was concerned with current industrial challenges and research agendas in fibre-reinforced composites; this lead to interesting new insights. The topics included the importance of fibre-reinforced composites in the construction of small aircraft and the importance of foreign partners in the European and international landscape. The fact that automation cannot be used universally in production was discussed, and the position that research institutions often see industrial companies as the driving force for their research agendas was another topic of discussion. Recommendations for action were shown as well, such as the expansion of networking between industrial companies and research establishments within the compound material industry. The necessity of risk-sharing models in order to cushion the impact of high investment requirements and long development times in aeronautics for Austrian companies in the Austrian aeronautics industry was also discussed. Challenges for the industry, such as competition in production from low-wage countries, the dollar risk and personnel shortages were the subject of further exciting discussion points.

Info on these events can be downloaded from the Austrian Research Promotion Agency (FFG) website:
www.ffg.at/content.php?cid=318&sid=285

## TTTech and SC-205 meeting – Vienna 2007

The federal review board for communication, navigation and monitoring of US air traffic management (Radio Technical Commission for Aeronautics, RTCA) and its non-profit counterpart in Europe (European Organisation for Civil Aviation Equipment, EUROCAE) are responsible for the definition of guidelines for the development of aviation software. Within the scope of the joint work group WG-71 of the special committees SC 205, the follow-on standard DO-178C for the currently valid standard DO-178B "Software Considerations in Airborne Systems and Equipment Certification" is currently being developed for the certification of new aviation software.

From 10 to 14 September 2007, a meeting of SC-205/WG-71 took place in Vienna. The content and result of this meeting was the integration and harmonisation of the standard of certification DO-278/ED-109 (CNS/ATM) as part of the core text of DO-178C. The refinement of the guidelines governing the use of formal methods for the verification of aviation software was also addressed here. At this meeting, the assembly discussed 16 documents, three of which were accepted by consensus and officially included in the DO-178C standard. Holding this meeting in Vienna allowed us to make 100 key international experts and numerous representatives of well-known companies from the aerospace sector aware of the importance of Austria's aeronautics industry. This meeting was organised by TTTech Computertechnik AG and financed by the TAKE OFF programme.

### *Info box*

***Project co-ordinator:***
*TTTech Computertechnik AG*
*Martina Sebastian*
*Schönbrunner Strasse 7, A-1040 Vienna*
*martina.sebastian@tttech.com, www.tttech.com*

## ISAP'9 – International summer school on aviation psychology

The Karl Franzen University of Graz and the Austrian Aviation Psychology Association co-operated in organising the fourth International Summer School on Aviation Psychology (ISAP'9), an advanced educational event held in Graz from 28 June to 3 July 2009. This event placed particular emphasis on preventative maintenance. The goal of ISAP'9 was the enhancement of the networking of experts in aviation psychology from universities, suppliers of services, industry and public authorities. This took the increasing importance of human factors for the safety, efficiency and capacity of the aviation system into consideration and generated new initiatives for concepts relating to future-oriented topics such as "human performance limitations" and "human factors in preventative maintenance".

The week-long summer school served as further training for advanced students, human factor experts from the aviation field, representatives of aviation suppliers and university colleagues. As with the previous summer schools, it was accredited by the European Association of Aviation Psychology (EAAP). A very diverse international character was apparent, both in terms of the speakers and those in attendance.

### *Info box*

***Project co-ordinator:***
*Karl-Franzens-University of Graz, Department of Psychology*
*K. Wolfgang Kallus*
*Universitätsplatz 2, A-8010 Graz*
*wolfgang.kallus@uni-graz.at, www.kfunigraz.ac.at/psywww*

# The TAKE OFF Programme for Research and Technology in Aeronautics

**Lightweight construction principles, selection of materials and manufacturing variants in aeronautical engineering**

On 24 and 25 September 2009 the "Lightweight Construction" seminar was held at the Technical University of Vienna. During this seminar current information about materials, production technology and design was presented over two days. In addition to the seminar itself, preceding workshops were offered for those active in this field. These included expert talks, visits to companies and on-site factory presentations at various Austrian aeronautics companies (Böhler Schmiedetechnik GmbH & Co KG, FACC AG, LKR Leichtmetallkompetenzzentrum Ranshofen GmbH, Austro Engine GmbH, Diamond Aircraft Industries) with a focus on different aspects of lightweight construction.

The initiative for this series of events came from industry which cited a need for further education in the area of lightweight construction. The topic covered in the workshops and the seminar, especially in the transportation area (road, rail and air), as a result of ecological and economic pressures was to increase fuel efficiency through reduction of weight; there is a need for expertise in the state of the art of lightweight construction, efficient design, selection of materials and production technology.

The well attended series of events gave an interesting overview of the present and future challenges in respect to materials and component structures, the Austrian aeronautics research establishment, production technology and many more interesting insights into the subject of lightweight construction.

### *Info box*

***Project coordination:***
*Technical University of Vienna, Department of Materials Sciences*
*Sigrid Lüftl*
*Favoritenstraße 9-11, A-1040 Wien*
*sek308@pop.tuwien.ac.at, http://info.tuwien.ac.at/E308/*

**Future trends in digital ATM communication technologies**

On 21 April 2009 an international conference entitled "Future Trends for Digital ATM Communication Technologies" took place in Salzburg with national and international participants from the field of air traffic management. Under the technical direction of the Department of Computer Sciences of the Paris Lodron University of Salzburg and Toni Eiser – Innovation, Strategy and Financing – 50 researchers and representatives of public authorities and users from the air traffic control area could be brought together around this specially chosen subject. Future speech communication technology was presented and discussed. This technology will find use in system-wide information management (SWIM), including all relevant organisations, and in the collaborative decision making (CDM) of the common European air space.

The influences of weather and the human factor of the new speech communication technologies were also discussed and the requirements for further education defined. The panel discussion on the subject of possibilities for co-operation for small and medium-sized companies in aeronautics research projects yielded consensus amongst the experts. In their view, it is in fact difficult for small and medium-sized companies to directly access support. For example in SESAR, such companies should align themselves with key companies such as Austro Control (Vienna airport) and Austrian Airlines AG in order to achieve a critical mass and not be left behind in terms of research. While certification in air traffic management would not be a mandatory prerequisite for success, practical research should still be carried out with conviction with a clear vision and strategy.

### *Info box*

***Project co-ordinator:***
*Innovation-Strategie+Förderungen*
*Toni Eiser*
*Jakob-Haringer-Straße 1 – Techno-Z, A-5020 Salzburg*
*eito@tonieiser.at, www.xing.com/go/invita/6988539*

# Specific Accompanying Structural Measures

## National networking in the marketing segments

Over the last two years, studies for the complete assessment of the status of all companies engaged in aeronautics and their networking within six market segments identified in the RTI aeronautics strategy were financed as part of TAKE OFF. This was a starting point for further courses of action in the implementation of the RTI aeronautics strategy. The results of these studies are expected to provide greater transparency concerning the activities of the Austrian aeronautics (supplier) industry and the aeronautics research environment. These results also indicate strengths and potential for co-operation in the value-added chains so that in the future critical masses can be formed to include the research capacities of national research establishments in the Austrian aeronautics (supplier) structure.

### AAR networks – Austrian aeronautics research networks

Although many Austrian companies and research entities are currently active in the area of aeronautics technology, little is known about the extent of their networking. For both large and small companies, co-operation and vertical integration in the added value chain are particularly important in order to survive in the face of increasing competition.

The objective of the study was to determine which Austrian organisations are already working together in aeronautics research.

It is then necessary to determine the form of this co-operation in terms of both content and the level of involvement of the parties taking part. This required representing the existing networks and structures in the area of Austrian aeronautics research and technology for the first time in the form of an overview and in terms of:

- the focal contents
- the organisations and their co-operation
- networking along the added value chain, both according to subjects and according to organisations in a national and international context

Within the scope of the project, the potential for co-operation in Austrian aeronautics research and technology was analysed at the level of the parties participating. Based on data from funded projects, patents and the literature, an overview of this networking was provided and then confirmed and interpreted by experts.

Based on the results of this study, further strategic measurements on the part of federal agencies as well as on the part of companies, research entities and universities can be defined.

***Info box***

***Project participant:***

*AIT – Austrian Institute of Technology*
*Marianne Hörlesberger*
*Donau-City-Straße 1 / TechGate, A-1220 Wien*
*marianne.hoerlesberger@ait.ac.at, www.ait.ac.at*

# Specific accompanying structural measures

### Ö-LINK – Austrian aeronautics industry: market participants and know-how expertise database

In order to achieve the goals of the RTI aeronautics strategy, it is important to promote and improve co-operation and communication between companies, R&D institutions, public authorities and users in Austria. Often, even Austrian companies or research establishments firmly rooted in the aeronautics industry are not aware of how many companies are active in this industry and where dormant potential for co-operation exists.

The goal of the project was to identify all companies active in aeronautics technology, generate an expertise atlas of the activities of these companies and institutions within the six market segments and summarise the results in a database.

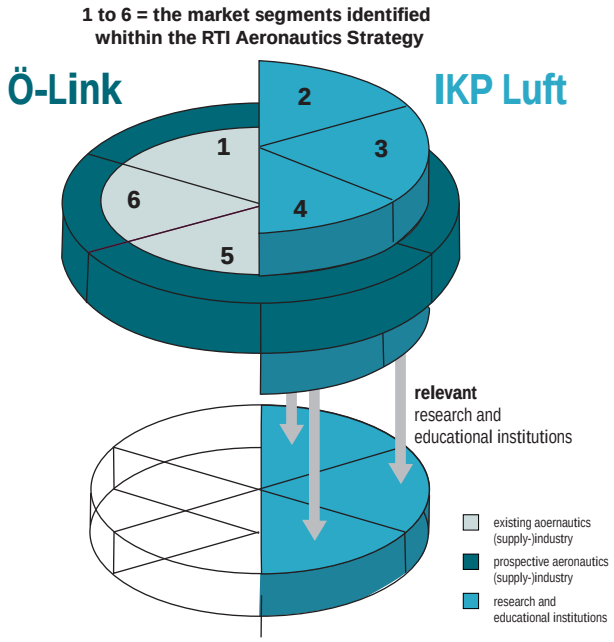
The project brought transparency to the economically viable activities in this sector. This serves as the basis for further strategic public works as well as for considerations regarding how to strengthen key companies. This in turn leads to more co-operative ventures within Austria in order to be able to offer greater vertical product performance on the global market. The result of the study therefore represents an important decision basis for possible collaborative formations.

#### *Info box*

***Project co-ordinator:***
*BRIMATECH Services GmbH*
*Andrea Kurz*
*Lothringerstr. 14/3, A-1030 Wien*
*ak@brimatech.at, www.brimatech.at*

### IKP-Luft – Identification of innovation and co-operation potential in selected segments of the Austrian aeronautics industry

The project was intended to identify the innovation and co-operation potential in selected segments of the Austrian aeronautics industry. It therefore generates transparency in respect to the companies as well as the research and educational institutions active in this area.




On the basis of a grouping and network method practised over many years, the innovation and co-operation potential in three selected market segments of the Austrian aeronautics industry (aircraft structures and components, cabin equipment and avionics) between companies were structurally surveyed. A similar analysis was performed to determine such potential between companies and research and education institutions.

On the basis of detailed co-operation and network analyses, recommended measures and concrete lines of action for the further expansion of co-operation and innovation in the area of aeronautics technology in Austria could be developed. Furthermore, a structured representation of synergetic and co-operation potential between the different parties emerged.

The study was accompanied by workshops in which possible co-operative projects were identified in order to develop a future-oriented research road map.

#### *Info box*

***Project co-ordinator:***
*PÖCHHACKER Innovation Consulting GmbH*
*Gerlinde Pöchhacker-Tröscher*
*Haus der Technik, Stockhofstraße 32/1, A-4020 Linz*
*gerlinde.poechhacker@p-ic.at, www.p-ic.at*

***Partner:***
*LKR Leichtmetallkompetenzzentrum Ranshofen GmbH*
*Horst Schmidt-Bischoffshausen*

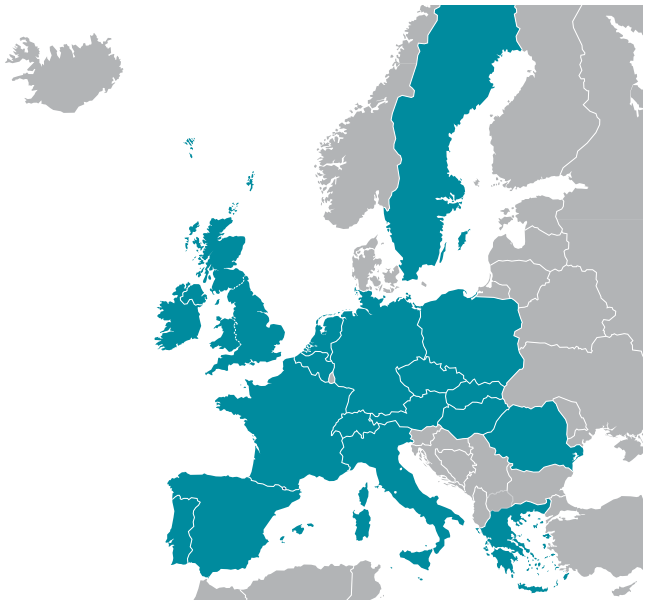
# International networking activities

### The ERA-NET AirTN

Within the scope of the European research framework programme, in 2006 the ERA-Net AirTN was initiated in order to develop national aeronautics and aeronautics-relevant research programmes. This is comprised of a very large consortium with partners from 27 public institutions (government ministries and programme agencies) selected from 18 countries. The networking and harmonisation of research support in the aeronautics area in various European member states was implemented in the hope of promoting interest in co-operative projects. The goal of the project is the qualitative and quantitative improvement of transnational co-operative research in the AirTN partner countries. On the Austrian side, BMVIT and FFG are taking part in this project.

Initial concrete results concerning the improvement of transnational co-operation and the co-ordination of national programmes was achieved for the first time in 2008. In TAKE OFF, for the first time a call for proposals was carried out in parallel with the German aeronautics programme LuFo during the fifth call for proposals. Partners could then apply in their own countries for research support in connection with the respective national part of the co-operative project. Three projects were selected, with a total funding amount of around 20 million Euros. The first transnational projects were started in 2009 and will run for three to four years. On the basis of this successful pilot activity between Germany and Austria, the European consortium is seeking to initiate other transnational co-operative research projects between the AirTN partner countries on the basis of co-operative/co-ordinated activities for proposal calls.

Further information about these activities can be found at www.airtn.eu



### Point of contact to the Aeronautical Research Group of the European Research Establishments in Aeronautics

The Austrian Institute of Technology (AIT) functions as the Austrian representative regarding the status of an associate member. It thus functions as an interface between the activities of the European Research Establishments in Aeronautics (EREA) and those at the national level. By its participation in meetings of the Aeronautical Research Group (ARG) and the EREA administrative council, a meeting held seven or eight times per year, networking with European aeronautics research establishments is made possible via mutual information exchange.

As a result of this point of contact, the AIT was successful in voicing Austrian interests for the seventh European research framework programme in the aeronautics sub-field and obtaining information about planned projects. The interfacing activities also included the distribution of information about planned programmes submitted (declarations of interest, planned co-operative projects and networks of excellence) within the Austrian Institute of Technology and therefore assisted in project initiation and the search for partners. For the future, in the interest of securing added value an information network for the Austrian research establishments to as well as from the EREA is also being considered. For this purpose, relevant information from the EREA will already be gleened and distributed as a newsletter per e-mail.

#### *Info box*

***Project co-ordinator:***

*AIT – Austrian Institute of Technology*
*Ernst Semerad, A-2444 Seibersdorf*
*ernst.semerad@ait.ac.at, www.ait.ac.at*

# A General Aviation

## Research Results 2007-2009



The development of new generations of aircraft is the greatest challenge in aeronautics. Not only the materials but also the construction and production must be optimal. This is further complicated by the fact that the best materials do not always allow for optimal construction and production.

For the development of new business jets, feasibility studies are required in the conception phase. These studies indicate and evaluate the advantages and disadvantages of integrating existing sub-systems (avionics, jet engines, production processes). Following the completion of the concept phase, the definition phase begins. In this phase, the realisation of the concept begins, for example with the generation of circuit diagrams and the definition of the spatial arrangement of the systems and their interfaces. Parallel to this, the marketing of the aircraft is initiated. Via close co-operation with the customers, the requirements and wishes of the customers are also taken into consideration during this early phase. The development phase then follows. This is characterised by detailed CAD drawings, construction of the production facilities and the beginning of production for the first model. The entire development process is strongly parallel in character. The integration of sub-systems, devices and equipment is also part of this phase. This is followed by the evaluation phase which ensures the absence of logical conflicts and includes the performance of safety analyses. Following these phases, the milestone "design freeze" is released and the model is approved via JAA/EASA.

This technical complexity is reflected in the economic side as the entire development phase must be financed in advance. With the selected forms of financing, the company is subject to the risk of fluctuating exchange rates. This results from the fact that invoicing in the aeronautics industry is in US dollars. The complexity of offering the right product at the right time and at a competitive price in the right market represents an enormous challenge for the Austrian supplier industry and for OEM manufacturers. The following projects represent an overview of Austrian achievements in the area of "general aviation".

*Tom Enders, President and Chief Executive Officer of Airbus:*

*"Thanks to the existing co-operation with Austria, the companies in the aeronautics industry in our countries are able to upgrade their products with the use of complementary technologies. With the help of these new products, we can develop and successfully enter new markets. Between aeronautics products for general aviation and large-capacity aircraft such as the Airbus A350 XWB there is the possibility for mutually learning about the most modern technologies. These are in the areas of compound materials, production, communication infrastructure, safety and environmental technology and can be further developed in co-operative research projects. The TAKE OFF programme, which has promoted transnational projects for many years, makes an important contribution to these efforts."*

# sCAT

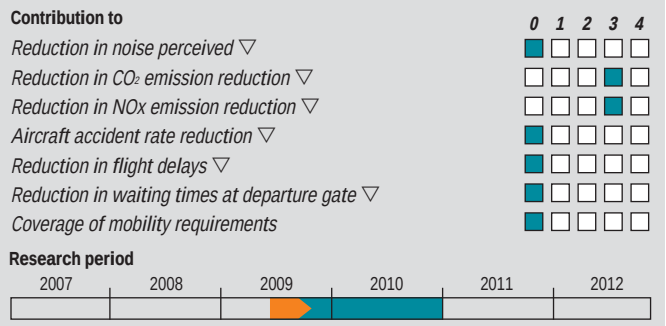
## Conceptual study of small cargo air transporters



The intercontinental courier and express parcel (CEP) markets, with annual turnovers in the billions, represent the backbone of transport and merchandise management (31.3 billion US$ for the U.S. market, 46.4 billion US$ for the EU region in 2005). Current key players utilise the traditional hub and spoke system of network airlines as well as rapidly ageing aircraft fleets for transport to and from central sorting locations. Because of the limitations of the hub and spoke system, time-critical packages, documents, emergency equipment, etc. cannot be transported in under 12 hours. Current estimates show that with a guaranteed transport time of ca. 10 hours, integrators in the logistics sector allow one to expect an additional market share of ca. 25%.

The goal of the small cargo air transporter concept is to provide the integrators for time-critical and consequently high-price transports. This will establish and offer point-to-point traffic routes. With the aid of this study, the market chances for end customers and aircraft manufacturers will also be investigated.

The entire concept comprises three project phases. The technical feasibility study constitutes the first phase and is concerned with a detailed market analysis of the CEP markets in the United States and Europe. This will determine the additional market potential with the aid of a computational and forecasting model, an analysis of competition and adaptation potential for existing aircraft manufacturers of business aircraft and in the segment of very light jet aircraft (VLJ). The analysis yields information about current aeronautics parameters such as range and load capacity. The final result is a concept for assessing the aerodynamic feasibility (wing design, cabin, H tail and V tail). This also evaluates the basic concept for the sCAT, taking into consideration weight and capacity.


### Info box

***Project type:*** *Stimulation project/technical feasibility study*

***Project co-ordinator:***

*European Training and Research Institut*
*Johannes Bachler*
*Schaufelberg 63, A-8380 Jennersdorf*
*bachler@etri.org, www.etri.org*

***Partner:***

*FH JOANNEUM Gesellschaft mbH*

# ASRJ

## Austrian small regional jet



This project incorporates a fundamental investigation into the feasibility and production of a regional jet in Austria for 19 to 45 passengers. The challenges lay in the evaluation of competitive production and operating costs, as well as the utilisation of the most modern technology along with successfully dealing with conflicting market signals. Furthermore, international partnerships are envisaged in order to cover the complementary expertise in research and development beyond that of the Austrian aeronautics industry and to deal with questions about conveying know-how in both directions.

Successful Austrian manufacturing partners have already been integrated in the project consortium for the potential realisation as well as one international partner with wide-ranging experience.

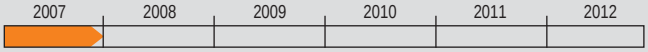
The goal of the project was to obtain clear information within the scope of a feasibility study. This study determined whether technology from the very light jet segment can be utilised for new processes in the compound materials sector and advanced avionics applications in a niche currently becoming increasingly unprofitable with today's aircraft. For a positive market result, the question of whether such a product could be established in Austria with the inclusion of several strategic partners had to be answered as well.

The investigations for the project concentrated on aircraft structures and systems, propulsion technology and avionics. Possible business models were developed and the development phases for the ASRJ defined. Possible domestic and foreign suppliers and know-how expertise were identified, and the foundation and development of the Graz Thalerhof Research and Development Centre was investigated from different perspectives.

**Contribution to**

| | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| *Reduction in noise perceived ▽* | ☐ | ☐ | ☐ | ☐ | ■ |
| *Reduction in $CO_2$ emission reduction ▽* | ☐ | ☐ | ☐ | ☐ | ■ |
| *Reduction in NOx emission reduction ▽* | ☐ | ☐ | ☐ | ☐ | ■ |
| *Aircraft accident rate reduction ▽* | ☐ | ☐ | ■ | ☐ | ☐ |
| *Reduction in flight delays ▽* | ☐ | ☐ | ☐ | ☐ | ■ |
| *Reduction in waiting times at departure gate ▽* | ☐ | ☐ | ☐ | ■ | ☐ |
| *Coverage of mobility requirements* | ☐ | ☐ | ☐ | ☐ | ■ |

**Research period**




### *Info box*

***Project type:*** *Stimulation/technical feasibility study*

***Project co-ordinator:***

*LKR Leichtmetallkompetenzzentrum Ranshofen GmbH*
*Rudolf Gradinger*
*Postfach 26, A-5282 Ranshofen*
*rudolf.gradinger@ait.ac.at, www.ait.ac.at*

***Partners:***

*MChE Trading Handelsges. mbH*

# FSA

## Future small aircraft



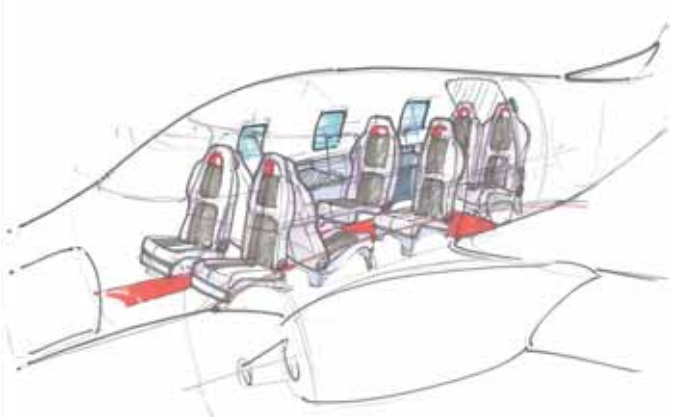
The goal of the consortium was the rapid development and realisation of market-driven, modern and highly efficient travel and business aircraft (Future Small Aircraft) in the general aviation class. Within the scope of the project, a certifiable prototype is to be developed and produced. This combines very high efficiency and safety, a high level of comfort, drastically reduced operating costs, and significant reduction of $CO_2$ and NOX emissions.

The consortium has already been formed and takes the potential future realisation of the research results into consideration.

In the first phase of the project, within four months several basic concepts are being developed in an inter-disciplinary process. This is based on the fundamental configuration and design of business aircraft as well as already existing marketing and feasibility studies. The exact definition of the development goals are set by a panel of experts which examine these basic concepts to arrive at the optimal concept for the new small aircraft.

Finally, a detailed technical concept will be developed down to the main assembly level. This will allow the optimising of costs and functions. A detailed production analysis will also be performed in order to anticipate consequences for further development and preclude wrong decisions.

Maximum cost efficiency will result from optimised load capacity and numbers of passengers. This in turn leads to low fuel consumption and a high travel speed, realised above all by the use of modern, fuel-saving, preferably diesel-driven propulsion and a drastic weight reduction due to high-end carbon fibre bundle technology.



**Contribution to**

| | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| *Reduction in noise perceived ▽* | ☐ | ■ | ☐ | ☐ | ☐ |
| *Reduction in $CO_2$ emission reduction ▽* | ☐ | ☐ | ☐ | ☐ | ■ |
| *Reduction in NOx emission reduction ▽* | ☐ | ☐ | ☐ | ☐ | ■ |
| *Aircraft accident rate reduction ▽* | ☐ | ☐ | ☐ | ☐ | ■ |
| *Reduction in flight delays ▽* | ☐ | ■ | ☐ | ☐ | ☐ |
| *Reduction in waiting times at departure gate ▽* | ☐ | ■ | ☐ | ☐ | ☐ |
| *Coverage of mobility requirements* | ☐ | ☐ | ☐ | ■ | ☐ |

**Research period**


### *Info box*

***Project type:*** *Co-operative project/pilot project*

***Project co-ordinator:***

*Diamond Aircraft Industries GmbH*
*Roland Zeillinger*
*N.A.-Otto Straße 5, A-2700 Wiener Neustadt*
*r.zeillinger@diamond-air.at*

***Partners:***

*Lynx Composites GmbH*
*AEG – Austro Engine GmbH*
*Johannes Kepler University of Linz, Department of Fluid Mechanics and Heat Transmission*

# B Complex Aircraft Structures and Components, Innovative Materials, Manufacturing Techniques

## Research Results 2007-2009



Today, technical systems have reached such a level of complexity that further improvements are possible only with multi-disciplinary system approaches. Here, the materials play a central role as their availability frequently determines whether the overall system can be produced. Nevertheless, research and development in the area of new materials alone is not sufficient. Producibility, availability and, last but not least, the costs of marketability and technical applicability of a material are equally important.

In the context of productivity, costs, process reliability and product quality, the focus of discussion in aeronautics is predominantly in the fields of material-specific requirements for the production of light metals and plastics. The realisation of specific component properties for realistic loading and environmental conditions via production processes is also important here. In particular scandium, magnesium, nickel-based, aluminium and titanium alloys (on the metallic side) and fibre-reinforced plastics (carbon fibre laminates and carbon laminate reinforced plastics), duromer matrix systems, nano-fillers, and nano-particle based exoxide compound materials (on the non-metallic side) are the focus of research for improving strength and rigidity.

In order to obtain components or even aircraft structures with the required material-specific properties from the starting materials, numerical simulation in advance of the production process is an important step in product development. Thus, research is continuously challenged to maintain pace with the increasing complexity of products and the demand for ever shorter development times. This requires the constant development of computer-supported engineering tools. Additionally linking with production and production scheduling simulation software, such tools (e.g. FEM, CAD, DMU, FSI) can prove very useful for product analysis and product optimisation (e.g. virtual reality, rapid prototyping, OrCAD, Simulink).

The complexity of today's production demands the knowledge and command of many individual details. Only the interplay of these details for product and process innovations will enable us to meet the requirements for integration in future generations of aircraft. Here, TAKE OFF would like to make a pro-active contribution

*Prof. Dieter Schmitt, Research Management and Technology, Bauhaus Luftfahrt e.V.:*

*"Bauhaus Luftfahrt is a think tank for the development of a sustainable and innovative future – solutions for air travel and air transport of tomorrow and beyond. The aim of our research work is to look at the complex aviation system from multiple viewpoints. For all projects, the technological, commercial, societal and ecological issues are taken into account. Since 2002 the Austrian research support programme TAKE OFF has encouraged innovative, high-tech projects to strengthen the Austrian aviation industry, making Austria an important contributor to the aviation of tomorrow."*

# Igel[2]

## Innovative principles of design for lightweight composite compounds in aeronautical structures



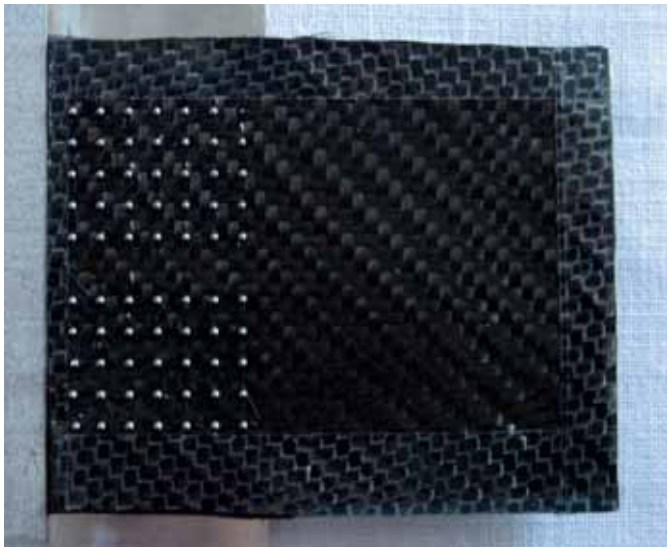
Today there is a marked increase in the use of carbon fibre laminates in primary aircraft structures. This leads to the requirement for improving the load transmission at the interfaces between carbon fibre laminates and metallic parts in respect to the acceptable forces and weights.

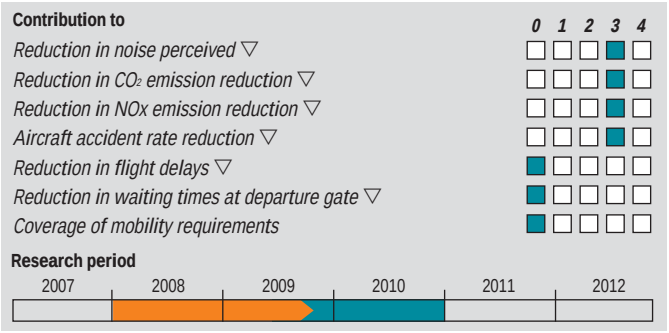
The goal of the project is the development of a new, innovative type of joining technology and the validation of the applicability of this bond for highly stressed and safety-relevant components. For this purpose, the special preliminary work of four companies was utilised and combined with the shared expertise of all eight partners in the areas of welding, bonding, plastic and fibre processing, computer-aided design (CAD) construction and finite element (FEM) methods of calculation. As a second focal activity, in an analogous approach the thermo-technical optimisation and the wear optimisation of tools for carbon fibre laminate production will be investigated.

In this project, innovative design principles for lightweight compound materials in aeronautical structures will be examined. The focus of development work is on the production of an efficient, non-detachable bonding which can fail only with very high plastic deformation energy. It is based on the mechanical interaction of thin wire sections welded to the metallic surface and the carbon fibre laminate fabric. This requires the development of both deposit welding process technology and production technology for attaching the carbon fibre laminates to the metallic parts with prepared wire sections, taking application aspects into consideration.

In order to validate the suitability of this bond for highly stressed and safety-relevant components, the wire sections must be researched and optimised, and the bonds must be tested as component-like parts and as model components. This also requires the utilisation of scientific finite element method (FEM) studies well beyond the state of the art.

For hybrid material concepts, a similar approach is followed. This entails the fundamental description of concept feasibility and the follow-up manufacture of tool-like structures to be tested under serial conditions. For both development focal points, benchmarking was performed in respect to today's technological state of the art in order to evaluate the improvement in performance. The applications range from load-bearing propulsion cover parts all the way to drive shafts for control surfaces and helicopter tail rotors.






### Info box

***Project type:*** *Co-operative project*

***Project co-ordinator:***

*AIT – Austrian Institute of Technology, Mobility Department*
*LKR Leichtmetallkompetenzzentrum Ranshofen GmbH*
*Rudolf Gradinger*
*Postfach 26, A-5282 Ranshofen*
*rudolf.gradinger@ait.ac.at, www.lkr.at*

***Partners:***

*FACC AG*
*Teufelberger GmbH*
*Fronius International GmbH*
*Alulight International GmbH*
*Joh. Fuchs & Sohn GesmbH*
*Welser Profile AG*
*SG concepts GmbH*

# ALUSTAN

## Study of the development of aluminium material options for use in air-jet propulsion

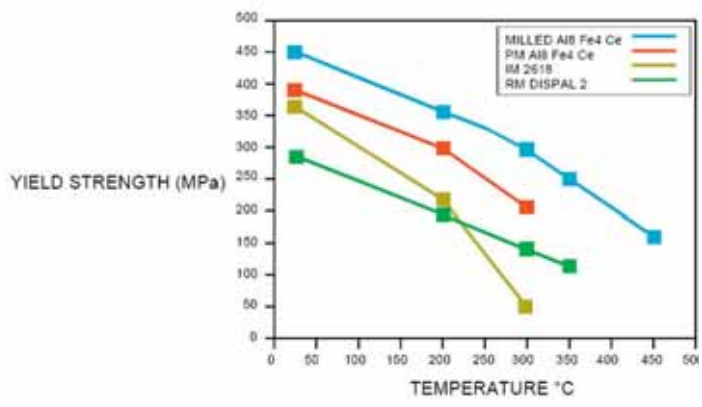


The ACARE targets for reduced environmental pollution and simultaneous improvements in performance, together with the reduction of weight and costs are very stringent. Aircraft engine manufacturers are therefore pursuing ambitious approaches for new materials, types of construction and production technology.

The purpose of the study was to determine the potential for special aluminium alloys and to evaluate aluminium material properties for use in propulsion. Furthermore, the possible production and processing steps along the supplier chain with value added contributions in Austria were evaluated.

As metallurgical prerequisites for heat strength, no detachment and/or transformation of the strength-enhancing phases may take place at the working temperature under mechanical load. Furthermore, no Ostwald ripening may occur at the working temperature and, for high-temperature applications, the amount of grain boundaries must be as low as possible in order to prevent the occurrence of creep phenomena. Studies were performed with certain common and innovative alloys, and detailed arguments considered. Analogously, possible lamination systems (metallic coatings, ceramic coatings, metal-ceramic coatings, metal-ceramic multi-layers, diamond and diamond-like coatings, polymer-ceramic coatings and polymer-based layers) were investigated and analysed in order to arrive at definite bonding concepts for the selected alloys.

The project was structured so that, following an analysis of the existing solutions, the marginal conditions and criteria for aluminium components in the high-pressure compressor of aircraft engines could be identified. Following comprehensive literature and patent searches for aluminium-based material concepts and compatible surface technologies, these were evaluated in detail with a focus on their service life. A number of options emerged, enabling the determination of a possible supplier structure using mostly Austrian companies. Besides the reference values for heat strength and fatigue strength, criteria for corrosion and erosion resistance and damage to aircraft due to foreign objects (FOD) were also considered.




| Contribution to | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| *Reduction in noise perceived ▽* | | | | ■ | |
| *Reduction in $CO_2$ emission reduction ▽* | | | | ■ | |
| *Reduction in NOx emission reduction ▽* | | | | ■ | |
| *Aircraft accident rate reduction ▽* | ■ | | | | |
| *Reduction in flight delays ▽* | ■ | | | | |
| *Reduction in waiting times at departure gate ▽* | ■ | | | | |
| *Coverage of mobility requirements* | ■ | | | | |

**Research period**

| 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|

### *Info box*

***Project type:*** *Stimulation/technical feasibility study*

***Project co-ordinator:***

*AIT – Austrian Institute of Technology, Mobility Department*
*LKR Leichtmetallkompetenzzentrum Ranshofen GmbH*
*Alfred Mundl*
*Postfach 26, A-5282 Ranshofen*
*alfred.mundl@ait.ac.at, www.lkr.at*

***Partners:***

*AIT – Austrian Institute of Technology*
*MTU Aero Engines GmbH (D)*

# ScaLA

## Scandium-alloyed aluminium materials for highly efficient aeronautics components

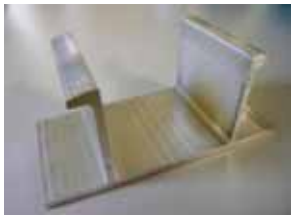


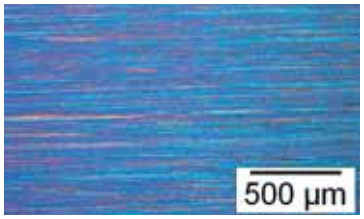
Due to the new conditions imposed by public authorities, aircraft operators and passengers, the developers of aircraft structures are required to pursue ambitious approaches for new materials, designs and production technology. The basis for the metallurgical concept of such a new type of material, with the name scallmalloy, is a new generation of high-strength, tough, corrosion-resistant aluminium-magnesium-scandium-zirconium alloys suitable for welding. The addition of high concentrations of scandium and zirconium to aluminium alloys of the magnesium-aluminium type potentially results in excellent properties in respect to strength, toughness, suitability for welding and corrosion resistance. This alloying concept was of particular interest for the fuselage of the Airbus A320-NG.

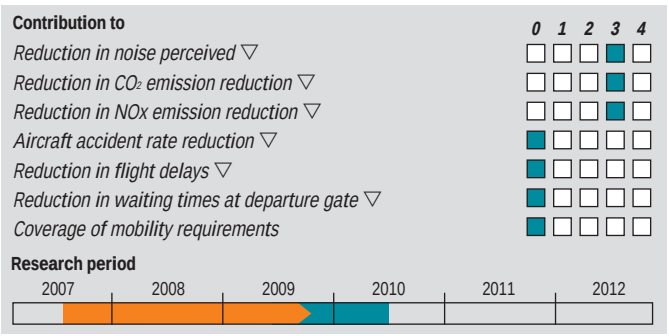
The overriding goal of the consortium is to identify the possibilities for new types of alloys to the extent possible. This is based on collective know-how and the related system technology in order to evaluate approaches for future applications.

In this project, the different companies assume certain duties consistent with the range of capabilities of each partner. The processes investigated include extrusion, closed-die forging, strip casting with a rapid solidification characteristic, cold roll forming, roller profiling of sheets and welding using the most modern processes. Furthermore, the research partners and foreign partners make crucial contributions to the experiments and analyses. The latter contributes the basic principles of scalmalloy technology and also knowledge of potential applications in aviation. The prerequisite of a rapid solidification process limits the possibilities for the use of the scalmalloy family of alloys in various industrial processes.

While experience was already available for the melt spinning, fragmentation and hot isostatic pressing (HIP) up to extrusion pressing production processes, the choice of continuous strip casting represents a new area of investigation. The combination of both production processes opens up possibilities for a broad demonstration of semi-finished parts and prototype components. This represents an opportunity for Austrian industrial partners to occupy a new niche well in advance of implementation.






### *Info box*

***Project type:*** *Co-operative project*

***Project co-ordinator:***

*AIT – Austrian Institute of Technology, Mobility Department*
*LKR Leichtmetallkompetenzzentrum Ranshofen GmbH*
*Maria Kühlein*
*Lamprechsthausenerstraße, PF 26, A-5282 Ranshofen*
*maria.kuehlein@ait.ac.at, www.lkr.at*

***Partners:***

*Hammerer Aluminium Industries GmbH*
*AMAG rolling GmbH*
*Fronius International GmbH*
*Neuman Aluminium Austria GmbH*
*FRANZ RÜBIG & SÖHNE GmbH & Co KG*
*Welser Profile AG*
*EADS Deutschland GmbH (D)*
*Bauhaus Luftfahrt e.V. (D)*

# Anti-Ice

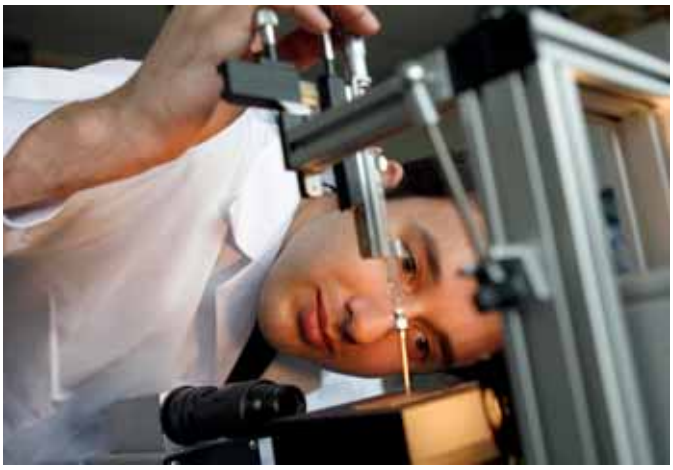
## Anti-icing/de-icing systems to improve aircraft performance and safety



Operating aircraft under adverse weather conditions can result in the icing of aircraft parts. This is not only a problem in terms of performance and convenience, but also represents a considerable safety risk. Icing has led to numerous plane crashes and remains one of the most critical aviation safety risks.

The goal of the project is the manufacture of new and innovative materials as a surface coating for aircraft to prevent icing. Furthermore, micro-mechanical (piezo) actuators will be developed for active de-icing. All test samples are tested in an adaptive wind tunnel in which icing conditions can be simulated. Simulation tools are also tested for their applicability. The results can be applied not only to aviation but also to the automotive industry, wind parks, architecture, water transport and more.

In the course of the project, the initial phase analyses the conditions leading to the formation of ice and at the same time investigates the adhesion properties of ice. Three different approaches to the problem are taken. The first of these investigates ice prevention by reducing adhesion with the use of a chemical surface coating. Another approach attempts to actively remove ice using piezo actuators. In addition, an attempt is made to simulate ice formation, together with the testing of samples in the ice wind tunnel. The aeronautics industry is taking part in the project and the results will be evaluated in respect to their relevance and applicability.



**Contribution to**

| | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| *Reduction in noise perceived ▽* | ■ | □ | □ | □ | □ |
| *Reduction in $CO_2$ emission reduction ▽* | □ | ■ | □ | □ | □ |
| *Reduction in NOx emission reduction ▽* | □ | ■ | □ | □ | □ |
| *Aircraft accident rate reduction ▽* | □ | □ | □ | □ | ■ |
| *Reduction in flight delays ▽* | □ | □ | ■ | □ | □ |
| *Reduction in waiting times at departure gate ▽* | □ | □ | ■ | □ | □ |
| *Coverage of mobility requirements* | □ | □ | ■ | □ | □ |

**Research period**


### *Info box*

***Project type:*** *Stimulation/technical feasibility study*

***Project co-ordinator:***

*AIT – Austrian Institute of Technology*
*Erich Kny*
*Research Centre, A-2244 Seibersdorf*
*erich.kny@ait.ac.at, www.ait.ac.at*

***Partners:***

*PROFACTOR GmbH*
*LKR Leichtmetallkompetenzzentrum Ranshofen GmbH*
*JOANNEUM University of Applied Science*
*AMES – Aerospace and Mechanical Engineering Services Ing Walter Starzacher GmbH*

# MITI64

## Modelling of microstructural changes in the thermo-mechanical treatment of the α-β titanium alloy Ti-6Al-4V and the influences on mechanical properties

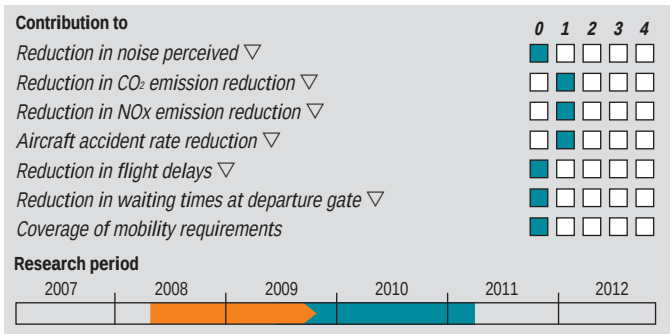


Due to the high costs of basic materials, all aeronautics customers strive to save costs on the way to the finished component. A cost reduction can be achieved with alloys by using special production processes. These include β-forging or a highly targeted orientation of the complete thermo-mechanical process in the direction of forging close to the end contours. In order to implement this and at the same time guarantee the mechanical properties specified by the customer, it is necessary to simulate the process in advance. In order to obtain possible component properties, it is also necessary to investigate the micro-structure.

The essential goal of the project is to understand and describe the metallurgical processes in the thermo-mechanical treatment of the titanium alloy Ti-6Al-4V. This must handle chemical variations well enough to enable the reliable prediction of the micro-structure of closed die-forged parts and thus their mechanical properties.

Following an initial literature search, primary material investigations of micro-structure and phase transformation kinetics were performed. Forming and heat treatment investigations of the physical-metallurgical processes were then carried out on a laboratory scale. Finally, microscopic examinations of the samples and the forged verification parts were performed. This was for the quantification of micro-structural changes during thermo-mechanical treatment in order to ultimately model the physical-metallurgical processes and to program a finite element user routine. Furthermore, a verification of the model will be undertaken. Essential milestones are the quantification of the micro-structural characteristics, as well as the possibilities for modelling the physical-metallurgical processes.

In the first year of the project, the micro-structures of two different primary material batches were investigated as a function of temperature and time. In addition, the first components for verification studies were forged. Deformation investigations in the laboratory followed by different heat treatment regimes will allow the quantitative description of micro-structural changes for this alloy. Micro-structural models based on these data, which will be coupled with commercially available finite element codes, will then enable the design of forging processes with an aim being the realisation of optimal mechanical properties. This will result in a competitive advantage.




### Info box

***Project type:*** *Co-operative project*

***Project co-ordinator:***

*Böhler Schmiedetechnik GmbH & Co KG*
*Martin Stockinger*
*Mariazellerstraße 26, A-8605 Kapfenberg*
*martin.stockinger@bohler-forging.com, www.bohler-forging.com*

***Partners:***

*Technical University of Vienna, Department of Materials Science and Materials Technology*

# TIZ²

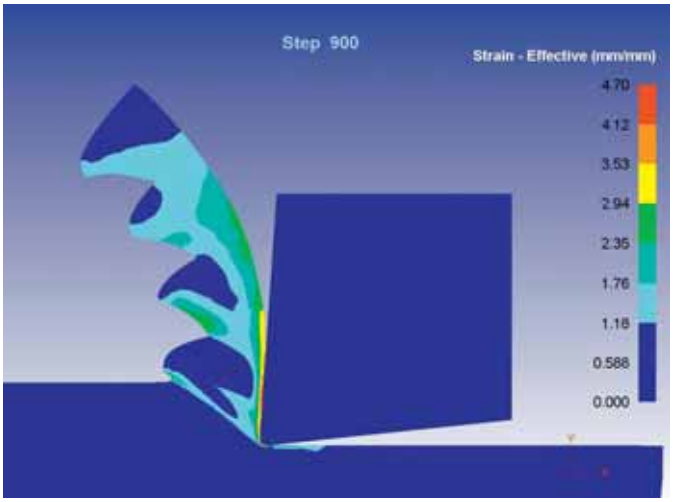
## Highly economical titanium chip removal – second point of emphasis

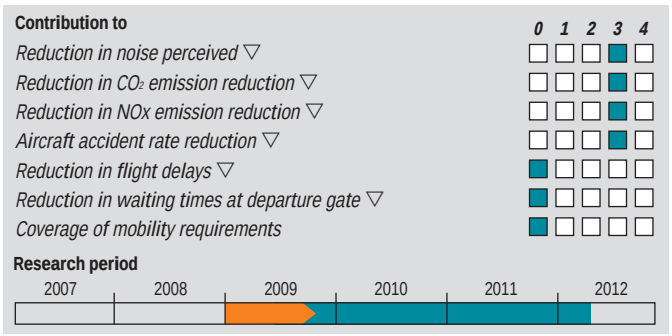


Due to its physical, mechanical and thermal properties, the lightweight construction material titanium is among the materials which are difficult to machine. The difficulty with the machining of titanium is seen above all in the following facts: because of the relatively low thermal absorption of titanium splinters, with low specific heat values, the cutting edge of the tool is subjected to high thermal stress. Due to its low modulus of elasticity, titanium yields to the pressure of the cutting tool, causing dimensional deviations and component tolerance problems and possibly oscillations of the tool. The latter generally accelerates tool wear. Titanium also tends to fuse to the tool (keywords: adherence, built-up edges).

The goal of this project is to achieve technological supremacy in titanium machining, ahead of the USA and Japan. This entails improving process reliability for the increasing complexity of components, with a performance increase greater than 100% compared to today's machining. The consortium partners can directly implement and utilise the results in aviation, where a large growth in titanium applications is predicted. Applications in other industries such as the automotive, racing, aerospace, energy and medical engineering sectors are also under consideration.

The consortium is seeking to achieve vast improvements and optimisation in titanium machining. This focuses on turning with indexible inserts and milling with solid carbides. The parallel investigation of both machining processes should identify synergetic effects and reduce the risks for the individual partner companies. The many specialised areas of expertise of the partner companies represent a solid basis for ensuring the success of the project. Decisive for the optimisation is to be able to achieve a high-quality compromise between a sharp cutting tool, high mechanical stability and good thermal strength.




### *Info box*

***Project type:*** *Co-operative project*

***Project co-ordinator:***

*AIT – Austrian Institute of Technology, Mobility Department*
*LKR Leichtmetallkompetenzzentrum Ranshofen GmbH*
*Rudolf Gradinger*
*Postfach 26, A-5282 Ranshofen*
*rudolf.gradinger@ait.ac.at, www.ait.ac.at*

***Partners:***

*WEDCO Handelsgesellschaft m.b.H.*
*Boehlerit GmbH & Co. KG*
*Pankl Aerospace Systems Europe GmbH*
*AIT – Austrian Institute of Technology*
*PROFACTOR GmbH*
*S&I Technologies DI Erwin Reiss GmbH*
*Premium Aerotec GmbH (D)*

# EXMAIR

## Use of EXJECTION technology for aircraft components



In the aviation sector, thin-walled profiles of aviation-specific high-performance thermo-plastics are particularly important aircraft components. Currently, these are predominantly manufactured in extrusion processes and adapted in laborious post-treatment processes to the requirements of the respective application. At present, these profiles can be manufactured only with compromises in quality or at high costs. This is due to the fact that either greater wall thickness is necessary for the stamping of the parts or it is necessary to manufacture these from plastic materials which are not optimal for the respective application. Usually, the material best suited for extrusion cannot be machined.

With this research project, the system, process and material-specific principles for the machining of aeronautical materials are investigated in the EXJECTION® process (combining the advantages of extrusion and injection moulding). The goal is the systematic study of production know-how. As a basis for follow-on experimental development, it will then be possible to produce components from aeronautical materials with the new technology.

On the basis of a still to be developed component geometry suitable for aviation requirements, a corresponding research form will be constructed. This will allow for the carrying out of experiments with aeronautics materials. Here, the limits in terms of wall thickness reduction will be determined considering the serial production of plastic parts. Parallel to this, data for the process reliability of the EXJECTION® process and the suitability of different metallic forming materials for important mould materials will be investigated. Furthermore, the development tools will be further developed in the simulation area in order to obtain the best possible match between the simulation results and the process flow actually observed.

The partners in this research project can further consolidate their position as established developers of aircraft components for large aviation companies. These include Airbus and Boeing. Based on the already existing EXJECTION® technology, this further development will give the consortium a considerable edge in development in relation to its competitors. The co-operation of the partners enables the complete range of activities, from the development of aeronautics parts through the design and manufacture of production tools as well as the delivery of plastic components to aviation companies.



**Contribution to**

| | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| *Reduction in noise perceived ▽* | ☐ | ■ | ☐ | ☐ | ☐ |
| *Reduction in $CO_2$ emission reduction ▽* | ☐ | ☐ | ☐ | ■ | ☐ |
| *Reduction in NOx emission reduction ▽* | ☐ | ☐ | ☐ | ■ | ☐ |
| *Aircraft accident rate reduction ▽* | ■ | ☐ | ☐ | ☐ | ☐ |
| *Reduction in flight delays ▽* | ■ | ☐ | ☐ | ☐ | ☐ |
| *Reduction in waiting times at departure gate ▽* | ■ | ☐ | ☐ | ☐ | ☐ |
| *Coverage of mobility requirements* | ☐ | ☐ | ☐ | ☐ | ☐ |

**Research period**


### *Info box*

***Project type:*** *Co-operative project*

***Project co-ordinator:***

*IB STEINER – Engineering office for plastics technology*
*Gottfried Steiner*
*Poststrasse 12, A-8724 Spielberg*
*g.steiner@ibsteiner.com, www.ibsteiner.com*

***Partners:***

*DEMA Engineering GmbH*
*HYBRID COMPOSITE PRODUCTS GmbH*

# Sprayforming

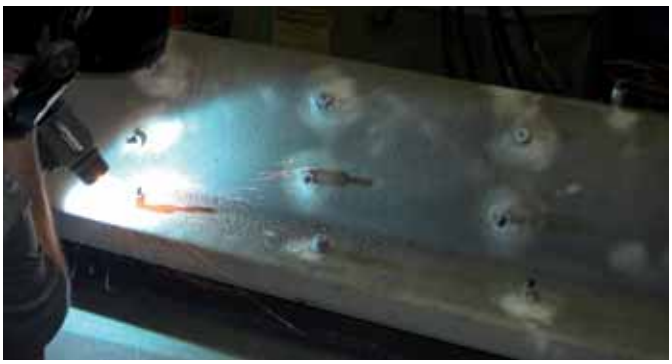
## Manufacture of carbon fibre laminate aeronautical production tools using thermal metal spraying

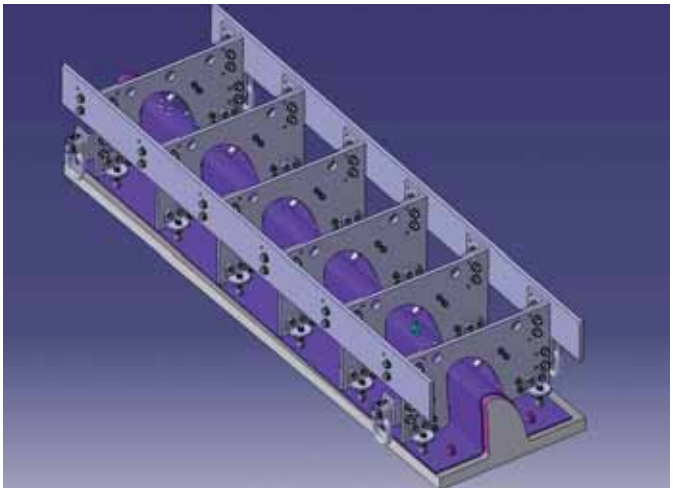


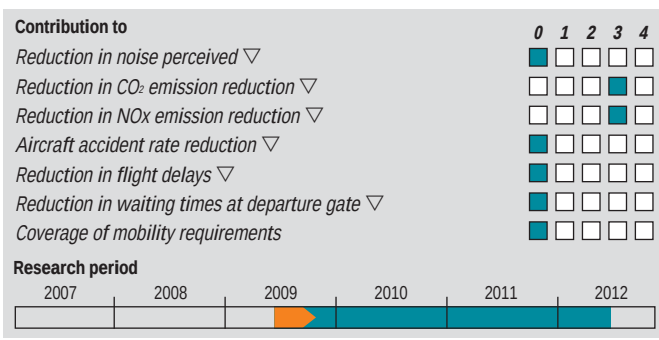
With the pronounced trend towards lightweight construction, aircraft structures are increasingly manufactured from carbon fibre laminate reinforced plastics. Since the introduction of these materials in civil aviation, the fraction of such structures has now increased to around 30% (see Airbus A380). For the Boeing 787, which is still in development, this fraction is 50%. For the current Airbus A350XWB programme, the carbon fibre laminate fraction will be even more than 50%. Consequently, the requirement for innovative tools and equipment for the production of fibre bundle components will dramatically increase in the coming years.

The goal of the German-Austrian co-operative "Sprayforming" project is therefore the development of a new and more cost-effective technology for the manufacture of fibre bundle component production moulds based on thermal spraying. This "bottom up" process will be used particularly with tools for geometrically complex and/or large-area carbon fibre laminate components. Sprayforming assumes the role of an alternative scientific technology to classical machining and electroplating. It also enables the integration of additional functions such as form- fitting heating/cooling or sensors. The process for the economically viable production of INVAR tools can considerably reduce material consumption and the throughput times for tool production.

For the manufacture of large-area, complex curved carbon fibre laminate structures, moulding tools are required. These must guarantee absolute dimensional accuracy and complete vacuum integrity. Because of the process temperatures of 180°C, many tools have been and will continue to be manufactured from INVAR steels with high nickel content (NiFe36). This alloy exhibits virtually no thermal expansion and therefore corresponds exactly to the thermal expansion behaviour of carbon fibre laminates. The production tooling is usually produced by the machining of block and plate material from carbon fibre or by electroplating. In particularly for large, saucer-type tools, the first variant is very costly as up to 80% of the material is wasted in machining in the form of milling splinters.








### *Info box*

***Project type:*** *Co-operative project*

***Project co-ordinator:***

*Westcam Fertigungstechnik GmbH*
*Marcel Klautzsch*
*Gewerbepark 38, A-6068 Mils*
*marcel.klautzsch@westcam.at, www.westcam.at*

***Partners:***

*EADS Deutschland GmbH, Innovation Works (D)*
*SCHMUHL Faserverbundtechnik GmbH & Co KG (D)*
*Quickstep GmbH (D)*
*University of the German Armed Forces Munich, Laboratory for Plasma Technology (D)*
*Zierhut Messtechnik GmbH (D)*
*Neue Materialien Bayreuth GmbH (D)*

# Multi-Carbon Braiding System

## Development of a geometry-controlled manufacturing process for carbon fibre stringer and hollow section profiles



Stringers of carbon fibre laminates are currently manufactured with prepreg technology. With this process, the technical structure is manufactured layer-by-layer and then hardened by autoclaving or pressing equipment. The process entails high investment and personnel costs. Furthermore, component manufacture utilising the prepreg process is possible only up to certain lengths. While currently ca. 10,000 linear metres per year can be produced on the basis of carbon, this figure is expected to rise to 2,500,000 linear metres per year within the next 10 years.

The goal of this project is the development of a new process for the manufacture of stringers and hollow section profiles. This is on the basis of carbon fibres, with a "multi-braiding system" for linear and curved profiles for the aviation industry. The essential innovation for this development is a continuous online process based on the integration of several machines, and not on a pressing method. This process braids, pre-shapes and hardens the component to the required geometry.

Besides the advantages described above this development aims to minimise costs and open up new areas of application. These will be decisive factors for the customers. The use of the multi-carbon braiding systems is planned for manufacture of special stringers and hollow profiles of carbon-based components. Above all, this is of interest for Airbus A350XWB and Airbus A320NG applications. The versatile design possibilities also allow further applications for other aircraft types and other aircraft manufacturers.

**Contribution to**

| | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| *Reduction in noise perceived ▽* | ■ | □ | □ | □ | □ |
| *Reduction in $CO_2$ emission reduction ▽* | □ | □ | □ | ■ | □ |
| *Reduction in NOx emission reduction ▽* | □ | □ | □ | ■ | □ |
| *Aircraft accident rate reduction ▽* | ■ | □ | □ | □ | □ |
| *Reduction in flight delays ▽* | ■ | □ | □ | □ | □ |
| *Reduction in waiting times at departure gate ▽* | ■ | □ | □ | □ | □ |
| *Coverage of mobility requirements* | ■ | □ | □ | □ | □ |

**Research period**


### *Info box*

***Project type:*** *Co-operative project*

***Project co-ordinator:***
*SECAR Technologie GmbH*
*Karl-Heinz Semlitsch*
*Industriepark 14, A-8680 Mürzzuschlag*
*kh.semlitsch@secar.at, www.secar.at*

***Partners:***
*Benteler SGL GmbH & CO KG*
*Liebherr Aerospace Lindenberg (D)*

# Aircraft Fuselage Assembly

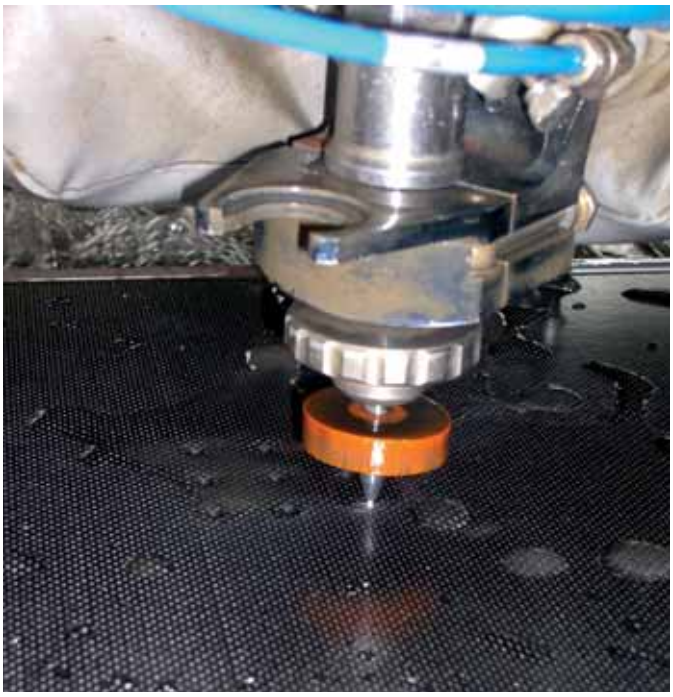
## Innovative assembly concept for aircraft fuselage assembly from fibre-reinforced components

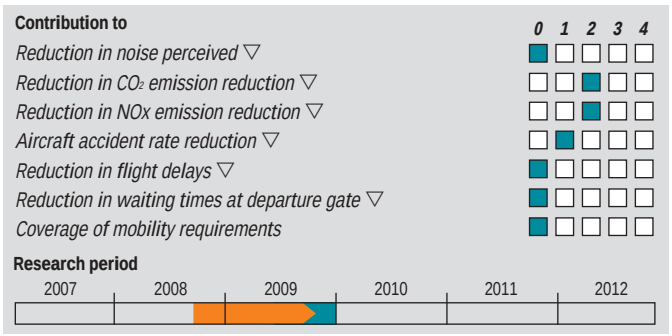


Aircraft fuselages are currently manufactured primarily from metallic materials. In recent years, the amount of material combinations has however increased. As a result of intensive research, above all in the area of materials technology, the non-metallic amount in these combinations is constantly increasing. This requires not only the development of a complete production system but also the development and introduction of new technologies required for the machining of new materials and material combinations.

The goal of this project is to investigate new processing technologies suitable for the machining and assembly of fibre bundle components (water jet cutting, drilling, processing and joining technology, positioning and handling). It is then necessary to validate these for industrial use in the aviation industry in order to contribute to the reduction of $CO_2$ emissions via weight reduction and in order to position and establish the project partners as know-how providers. Another goal of the project is the greatest possible automation of the production process, particularly in the area of aircraft fuselage assembly. Achieving the required accuracy in respect to dimensions (large carbon fibre laminate components) is one of the focal points in this innovative area of technology. This is especially important, as failure to achieve this would prevent or significantly delay the realisation of this technology.

The expectations are concentrated on large technological advance concerning the economically feasible application of water jet machining. This concerns the area of multi-layer fibre-reinforced components and also the further development and optimisation of use for classical drilling technologies for areas in which accessibility precludes the use of new water jet cutting technologies. These new materials demand both new processing and joining technologies and new concepts for their placement and handling.






### Info box

***Project type:*** *Co-operative project*

***Project co-ordinator:***

*MCE-Stahl und Maschinenbau GmbH & Co*
*André Machatzky*
*Lunzerstraße 64, A-4031 Linz*
*Andre.Machatzky@mce-smb.at, www.mce-smb at*

***Partners:***

*ESCAD Austria GmbH*
*PAYR Engineering GmbH*
*PAYR Production GmbH & CoKG*

# C Aircraft Propulsion

## Research Results 2007-2009



Civil air traffic is on the increase, and the use of existing flight routes could more than double by 2026[8]. Nevertheless, the growth of this industry also brings increasing responsibilities as this growth also results in increasing air traffic pollution levels. In order to at least partly compensate for this increase, it is necessary to invest in new technologies. The reduction of $CO_2$ emissions is of greatest interest here as $CO_2$ is unavoidably produced by the combustion of kerosene. ACARE (Advisory Council for Aeronautics Research in Europe), the European technology platform for aeronautics, has already formulated targets for the reduction of noise, carbon dioxide ($CO_2$) and nitrogen oxide (NOx) emissions by the year 2020:

- Reduction of noise emission by 50%
- Reduction of carbon dioxide emissions per passenger kilometre by 50%
- Reduction of nitrogen oxides by 80%

In order to fulfil this vision, it is necessary to examine the aircraft engine, aircraft and flight mission as a single, unified system. Important advances are possible here with the use of new lightweight materials (use of nickel-based, wrought and titanium-aluminium alloys), the improvement of aerodynamics, the application of new aircraft engine concepts (development of a turbofan, with and without shrouding), the improvement of the configuration, and the optimisation of the "all electric aircraft" concept. All of these areas will significantly influence the overall fuel consumption for future generations of aircraft.

For the reduction or prevention of pollutants from aircraft engines, different possibilities are available. These are essentially characterised by the alteration of thermodynamic cycle data, the lowering of fuel consumption, alternative combustion chamber concepts and alternative fuels (methane, hydrogen, bio-fuels, etc.).

The following innovative TAKE OFF research projects show how fuel consumption can be reduced in future generations of aircraft engines. In view of the current focus on the inclusion of the aeronautics industry, this is of interest in relation to emission trading.

*Egon W. Behle, Chief Executive Officer (CEO), MTU Aero Engines GmbH:*

*"Innovation drives our business enterprise and is one of the five strategic pillars of MTU Aero Engines. With over 100 patent applications per year, the firm is secure in its technological lead in its core competencies of low pressure turbines and high pressure compressors as well as high-tech production and maintenance. Strong interconnectedness with partners in industry, education and research is an indispensable prerequisite for the successful development of new technologies. TAKE OFF provides the means for Austrian firms and research institutions to build connections with MTU Aero Engines, developing co-operative endeavours for the realisation of new, environmentally friendly and $CO_2$-reducing engines for a clean future."*

[8] "Summary of the efficiency potentials for aircraft, with special consideration of current aircraft engine technology and predictable developments over the middle-term", requested by the Federal Ministry of the Environment, Nature Conservation and Reactor Safety, by Dr.-Ing. Oliver Lehmann, 25 March, 2008

# 2TTD

## Two-stroke turbodiesel aircraft engines



Requirements which are always important for aircraft engines are reliability, weight, performance, fuel consumption, cost and noise- and environmental compatibility. Diesel motors basically satisfy these requirements. However, the necessary technical know-how is lacking here to be able to combine known physical advantages with aircraft engine reliability. A main starting point for the improvement of the two-stroke motor lies in the area of supercharging.

The goal of this project was the theoretical treatment of the dimensioning of the start-up support for the supercharger. For this, the required amounts of air conveyance, pressures and turbo support power were accordingly investigated. In a general concept, a power flow in (low velocities) and from the supercharger (higher velocities) were defined independently of the type of transmission. The theoretical investigation was also verified under realistic conditions with prototype engines. Within the scope of the study, the properties of two-stroke turbodiesel aircraft engines were investigated. In the course of the study, it was found that this small, lightweight, economical and cost-effective engine shows considerable market promise for generator charging in electric vehicles.

Internationally recognised engine experts also see the two-stroke turbodiesel as a very interesting development. On the basis of the high market volume as a battery charger (range extender) for electric vehicles, an Austrian company has already applied for a patent and is currently working together with interested parties. Extending the range of applications for the two-stroke turbodiesel engine in the aircraft engine area would lead to considerable cost advantages as a result of mass production. It has also been shown that two-stroke turbodiesel engines can satisfy a number of goals set for aircraft engines. These include the reduction of weight, compact design, fuel savings and the closely related lowering of $CO_2$ emissions as well as cost-effective construction.

**Contribution to** *0 1 2 3 4*

- *Reduction in noise perceived* ▽ ☐☐☐☐☐
- *Reduction in $CO_2$ emission reduction* ▽ ☐☐☐☐☐
- *Reduction in NOx emission reduction* ▽ ☐☐☐☐☐
- *Aircraft accident rate reduction* ▽ ☐☐☐☐☐
- *Reduction in flight delays* ▽ ☐☐☐☐☐
- *Reduction in waiting times at departure gate* ▽ ☐☐☐☐☐
- *Coverage of mobility requirements* ☐☐☐☐☐

**Research period**

2007 | 2008 | 2009 | 2010 | 2011 | 2012

### *Info box*

***Project type:*** *Concept initiative*

***Project co-ordinator:***

*Michael Putz*
*Lobaustr. 23/4, A-2301 Groß Enzersdorf*
*michael.putz@putz.st, www.putz.st*

# AELS

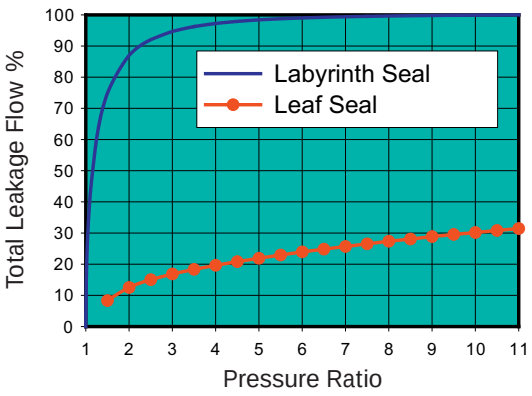
## Feasibility study on the application of leaf seals in aeronautical gas turbines



The essential characteristics of modern aircraft gas turbines are high temperatures, high pressures and high peripheral velocities. The sealing of rotating and stationary components by means of contact seals is therefore not possible. Originally, for this purpose labyrinth seals were used exclusively. As these are contact-free seals, leakage occurs. This can adversely effect the efficiency, and therefore the specific fuel consumption, of the aircraft engine. Recently, a completely new type of seal construction has become a reality; because of its design it is referred to as a leaf seal. The seal is comprised of a large number of thin lamellar plates which offer high resistance to flow. The use of leaf seals is of greatest interest in connection with aircraft gas turbines, and also with stationary gas turbines, steam turbines, electrical machines and general machine tools.

The goal of the project is the development of a computational procedure for the design of leaf seals. This must account for the flow rate, deformation and friction. Above all, the forward-looking seal concept leads to improved aircraft engine performance, in turn reducing fuel consumption.

Within the scope of a feasibility study, it is necessary to answer the question as to whether leaf seals can be utilised in aircraft engines of the future. For this purpose, computational models have been developed which enable the prediction of flow and deformation in the leaf seal. Of particular interest here is the flow behaviour. The target is to reduce leakage by up to 70% compared with a comparable labyrinth seal. The calculated pressure distribution in the leaf seal is also of importance as the special design results in the completely wear-free functioning of the seal. In the future, leaf seals can be employed for vastly higher differential pressures.

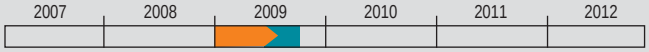



Within the scope of a follow-on project, a small or middle-sized Austrian company will contribute to the practical realisation of the results.

**Contribution to**

| | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| *Reduction in noise perceived ▽* | ☐ | ☐ | ☐ | ☐ | ☐ |
| *Reduction in $CO_2$ emission reduction ▽* | ☐ | ☐ | ☐ | ☐ | ☐ |
| *Reduction in NOx emission reduction ▽* | ☐ | ☐ | ☐ | ☐ | ☐ |
| *Aircraft accident rate reduction ▽* | ☐ | ☐ | ☐ | ☐ | ☐ |
| *Reduction in flight delays ▽* | ☐ | ☐ | ☐ | ☐ | ☐ |
| *Reduction in waiting times at departure gate ▽* | ☐ | ☐ | ☐ | ☐ | ☐ |
| *Coverage of mobility requirements* | ☐ | ☐ | ☐ | ☐ | ☐ |

**Research period**




### Info box

***Project type:*** *Stimulation/technical feasibility study*

***Project co-ordinator:***

*Technical University of Vienna,*
*Department of Thermodynamics and Energy Conversion*
*Reinhard Willinger*
*Getreidemarkt 9 / 302, A-1060 Wien*
*reinhard.willinger@tuwien.ac.at, www.ite.tuwien.ac.at*

***Partners:***

*MTU Aero Engines GmbH (D)*

# CFD-TRANS

## Innovative numerical calculation of trans-sonic flow in highly stressed turbines



The capability of being able to more accurately calculate the trans-sonic flow through turbines in consideration of the laminar-turbulent transition is regarded as one of the key technologies for the future design of efficient, low-noise aircraft engines. A large German aircraft engine manufacturer, an Austrian small/middle-sized company and a department of the Technical University of Graz are therefore combining their specialised knowledge in this project. The goal is to improve the design calculation of aircraft engines beyond the current state of the art of technology.

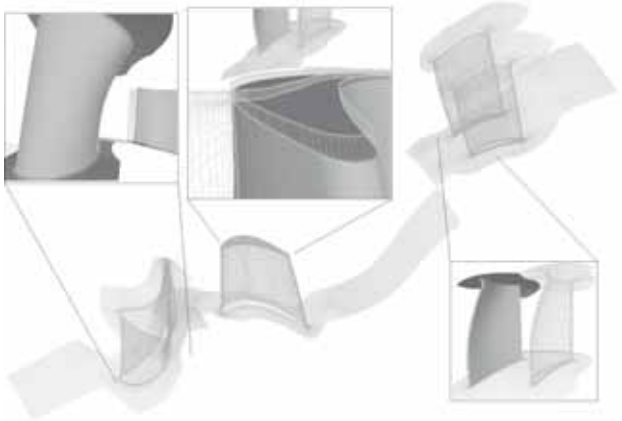
The ultimate aim of the project is to ensure the competitiveness of the project partners, based on the following technical goals:

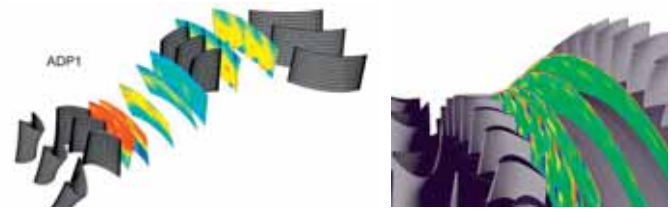
- Development of new numerical approaches for transition and relaminarisation in aircraft engines
- Better understanding of flow processes in aggressively designed turbine transition channels
- New type of mains-driven generator specifically for aircraft engine applications
- Validated analytical methods and "CFD Best Practice Guidelines" for transition channels

This project concentrates on the calculation of complex, three-dimensional flow in turbine stages and in aggressively designed transition channels in which secondary effects, laminar-turbulent transitions and relaminarisation are prevalent. In this project, the non-stationary flow release already developed in the department for turbo machines will be further developed to investigate the reliable consideration of transition and relaminarisation in the boundary layer transition. Above all, this requires the development of empirical models for relaminarisation. Following initial validations, these models were employed for the transition channels measured in the EU project AIDA in order to more precisely describe the flow behaviour. An important final result is the definition of "CFD Best Practice Guidelines" for transition channels in future aircraft engine designs.

Furthermore, a mains-driven generator was developed. This quickly generates high-quality calculation grids, above all in the vicinity of the periphery, as this is necessary for an exact treatment of the boundary layer behaviour.

With this project, the university department can further enhance its expertise in the area of flow modelling in aircraft engines. This improves its chances for taking part in future European research projects. Through its collaboration in the project, S&P can present itself in the future as an expert partner in the solution of special mathematical problems for the aeronautics industry. Using the new tools, MTU Aeroengines hopes to be able to offer better designs for its future aircraft engines.






| Contribution to | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| Reduction in noise perceived ▽ | ■ | □ | □ | □ | □ |
| Reduction in $CO_2$ emission reduction ▽ | □ | □ | ■ | □ | □ |
| Reduction in NOx emission reduction ▽ | □ | □ | ■ | □ | □ |
| Aircraft accident rate reduction ▽ | ■ | □ | □ | □ | □ |
| Reduction in flight delays ▽ | ■ | □ | □ | □ | □ |
| Reduction in waiting times at departure gate ▽ | ■ | □ | □ | □ | □ |
| Coverage of mobility requirements | □ | ■ | □ | □ | □ |

**Research period**


### *Info box*

***Project type:*** *Co-operative project*

***Project co-ordinator:***

*Technical University of Graz,*
*Department of Thermal Turbomachines and Machine Dynamics*
*Wolfgang Sanz*
*Inffeldgasse 25a, A-8010 Graz*
*wolfgang.sanz@tugraz.at, www.ttm.tugraz.at*

***Partners:***

*Springer und Pieringer EDV OEG*
*MTU Aero Engines GmbH (D)*

# D Cabin Equipment (Including Infotainment)

## Research Results 2007-2009



The growth in air traffic in the coming years and decades predicted by the European Commission will inevitably lead to more noise and $CO_2$ emissions, environmental pollution and capacity bottlenecks. In order to best respond to these effects, it is not sufficient to merely further develop the cabin, propulsion, fuels, wing design, etc. These very ambitious goals for environmental effects and safety can be achieved only if the aircraft is viewed and considered as a whole, i.e. including cabin equipment. At the same time, the increasing demand from passengers for greater comfort poses problems here. The increasing requirements for the mobility of society must therefore consider both ecological aspects and comfort aspects while optimising time and costs.

The cabin will be developed along two approaches, namely in the interest of comfort and innovation and in the interest of cost savings. The important key technologies will be found in the area of information technology.

ACARE (Advisory Council for Aeronautics Research in Europe), the European technology platform for aeronautics, has also recognised these needs and formulated them as goals for a future-oriented strategic research agenda (SRA) at the European level.

TAKE OFF is also aware of the explosive nature of the subject of cabins. As a result, TAKE OFF will support advanced technology developments for cabin equipment (complete interior furnishings and interior equipment components), technology for on-board communication, information and entertainment, and for improving the temperature, air pressure, humidity and air circulation, including control elements of the cabin environment. This project will result in improving the cabin environment, passenger satisfaction, a considerable reduction of energy consumption in the aircraft and a substantial weight reduction.

*Frederico Fleury Curado, President & CEO, Embraer – Empresa Brasileira de Aeronautica S.A.*

*"Embraer develops and builds aircraft where new technology is key in creating more value to our customers. Safety, reliability, comfort and reduction in operation costs have been and will remain the major drivers for innovation, together with our goal of contributing to minimize the impact of aviation on the environment.*

*As a player in this very competitive industry we continuously address this challenge by searching globally for the better and most sustainable technological solutions. Austrian companies and the best they have to offer us would be no exception."*

# ConTag

## Contactless identification of aircraft cushions and dress covers with RFID tags



Compelled by the large aircraft manufacturers Airbus and Boeing, at the present time in the aeronautics industry the use of electronic, contact-free identification systems (radio frequency identification, RFID) will be supported. These systems are expected to replace the conventional imprinted, embossed or adhesive markings on aircraft components and equipment objects.

This project will investigate which features an RFID-based identification system, in this case taking the example of aircraft seats and seat covers, must possess in order to permit the use of transponders (tags) for the identification of the specific aircraft equipment.

On the basis of certification requirements, existing standards and commercial considerations, a criterion matrix for the selection of suitable system components was generated. With this as a basis, test scenarios for laboratory and field investigations were defined. In addition, a mobile testing system, a laptop computer with an internet connection to a database, a reading device and the transponders were developed. Seating rows located in the rear section of a Dornier DO-728 were used to simulate a realistic environment for field tests. Tests at the laboratory level were performed in order to investigate such technical factors as environmental influences. Along with these studies, an investigation of the profitability and sustainability of the applied technology was carried out and taken into the final consideration of the system.

The results of this project should enable aviation authority inspectors to obtain information on the equipment installed in the aircraft via contact-free querying. Furthermore, this should also improve the reliability of the equipment by ruling out the mixing up of parts and product piracy. Ultimately, this will improve the cost-effectiveness in the value added chain as the inventory can be managed by the airline with less effort on the part of the personnel.

**Contribution to**

| | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| *Reduction in noise perceived ▽* | ■ | □ | □ | □ | □ |
| *Reduction in $CO_2$ emission reduction ▽* | ■ | □ | □ | □ | □ |
| *Reduction in NOx emission reduction ▽* | ■ | □ | □ | □ | □ |
| *Aircraft accident rate reduction ▽* | □ | □ | ■ | □ | □ |
| *Reduction in flight delays ▽* | □ | □ | ■ | □ | □ |
| *Reduction in waiting times at departure gate ▽* | □ | □ | ■ | □ | □ |
| *Coverage of mobility requirements* | ■ | □ | □ | □ | □ |

**Research period**


### *Info box*

***Project type:*** *Co-operative project*

***Project co-ordinator:***
*JOANNEUM University of Applied Science Aviation*
*Holger Flühr*
*Alte Poststraße 149, A-8020 Graz*
*holger.fluehr@fh-joanneum.at, www.fh-joanneum.at/lav*

***Partners:***
*Greiner PURtec GmbH*
*Austrian Airlines AG*

# NO-WASTE

## New onboard waste management system



The problem of waste disposal on long-distance flights essentially comes from the large volume of waste. At the same time, the difficult handling of this waste, such as the transporting of waste to and from an easily damaged compactor, also poses problems. Due to the European hygiene regulations, separation of waste following the flight is not possible so this must be done directly on-board. Limiting factors are aircraft specifications and a number of European regulations.

The goals of the project are the development of a new waste trolley with vacuum connection and an improved waste management system for on-board wastes as well as the analysis and improvement of waste separation. The new waste trolley is intended for use especially on long-distance flights to replace the compactor, but also on short flights in place of the usual waste trolley. This should reduce the level of waste in the aircraft galleys. The roughly 70kg compactors will be replaced by lighter trolleys in the interest of reducing fuel consumption and emissions. The new waste concept allows a greater amount to be recycled and reduces the accumulation of residual waste, again resulting in cost savings.

The project began with an analysis of waste amounts on-board and the collection and waste separation procedures on selected flights. It also considers other complex waste disposal procedures. At the Vienna airport, two waste separation weeks were already organised. The knowledge gained was considered in the development of the waste trolley and also in the choice of film for compressing the waste. In the final phase, a certification analysis will be performed and the new waste trolley tested in operation.

**Contribution to**

| | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| *Reduction in noise perceived ▽* | ■ | □ | □ | □ | □ |
| *Reduction in $CO_2$ emission reduction ▽* | □ | □ | ■ | □ | □ |
| *Reduction in NOx emission reduction ▽* | □ | □ | ■ | □ | □ |
| *Aircraft accident rate reduction ▽* | ■ | □ | □ | □ | □ |
| *Reduction in flight delays ▽* | ■ | □ | □ | □ | □ |
| *Reduction in waiting times at departure gate ▽* | ■ | □ | □ | □ | □ |
| *Coverage of mobility requirements* | ■ | □ | □ | □ | □ |

**Research period**


### *Infobox*

***Project type:*** *Co-operative project*

***Project co-ordinator:***

*Austrian Airlines AG*
*Anton Novak*
*Office Park 2, A-1300 Vienna airport*
*anton.novak@austrian.com, www.austrianairlines.co.at*

***Partners:***

*denkstatt GmbH*
*Diamond Aircraft Industries GmbH*
*DO & CO Restaurants & Catering AG*
*JOANNEUM Technical University*
*Engineering Office Wolfgang Fuchs*
*ISS Ground Services*

# E Aircraft Electronics/Avionics

## Research Results 2007-2009



The concept of "more electric aircraft" offers a possibility for improving the profitability and environmental compatibility of future passenger aircraft. This goal can be achieved by substituting certain ground supply processes and by the increased use of electronics and mechatronics components, such as for cabin air conditioning, navigation and navigation monitoring.

A focal point of research is thus naturally aircraft avionics, referring to all on-board electrical and electronic devices of the aircraft including the flight instruments. Sub-disciplines of avionics include the systems for flight guidance, flight control, navigation, instrumentation, communication, data transfer, radar and electronic regulation along with aircraft engine monitoring together with the cabin and supply systems. In the newest generations of aircraft, the Bowden guidance cables have been completely replaced by a fly-by-wire control which regulates the actuating drives and therefore such components as the landing flaps, control surfaces, landing gear and thrust reverser function via electrical data bus signals. The goal of "more electric aircraft" is to reduce fuel consumption and improve the reliability of the aircraft systems. In recent years, a number of research projects have already been initiated on the European level (MESEMA, Power Optimised Aircraft, MOET, DRESS, etc.)

TAKE OFF would like to contribute to these efforts as well. Consequently, technological developments in the area of avionics, aligned to the future requirements of SESAR (Single European Sky ATM Research Programme), future-oriented concepts and technologies with an aim to increase modularity and the integration of avionics components and systems, and also projects relating to new de-icing systems. In addition, TAKE OFF welcomes projects relating to "more electric aircraft" and optimised energy management including the application of fuel cells in aircraft. Technology for the reduction of weight in mechanical and hydraulic systems will also be supported within the scope of the programme.

*András Siegler, Director Transport Research, European Commission, DG Research:*

*"The increasing participation of Austrian companies and research institutions in the European Research Framework Programmes is already remarkable. The research projects presented in this brochure contribute to the fostering of Austrian competence in the field of aviation and enable its industry and research institutions to become expert partners in international research projects of the European Framework Programme by gaining experience in consortium management. Austria is one of the partners in the Aeronautics ERA-Net AirTN which has 27 participating organisations. This helps to integrate Austria into the network of European aeronautics research activities. As a result, first transnational calls for proposals have already taken place. They can yield long-term success and will help in deepening co-operation among partners from many European countries."*

# DynCable

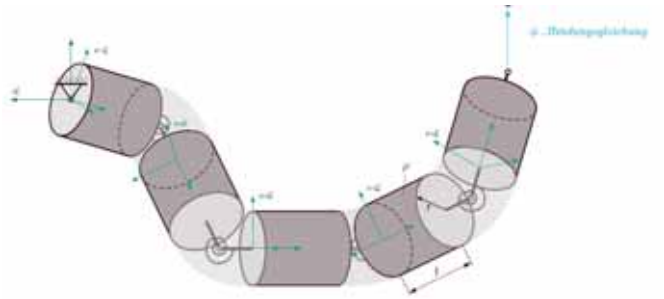
## Energy supply for electric helicopter rotor blade de-icing systems – dynamically stressed cable systems



Today, helicopters are indispensable for a number of civil and military uses. Examples are the rapid provision of care for accident victims, the efficient monitoring of borders and roadways, supplying remote areas and offering help during catastrophes and crises. Increasingly important is the equipment for deployment under icy conditions. For this purpose, electrical heating elements are installed on the main and tail rotors to prevent the formation of ice. The heating cables required for supplying power to the rotor head are subject to high dynamic loads under the most adverse of weather conditions. These results in system failures during operation along with high costs for the maintenance and periodic replacement of these cable systems.

The goal of the project is to define the basis for the development, efficient manufacture and certification of such cable systems and significantly extend service life. This will enable access to the market – both for new developments and for existing prototypes – through supplemental type certificate. The customer profits from lower operating costs, greater technical clarity and the possibility for use under adverse weather conditions in which often no help is possible by helicopter. A strategic goal of the project is the establishment of participating companies as service providers in the helicopter sector and the reduction of dependence upon the civil air traffic cycle.

The consortium combines the expertise in the areas of development, production and flight operation for the development of high-load cable systems with high operational reliability and longer maintenance intervals. At the same time, this lowers manufacturing costs. The combination of the EASA Part 21J certified design organisation and the Part 21G certified production organisation with flight operation expertise ensures that not only development and production but also certification and market access are optimised. Already during technological development, the planned future certifiability in accordance with EASA (European Aviation Safety Agency) design regulations CS-27 and CS-29 is continually checked. In order to better understand the problems of dynamic loading, a simulation model will be developed and verified by testing the existing cable systems in collaboration with the Technical University of Graz.



| Contribution to | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| Reduction in noise perceived ▽ | ■ | □ | □ | □ | □ |
| Reduction in $CO_2$ emission reduction ▽ | ■ | □ | □ | □ | □ |
| Reduction in NOx emission reduction ▽ | ■ | □ | □ | □ | □ |
| Aircraft accident rate reduction ▽ | □ | □ | □ | □ | ■ |
| Reduction in flight delays ▽ | ■ | □ | □ | □ | □ |
| Reduction in waiting times at departure gate ▽ | ■ | □ | □ | □ | □ |
| Coverage of mobility requirements | □ | □ | □ | ■ | □ |

**Research period**


### *Info box*

***Project type:*** *Co-operative project*

***Project co-ordinator:***

*AMES – Aerospace and Mechanical Engineering Services Ing. Walter Starzacher GesmbH*
*Michael Huber*
*Grazerstrasse 10, A-8130 Frohnleiten*
*Michael.Huber@ames.co.at, www.ames.aero*

***Partners:***

*KTS Peter Sporrer Handelsagentur für Kabeltechnik GesmbH*
*Engineering Office Manfred Bleyer*

# MIXVAL

## Mixer simulation and validation

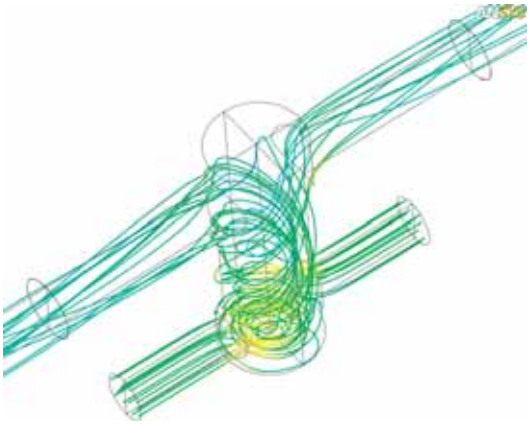


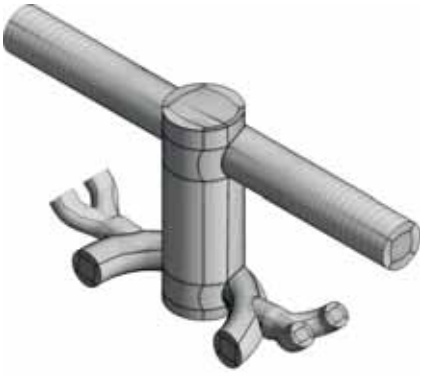
In passenger aircraft, the mixing and distribution of humid air streams are controlled from the cabin and from the aircraft engines into the cockpit and the passenger cabin and also to the electronic components from a central point in the air conditioning system, namely the mixer. This mixture and distribution of humid air streams results in a multi-phase flow with phase transitions which until now cannot be reliably simulated.

The goal of the project is to numerically describe the physical behaviour of this flow and thus develop and validate a method for flow simulation.

Due to mixing and distribution, in the mixer an extremely complex air flow with swirl, shear, temperature layers, humidity layers and mixing is formed. There is also condensation of ice. Up to now, it has not been possible to calculate the flow and heat transfer processes and the formation and accumulation of ice with sufficient accuracy. Consequently, corresponding physical models will be implemented in numerical 3D flow calculation software. These will be experimentally validated and a method for the simulation of the physical processes developed.

The participation of a leading manufacturer of passenger aircraft underscores the topical importance of the project. With the successful realisation of the project, a validated computational model for the simulation of processes in the mixer will be made available. The mixer can then be optimised for a pre-determined function in order to reduce the weight and energy requirements.






| Contribution to | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| *Reduction in noise perceived* ▽ | ■ | □ | □ | □ | □ |
| *Reduction in $CO_2$ emission reduction* ▽ | □ | □ | □ | ■ | □ |
| *Reduction in NOx emission reduction* ▽ | ■ | □ | □ | □ | □ |
| *Aircraft accident rate reduction* ▽ | □ | ■ | □ | □ | □ |
| *Reduction in flight delays* ▽ | ■ | □ | □ | □ | □ |
| *Reduction in waiting times at departure gate* ▽ | ■ | □ | □ | □ | □ |
| *Coverage of mobility requirements* | ■ | □ | □ | □ | □ |

**Research period**


### *Info box*

***Project type:*** *Co-operative project*

***Project co-ordinator:***

*JOANNEUM University of Applied Science, Aviation*
*Bruno Wiesler*
*Alte Poststraße 149, A-8020 Graz*
*bruno.wiesler@fh-joanneum.at, www.fh-joanneum.at/lav*

***Partners:***

*PRISMA Engineering GmbH*
*Technical University of Graz, Department of Fluid Mechanics and Heat Transfer*
*Airbus Deutschland GmbH (D)*

# HPP

## High-performance aviation fuel and lube oil pumps



In aircraft, fuel pumps serve to continuously supply turbines with fuel. Lubricant oil pumps are used to supply lubricating oil circulation in turbines and transmission systems. In recent decades, there have been only a few new developments in the area of fuel and lubre oil pumps. Due to the lightweight construction and the limited installation space necessary for aircraft, small, high-performance, high-speed concepts are required. However, as a result of physical realities these are characterised by poor efficiency. In view of the increasing importance of low emissions ($CO_2$, noise), improvement potential also exists for fuel and lubricating oil pumps.

The project paves the way for the development of high-performance fuel and lubricating oil pumps with greater efficiency and less weight. A 25% reduction in weight should lead to a 40% improvement in efficiency. Another goal is a drastic reduction in the development and approval time for future pump generations.

The project goals will be achieved with the application of new, innovative materials, analytical methods and the numerical simulation of flow optimisation. It will also investigate multi-phase flow modelling for the description of critical flight conditions such as icing of pumps.

At the beginning of the project, an evaluation of the potential for using new types of materials was performed. This was based on powder-metallurgically processed special aluminium alloys for the manufacture of fuel and lubricating oil pumps. On the basis of these investigations, suitable materials were selected, manufacturing processes defined and parts produced for qualification.

In the next phase, the simulation of flow behaviour for the optimisation of pump design will follow with particular emphasis on weight and efficiency. Fuel pump behaviour during icing will also be simulated followed by verification of the results with prototypes.

**Contribution to**

| | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| *Reduction in noise perceived ▽* | ■ | □ | □ | □ | □ |
| *Reduction in $CO_2$ emission reduction ▽* | □ | □ | □ | □ | ■ |
| *Reduction in NOx emission reduction ▽* | □ | □ | □ | □ | ■ |
| *Aircraft accident rate reduction ▽* | ■ | □ | □ | □ | □ |
| *Reduction in flight delays ▽* | ■ | □ | □ | □ | □ |
| *Reduction in waiting times at departure gate ▽* | ■ | □ | □ | □ | □ |
| *Coverage of mobility requirements* | ■ | □ | □ | □ | □ |

**Research period**


### *Info box*

***Project type:*** *Co-operative project*

***Project co-ordinator:***
*TEST-FUCHS GmbH*
*Martin Schuller*
*Test-Fuchs-Straße 1-5, A-3812 Gross Siegharts*
*m.schuller@test-fuchs.com, www.test-fuchs.com*

***Partners:***
*Johannes Kepler University of Linz*
*LKR Leichtmetallkompetenzzentrum Ranshofen*
*Alulight International GmbH*

# LH2 Storage

## Development of a liquid hydrogen storage system for supplying fuel cell systems in aircraft of the future



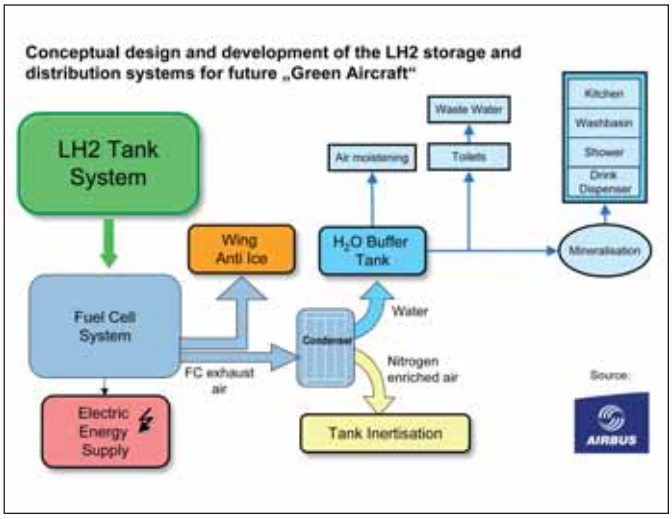
A large European aircraft manufacturer is placing its hopes in fuel cells for the development of the next aircraft generation. This is expected to offer the following advantages for civil aviation:

- Reduction in fuel consumption
- Low-emission operation of aircraft during flight and, particularly, on the ground
- Reduction in the purchase and operating costs
- Introduction of new sustained, environmentally friendlier and more cost-effective technology in civil aviation

The Austrian project partner is a leading company in the area of liquid hydrogen storage. As a development partner, it is therefore seeking to undertake the development and verification of a liquid hydrogen system for supplying fuel cells.

The goal of the current project is the definition and development of a suitable lightweight storage system for use in aircraft using fibre bundle technology. The project also envisages the construction of a test sample for the verification of the sub-system function, followed by integration in the overall system. This represents the basis for further development up to the level of a certifiable liquid hydrogen storage system for use in aviation. With this storage system, the functional requirements of the overall system will be tested up to a technology readiness level (TRL) of six and evaluated in accordance with the specifications.

The common goal of the consortium is to expand its technological leadership in this area over the long-term. This will be based on the concept of innovative, complex, electrical aircraft system architectures. In this German-Austrian project, the technology required for future aircraft programmes will be developed. Applications can be expected in future Airbus products. With the responsibility for system integration in the hands of Airbus, all prerequisites for making use of and marketing this new technology in terms of a mass-produced aeronautics product are ensured.




**Contribution to**

| | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| *Reduction in noise perceived ▽* | | | | | ■ |
| *Reduction in $CO_2$ emission reduction ▽* | | | | | ■ |
| *Reduction in NOx emission reduction ▽* | | | | | ■ |
| *Aircraft accident rate reduction ▽* | | ■ | | | |
| *Reduction in flight delays ▽* | ■ | | | | |
| *Reduction in waiting times at departure gate ▽* | ■ | | | | |
| *Coverage of mobility requirements* | | | ■ | | |

**Research period**


### *Infobox*

***Project type:*** *Co-operative project*

***Project co-ordinator:***

*MAGNA STEYR Fahrzeugtechnik AG & Co KG; Space Technology*
*August Fenz*
*Puchstraße 85, A-8020 Graz*
*august.fenz@magnasteyr.com, www.magnasteyr.com*

***Partners:***

*AIT – Austrian Institute of Technology*
*Airbus Deutschland GmbH (D)*

# CAPTAIN

## COTS Airborne PMC card for time-triggered aerospace interfaces and networks



At the present time, cost reductions are the greatest driving force within the aeronautics industry. The use of so-called off-the-shelf commercial products, that is to say mass produced identical products from the software and electronics sector, allow the distribution of high one-time costs for system design over many customers.

The goal is to develop new aviation hardware for the time-triggered communication within a network and to demonstrate its capabilities by using this hardware in unmanned aircraft (UAV).

The hardware specialist of the consortium has developed the COTS PCI mezzanine card (PMC card) for time-triggered communication. This is based on a time-triggered protocol (TTP) in the aircraft. In order to guarantee the possibility for universal use of the PMC card, an aeronautics and aerospace-specific physical layer and a test environment were also created. Parallel to this, both the software for the embedded central processing unit (CPU) and the software tools for the user were implemented. Starting with the PMC card, a research institution implemented a fly-by-wire system in a simulator which was based on the time-triggered protocol. With a scale model of the aircraft ("iron bird"), the functionality of the time-trigger controlled fly-by-wire solution could be demonstrated and functional tests carried out.

In this project, the first COTS PMC card for the time-triggered communication of a network on the market has been developed and the use of this card in a fly-by-wire application demonstrated. The PMC card can be used for flight tests during the development of civil aircraft, for unmanned aircraft, and in the military sector as a network card for the communication of control and sensor data (e.g. as part of the aircraft communication system). This new development and its demonstration in an unmanned aircraft have strengthened the competitiveness and the market position of the partners in the industrial and university environment.

For the project co-ordinator, this development promises entry to the new distribution market for COTS products which will have a positive effect on turnover growth. Thanks to the inclusion of a research institution, further know-how can also be gained there in the area of time-triggered technology.

**Contribution to**

| | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| Reduction in noise perceived ▽ | ■ | □ | □ | □ | □ |
| Reduction in $CO_2$ emission reduction ▽ | □ | ■ | □ | □ | □ |
| Reduction in NOx emission reduction ▽ | □ | ■ | □ | □ | □ |
| Aircraft accident rate reduction ▽ | □ | □ | ■ | □ | □ |
| Reduction in flight delays ▽ | ■ | □ | □ | □ | □ |
| Reduction in waiting times at departure gate ▽ | ■ | □ | □ | □ | □ |
| Coverage of mobility requirements | □ | ■ | □ | □ | □ |

**Research period**


### Info box

***Project type:*** *Co-operative project*

***Project co-ordinator:***
*TTTech Computertechnik AG*
*Martina Sebastian*
*Schoenbrunner Strasse 7, A-1040 Wien*
*martina.sebastian@tttech.com, www.tttech.com*

***Partners:***
*JOANNEUM University of Applied Science*

# CertLink

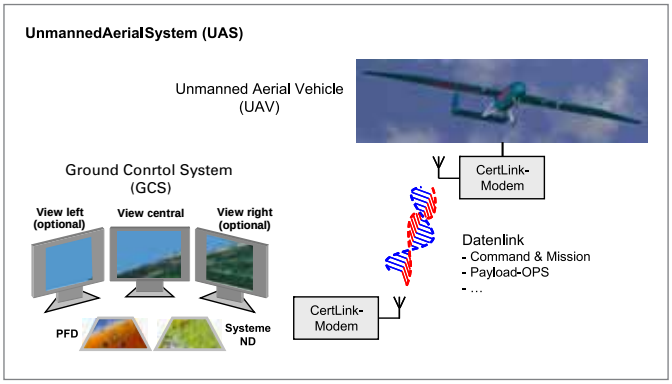
## Certifiable data link in time-triggered architecture for remote control of unmanned aerial vehicles



At present, unmanned flight systems, including an unmanned aircraft, a ground control station and a ground-to-air data link, are becoming increasingly important in both military and civil applications. For example, investigations of climate change in the polar regions and the monitoring of critical infrastructure have been made possible. Here, data link systems are employed for flight control, air traffic control, the prevention of collisions and the mission itself (payload operations). While unmanned aircraft and ground control stations can be operated very reliably from high-availability systems, the loss of a data link must be classified as a safety risk.

The goal of the project is the development and demonstration of the concept of certifiable wireless data communication (wireless TTP) within an unmanned aircraft system which can also be realised in flexible hardware. The certification of the system is not planned within the scope of the project, but is in preparation through having included the relevant organisations.

Within the scope of the project, the system architecture design of an unmanned aircraft system with the use of commercially available components will be investigated. The objective is also to obtain a high-availability general system via the air interface. This will be studied on several levels and incorporate the physical layer (radio interface and channel availability), its integration in a time-triggered network and the design of the air-to-ground interface ("CertLink" modem) itself. The basic commercial conditions relevant to the application of such technology with safety-relevant functions in the aviation area (e.g. certifiability and the long-term availability of components) will be studied in terms of examples.




**Contribution to**

| | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| *Reduction in noise perceived ▽* | ■ | □ | □ | □ | □ |
| *Reduction in $CO_2$ emission reduction ▽* | ■ | □ | □ | □ | □ |
| *Reduction in NOx emission reduction ▽* | ■ | □ | □ | □ | □ |
| *Aircraft accident rate reduction ▽* | □ | □ | ■ | □ | □ |
| *Reduction in flight delays ▽* | □ | □ | ■ | □ | □ |
| *Reduction in waiting times at departure gate ▽* | ■ | □ | □ | □ | □ |
| *Coverage of mobility requirements* | □ | □ | ■ | □ | □ |

**Research period**


### *Info box*

***Project type:*** *Co-operative project*

***Project co-ordinator:***

*JOANNEUM University of Applied Science, Aviation*
*Holger Flühr*
*Alte Poststraße 149, A-8020 Graz*
*holger.fluehr@fh-joanneum.at, www.fh-joanneum.at/lav*

***Partners:***

*TTTech Computertechnik AG*
*Blue Sky Media*

# F Intelligent Aircraft Infrastructure, Ground Test and Testing Equipment

## Research Results 2007-2009



Maintainability and servicing are very important factors which cannot be neglected when contemplating the development of new aircraft. The increasing use of new materials raises many questions, particularly in the areas of fibre bundle materials and new technologies. A critical analysis of time-honoured testing and inspection methods is therefore necessary. This also leads to ever greater challenges in relation to maintenance.

The predicted increasing requirements for mobility are accompanied by the demand for ever shorter development and market launch times. On the one hand, aircraft safety should be increased. Yet at the same time cost reductions must also be realised. Not only the aircraft manufacturer but also the maintenance scheme must be able to respond equally well to these conflicting trends.

The newest developments in maintenance for the optimisation of safety, costs and time efficiency can be found at both the national and the European level. These are concerned with the areas of online damage monitoring, i.e. the active monitoring of aircraft status, automatic fault inspection, non-destructive materials testing, for example using a thermo-mechanical method, the electronic identification of systems and much more.

TAKE OFF supports projects in the area of intelligent aircraft structure, ground tests and testing equipment. Such projects should have the goal of achieving more cost-effective, faster and environmentally friendlier maintenance. Special attention is focused on increasing the service life and reusability of components, possibilities with automatic self-inspection and forward-looking diagnostics. Furthermore, projects in the areas of data analysis, the reduction of toxic chemicals and the use of raw materials in maintenance, repair and overhaul are also supported.

*August Wilhelm Henningsen, Chairman of the Executive Board of the Lufthansa Technik AG:*

*"The Lufthansa Technology Group is one of the leading manufacturer-independent suppliers of aviation services. We offer our customers technical fleet management and aircraft maintenance for commercial aircraft, aircraft engines and systems. In Austria, we have worked closely and successfully for many years with the Austrian Technik of the Austrian Airlines Group. This has resulted in the use of stationary and mobile test equipment for different media (hydraulics, pneumatics, fuel, electrical systems/electronics) and components from Austria. The TAKE OFF programme supported their development."*

# HPM-xx

## Modular hydraulic test bays as a new product family



The increase in the number of aircraft means an increasing demand for maintenance and therefore more testing equipment. Increasing cost pressures as well as the ever shorter time to market for a product no longer allow the transfer of the development risks for testing equipment to a single customer. In particular, the suppliers of such testing equipment must therefore offer ready solutions. These solutions must have the necessary flexibility to enable customers worldwide to make use of this testing equipment regardless of aircraft type, national regulations, level of training of the operators or the local language.

The goal of modular hydraulics test stand development is the more cost-effective, faster and environmentally friendlier testing of aircraft components. The low price will be realised through cost-effective manufacture. Time savings will be realised through the optimisation of the different modules according to aircraft component product groups.

Diagnosis on the basis of an embedded simulation model will contribute to environmental compatibility. Furthermore, in this project a cost-effective measurement, control and regulation (MSR) system will be developed for the test stands. This will be used in place of the MSR system usually used.

The modular design of the testing equipment allows for flexibility in the combination of the different components. For example, a chucking fixture with 350 bar system pressure (A380, B787) serves to make the changing of the aircraft components to be tested simpler and safer. By means of dynamic test stands for modern actuators with complex regulation, both large-force hydraulics actuators and electrical actuators with a high dynamic ratio can be tested on a modular test fixture.

With this project, the company can realise a significant technological advantage in the development of testing equipment. It can then introduce the product family "modular hydraulics test stand" to the market.

| Contribution to | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| *Reduction in noise perceived ▽* | ■ | □ | □ | □ | □ |
| *Reduction in $CO_2$ emission reduction ▽* | ■ | □ | □ | □ | □ |
| *Reduction in NOx emission reduction ▽* | ■ | □ | □ | □ | □ |
| *Aircraft accident rate reduction ▽* | □ | □ | □ | □ | ■ |
| *Reduction in flight delays ▽* | □ | □ | □ | □ | ■ |
| *Reduction in waiting times at departure gate ▽* | ■ | □ | □ | □ | □ |
| *Coverage of mobility requirements* | ■ | □ | □ | □ | □ |

**Research period**


### *Info box*

***Project type:*** *Co-operative project*

***Project co-ordinator:***
*Test-Fuchs GmbH*
*Michael Schilling*
*Test-Fuchs-Strasse 1-5, A-3812 Gross-Siegharts*
*m.schilling@test-fuchs.com, www.test-fuchs.com*

***Partners:***
*AIT – Austrian Institute of Technology*
*Wiener Neustadt Business and Technical College*
*Sigmatek G.m.b.H & Co. KG*

# ASHMOSD

## Structural health monitoring

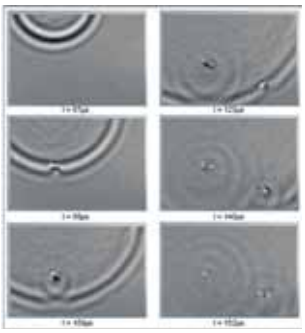


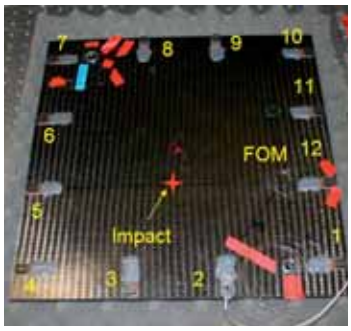
With the usual maintenance methods, aircraft must be serviced at regular intervals. It is well known that the amount of fibre bundle (carbon fibre laminate) materials used is increasing. This offers dormant potential. However, the utilisation of this potential is currently not possible because the detection of difficult to see impact damage is still subject to unacceptably high uncertainties. The implementation of online structural health monitoring (SHM) systems in largely inaccessible areas of these carbon fibre laminate aeronautics components will greatly lower maintenance costs and reduce the weight by up to 25%. This in turn reduces fuel consumption and therefore $CO_2$ emissions as well.

The goal of the project is the development, implementation and verification of an online damage monitoring system. This will be installed in a fibre bundle component of wide-bodied aircraft. With this system, it will be possible to detect the delamination of layers caused by compressive loads in compound materials. Initially, ultrasonic radar, in the form of a hybrid piezo actuator and a fibre-optic detector field, was chosen and initial successful tests completed. The system will later be integrated in a real component in order to verify functionality under simulated real world conditions.

The expected cost savings offer considerable potential for developers, manufacturers and suppliers of such damage monitoring systems in the aviation market. Other areas of application are the monitoring of critical components for cargo tankers, power plants and civil infrastructure.

At the beginning of the project a suitable sensor principle was chosen. On this basis, the sensor system was developed. This includes the hardware components and also the software with the embedded damage quantification algorithm. The verification of the behaviour of the sensor system developed for use with test components is based on static and dynamic loading tests under the relevant operating conditions (temperature and humidity). In the second phase of the project, the sensor system developed, including sensor, hardware and software, will be installed in a component produced for use in aviation. It will then be tested under the environmental conditions relevant for operation such as loading, temperature and humidity. This constitutes the verification of suitability for use.







**Contribution to**

| | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| *Reduction in noise perceived ▽* | ☐ | ■ | ☐ | ☐ | ☐ |
| *Reduction in $CO_2$ emission reduction ▽* | ☐ | ☐ | ■ | ☐ | ☐ |
| *Reduction in NOx emission reduction ▽* | ☐ | ☐ | ■ | ☐ | ☐ |
| *Aircraft accident rate reduction ▽* | ☐ | ☐ | ☐ | ☐ | ■ |
| *Reduction in flight delays ▽* | ☐ | ■ | ☐ | ☐ | ☐ |
| *Reduction in waiting times at departure gate ▽* | ☐ | ■ | ☐ | ☐ | ☐ |
| *Coverage of mobility requirements* | ■ | ☐ | ☐ | ☐ | ☐ |

**Research period**


### *Info box*

***Project type:*** *Co-operative project*

***Project co-ordinator:***

*AIT – Austrain Institute of Technology GmbH*
*Michael Scheerer*
*A-2444 Seibersdorf*
*michael.scheerer@ait.ac.at, www.ait.ac.at/*

***Partners:***

*Integrated Microsystems Austria GmbH*
*Joanneum Research Forschungsgesellschaft mbH*
*Austrian Academy of Sciences*
*PROFACTOR Produktionsforschungs GmbH*
*Software Competence Center Hagenberg GmbH*
*Bernard Ingenieure ZT GmbH*
*FACC AG*
*Siemens AG Austria*
*EADS – IW (D)*

# AEROTHERM

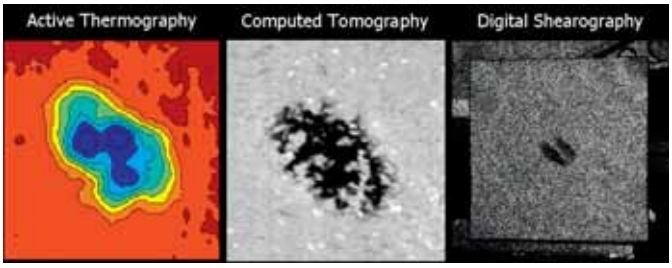
## Active thermography and shearography for the non-destructive testing of fibre-reinforced composites in the aeronautics industry – use in production and maintenance

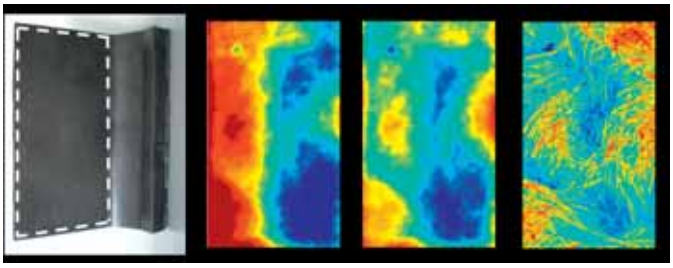


The increasingly common lightweight construction methods in the aeronautics industry require the use and optimisation of new compound materials. This also requires new approaches in materials and component testing. Today's non-destructive materials testing methods were developed during a time when the majority of the aircraft was still made of metal. In contrast, for the testing of new materials systems and in view of the complex superstructure of modern aircraft, conventional non-destructive materials testing methods no longer offer the required fault detection sensitivity and unambiguous interpretation of data. In particular, active thermography and shearography, which also offer the advantage of fast and cost-effective analysis, yield new solution approaches here.

An important goal of the planned co-operation is to expand on the results obtained in a forerunner project for porosity measurements and the investigation of inclusions and other faults in composites. In particular, the detection limits will be improved by the optimisation of algorithms and the testing speed further increased. Finally, quantitative information will be made available, for example regarding the type, magnitude and structural depth of faults.

New approaches and methods for the non-destructive testing of fibre-reinforced composites in the aeronautics sector can be defined on the basis of a systematic procedure. For example, this will be done with the aid of comparative studies using x-ray computed tomography and numerical simulations. These studies will lay the groundwork for the calibration of measured data and later allow quantitative analysis. This development work will enable the modelling of physical processes on the basis of empirical results. These processes will yield analytical relationships, not least for implementation in industrial applications.



**Contribution to**

| | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| *Reduction in noise perceived ▽* | ☐ | ☐ | ☐ | ☐ | ☐ |
| *Reduction in $CO_2$ emission reduction ▽* | ☐ | ☐ | ☐ | ☐ | ☐ |
| *Reduction in NOx emission reduction ▽* | ☐ | ☐ | ☐ | ☐ | ☐ |
| *Aircraft accident rate reduction ▽* | ☐ | ☐ | ☐ | ☐ | ■ |
| *Reduction in flight delays ▽* | ☐ | ☐ | ☐ | ☐ | ☐ |
| *Reduction in waiting times at departure gate ▽* | ☐ | ☐ | ☐ | ☐ | ☐ |
| *Coverage of mobility requirements* | ☐ | ☐ | ☐ | ☐ | ☐ |

**Research period**


### *Infobox*

***Project type:*** *Co-operative project*

***Project co-ordinator:***

*University of Applied Science Upper Austria Wels campus*
*Günther Hendorfer*
*Stelzhamerstraße 23, A-4600 Wels*
*g.hendorfer@fh-wels.at, www.fh-ooe.at*

***Partners:***

*FACC AG*
*Eurocopter Deutschland GmbH (D)*

# G Networked Air Traffic Infrastructure and Air Traffic Control Applications

## Research Results 2007-2009



The future strategy for low-emission air travel is based largely on four central concepts:

- The use of new lightweight construction concepts (e.g. the development of magnesium alloys)
- The development of alternative fuels (e.g. bio-fuels)
- The development of new propulsion concepts (e.g. the open rotor concept)
- The optimisation of air traffic management (e.g. CDM)

The projects supported should contribute to low-emission air travel which can be achieved by the efficient planning of flight routes and better co-operation between airport operators, airlines and air space management.

Under present conditions, it is not always possible for aircraft to make use of the shortest route to the destination. Often, one is compelled to fly a zig-zag route due to limitations in the different air spaces over different countries. In Europe, the air space is currently fragmented into numerous small control segments. Very different air space monitoring systems are often used in these segments. The current development towards a Single European Sky (SES) will bring about significant environmental improvements. More efficient and shorter flight routes and also optimised flight profiles will greatly reduce flight times and fuel consumption.

In addition to the European SESAR research activities, TAKE OFF supports research projects which will, for example, reduce the waiting time before reaching the runway in order to prevent unnecessary fuel consumption. In the seventh TAKE OFF call for proposals in 2009, research projects related to networked air traffic infrastructure and air traffic applications (air traffic management (ATM) and airport engineering, airside and landside) will again be welcomed. Within the scope of TAKE OFF, above all projects are sought which meet the challenge of successfully dealing with both air traffic management and air traffic infrastructure in the face of increasing air traffic. These must have the goal of improving the capacity, safety, cost efficiency, flexibility and predictability as well as firmly anchoring the environmental consciousness of the Austrian air transportation system.

*Patrick Ky, Executive Director of SESAR:*

*"SESAR represents the technological side of the Single European Sky initiative. The Joint Undertaking is developing a new generation ATM system that will ensure the safety and fluidity of air transport worldwide over the next 30 years. Specifically, it is co-ordinating and concentrating all ATM research efforts so that Europe can handle a threefold increase in air traffic by 2020 while improving safety by a projected factor of ten. SESAR also aims to reduce the environmental impact of air travel by 10% per flight by reducing fuel requirements. Besides Austro Control's participation in the FAB CE Preparatory Phase Project, Frequentis participates as a selected member in SESAR and helps to meet the challenges to find new solutions for the air navigation service providers to achieve the ACARE Strategic Research Agenda."*

# Integrated Runway Sequencer (IRS)

## Integration of the runway sequencer system (IRS) and the A-SMGCS for the optimisation of roll management



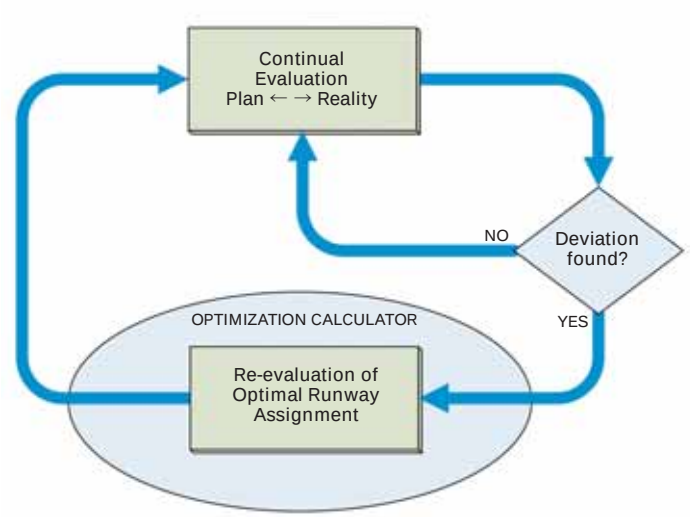
Anyone travelling by air is familiar with the situation of long waiting times when many planes are queued and waiting for permission to take off. This causes delays and unnecessary fuel consumption and relatedly environmental pollution. The usual cause of these waiting times is the fact that air traffic controllers clear startup and pushback without the aid of an optimisation system. Without systematic calculation, the waiting times must be estimated on the basis of personal experience, often resulting in unnecessary waiting times.

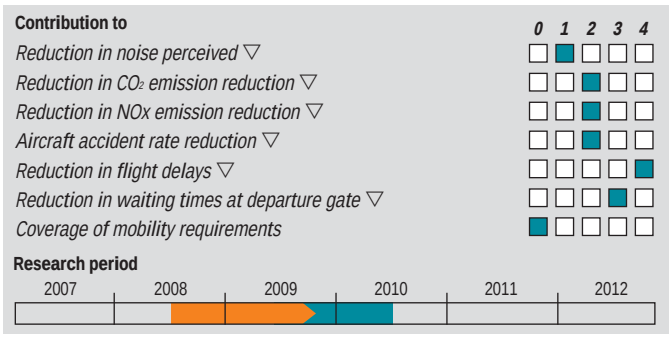
The integrated runway sequencer system (IRS) will make all information from roll management (A-SMGCS), the taxiway lighting control system and arrival management available. Statistics for roll times and typical aircraft information will be made available to the air traffic controllers online.

The goal is to have a maximum of three to five aircraft ready for take off on the respective runway.

In this way, roll times and waiting times with engines running can be significantly reduced. This will result in considerable cost savings for the airlines in terms of fuel consumption and, thanks to improved in punctuality, reduced transfer times. The general level of satisfaction on the part of passengers will improve as well. Furthermore, the air traffic controllers will be able to plan better via online optimisation, easing the pressure under which they have to work and reducing the frequency of radio contact required.


The development of the integrated runway sequencer system is planned to take place in five phases. Initially, airport-specific statistics were compiled on the basis of recorded roll management data (A-SMGCS) and the electronic taxiway lighting control system. These data served to define the basic system configuration. This was followed by an analysis of airport-specific conditions in respect to arrival management and the algorithmic core development of optimisation methods. These will subsequently be combined into a comprehensive system. The final phase will consist of integration and test runs, yielding the first data on the performance capability of the process.




### Info box

***Project type:*** *Co-operative project*

***Project co-ordinator:***

*AviBit data processing GmbH*
*Stefan Kunz*
*Händelstraße 57, A-8042 Graz*
*s.kunz@avibit.com, www.avibit.com*

***Partners:***

*Karl-Franzens-University of Graz, Department of Statistics and Operations Research*

# CoLB

## Consolidated L-DACS1 based on B-AMC



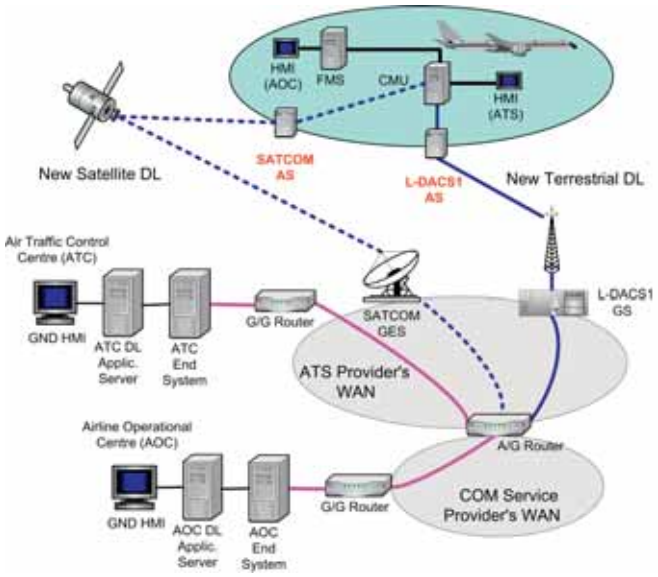
The immense European research project for a single European airspace (Single European Sky ATM Research – SESAR) has identified the broadband multi-carrier communications system (B-AMC-system) as one of the two possible broadband technologies for the future L-DACS data link.

In this project, sub-areas of importance for the quality and performance of the B-AMC system will be investigated and further developed. Furthermore, this will verify the application of B-AMC technology for navigation and airspace monitoring and realise the extensive harmonisation of the aeronautical broadband solutions (B-AMC, WiMax, P34). With these complementary properties it is more likely that the two large aviation authorities, EUROCONTROL and the Federal Aviation Administration (FAA), will choose the B-AMC-based L-DACS1 system as the aeronautical communication technology of the future.

With the SESAR concept, the future data link plays an important role. As none of the already existing technologies can support the expected data rates and other requirements, a new radio system must be developed for the digital data link. The main focus of the initial activities for such a development was on communication between the control centre and the aircraft. This project will also investigate possibilities for possible improvements and enlargement in order to include navigation and control applications in the basic communication functionality. It will also enable air-to-air communication.

This project therefore represents the first step towards the development of an integrated communication, navigation and air space monitoring system. Such a system can bring about significant savings in the systems required for air travel.

The project began with a technical analysis of the actual situation in order to indicate potential for improvement. The changes needed in the existing system design will be investigated in order to further extend the functionality (navigation and flight monitoring as well as air-to-air communication). These upgrades will be documented in detail and the system functions investigated using simulations. The results of the project will be used as the basis for the further optimisation of the envisaged system. The processing of the information required by international decision makers is therefore of considerable importance.




| Contribution to | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| *Reduction in noise perceived ▽* | ■ | □ | □ | □ | □ |
| *Reduction in $CO_2$ emission reduction ▽* | ■ | □ | □ | □ | □ |
| *Reduction in NOx emission reduction ▽* | ■ | □ | □ | □ | □ |
| *Aircraft accident rate reduction ▽* | □ | □ | □ | ■ | □ |
| *Reduction in flight delays ▽* | □ | □ | □ | ■ | □ |
| *Reduction in waiting times at departure gate ▽* | ■ | □ | □ | □ | □ |
| *Coverage of mobility requirements* | ■ | □ | □ | □ | □ |

**Research period**


### *Info box*

***Project type:*** *Co-operative project*

***Project co-ordinator:***

*Frequentis AG*
*Christoph Rihacek*
*Innovationsstraße 1, A-1100 Wien*
*christoph.rihacek@frequentis.com, www.frequentis.com*

***Partners:***

*Paris Lodron Universität Salzburg*

# IHPAT

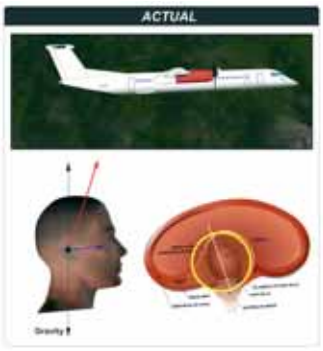
## Integrated human performance awareness training

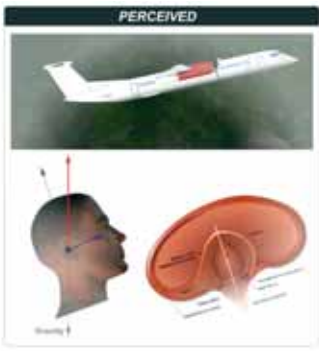


The human factor continues to play an essential role in the chain of events leading up to aircraft accidents. In general aviation, this accounted for more than 80% of all aircraft accidents. Primarily external conditions (e.g. limited visibility, inclement weather, spatial disorientation) overtax pilots in critical situations. The aviation authorities require only mandatory theoretical training on the subject of human performance and limitations. A proficiency-oriented training with a focus on human performance and limitations, comprised of interactive multimedia computer-based training (electronic-based performance training, EBPT) and supplemented by practical training in a special dynamic flight simulator offers a promising solution. Unfortunately however, such a system does not exist.

The project therefore has the goal of reducing the risk of accidents with the use of theoretical multimedia-based training (MBT) for pilots and training in disorientation simulators. Furthermore, the development of such web-based training should meet with widespread acceptance and integration in existing training organisations and air travel companies. At the same time, individually booked special simulator training can be offered for pilots at training centres. The project gives special attention to the direct integration capability of the training units in the existing training curriculla of the European and American aviation authorities. This is very important for possible implementation.

Within this project, the transition from traditional theoretical instruction to integrated learning (blended learning) will be developed. Furthermore, it will also be investigated as to whether multimedia-based training can function as a link for the awareness of human performance and limits. In an empirical approach, the concept also includes the effectiveness of this link in integrated training. For the evaluation of training, different test groups will be confronted with the same phenomena and tasks. The results will then be recorded and evaluated.





| Contribution to | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| Reduction in noise perceived ▽ | | | | ■ | |
| Reduction in $CO_2$ emission reduction ▽ | | | | ■ | |
| Reduction in NOx emission reduction ▽ | | | | ■ | |
| Aircraft accident rate reduction ▽ | | | | | ■ |
| Reduction in flight delays ▽ | | ■ | | | |
| Reduction in waiting times at departure gate ▽ | ■ | | | | |
| Coverage of mobility requirements | | ■ | | | |

**Research period**


### Info box

***Project type:*** *Co-operative project*

***Project co-ordinator:***
*infoWERK multimedia GmbH*
*Hans-Jörg Lotter*
*Martinsbühel 6, A-6170 Zirl*
*info@infowerk.at, www.infowerk.at*

***Partners:***
*AMST Systemtechnik GmbH*
*Karl-Franzens-University of Graz, Department of Psychology*

# KOWEB

## Expertise and competitiveness of the Austrian air-transport sector through education and information measures



Due to the continuing growth in air traffic, vastly greater demands are being placed on air traffic management of European airspace. At the same time, the demand for qualified air traffic control personnel is increasing.

The overriding goal of this project is to define measures for improving the education and continued training of air traffic controllers and the transfer of information and knowledge between the stakeholders of air traffic management.

Three goals are envisaged, focussing on the areas of education and training, information and networking:

1. The development of an up-to-date, e-learning based education and further training scenario. This represents both – pedagogically and didactically – a new treatment of the instructional content. The instructional content should deal with the special requirements of air traffic management in general and air traffic controllers in particular. It must also enable an improvement in the efficiency of qualification measures.
2. Survey-based definition of the requirements for the administration and dissemination of information among the participants of Austrian air traffic management. This is in order to ensure simplified access to important material and resources of the stakeholders.
3. By means of field analyses (on-site), the TAKE OFF project will support the partnership exchange between national and international aviation partner operations within the planned Single European Sky (SES).

The project will concentrate on analyses of existing education and continued training as well as information processing and networking activities in air traffic management. On this basis, the didactic concept for the educational support of learning scenarios, including training for stakeholders in the learning centre (use of the learning management system) will follow. This will also be the basis for the information server concept in the area of air traffic management.

**Contribution to**

| | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| *Reduction in noise perceived ▽* | ■ | □ | □ | □ | □ |
| *Reduction in $CO_2$ emission reduction ▽* | ■ | □ | □ | □ | □ |
| *Reduction in NOx emission reduction ▽* | ■ | □ | □ | □ | □ |
| *Aircraft accident rate reduction ▽* | □ | ■ | □ | □ | □ |
| *Reduction in flight delays ▽* | □ | □ | □ | □ | ■ |
| *Reduction in waiting times at departure gate ▽* | □ | □ | □ | ■ | □ |
| *Coverage of mobility requirements* | □ | ■ | □ | □ | □ |

**Research period**


### *Info box*

***Project type:*** *Co-operative project*

***Project co-ordinator:***
*Danube University of Krems*
*Erwin Bratengeyer*
*Dr.-Karl-Dorrek Straße 30, A-3500 Krems*
*erwin.bratengeyer@donau-uni.ac.at, www.donau-uni.ac.at*

***Partner:***
*Austro Control – Austrian Civil Aviation Authority*

# DIBMETSAT

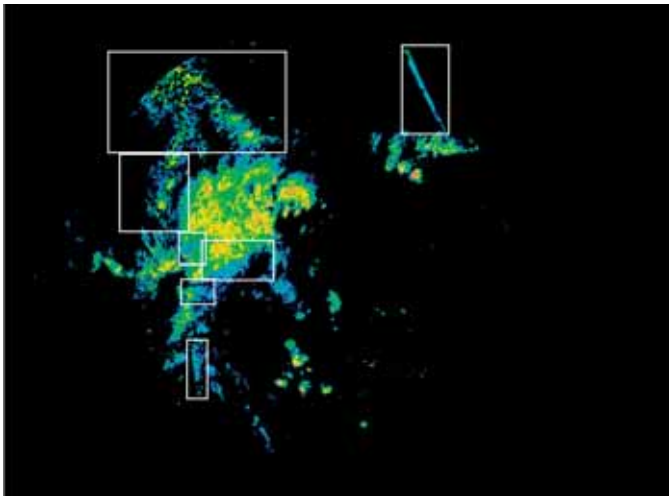
## Digital image processing – supported meteorology – services for air traffic management

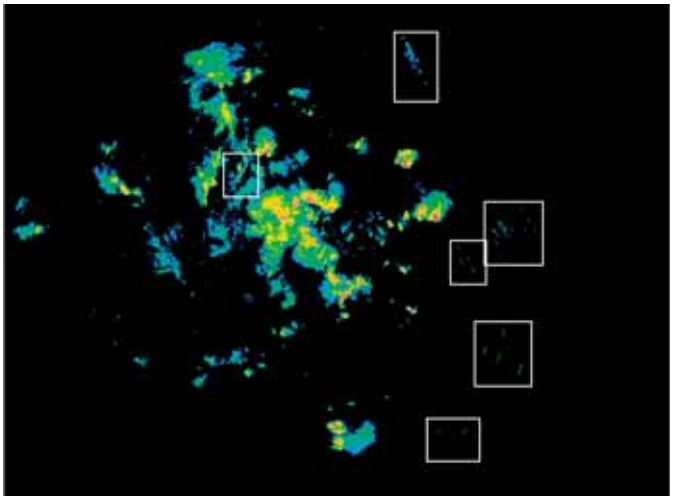


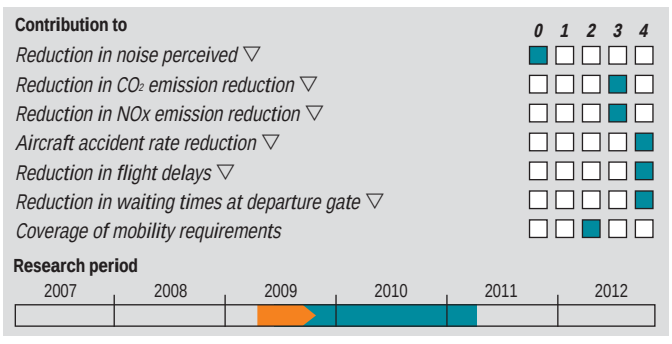
Air traffic controllers are confronted with the challenge of having to deal with a veritable flood of information. Images and measured values of the current weather situation are an important piece of information. The development of technology for more accurate and fewer incorrect predictions of weather conditions will reduce the frequency of dangerous flight situations. This will contribute to a reduction in the rate of aviation accidents. At the same time, these improved predictions can also be utilised in the interest of avoiding flight delays as well as reducing waiting times at the departure gate.

The goal of the project is to automatically furnish the most important information from weather radar and satellite images. The combination of these data and the generation of new measured values for better estimates of visibility will distinctly simplify the work of the air traffic controllers. The precise capture of significant phenomena will help air traffic control to plan more exactly and thus minimise delays. Less delays also mean shorter waiting queues and reduced pollutant emissions.

In the initial phase of the project, the state of the art of the technology was determined in respect to methods and processes for the improvement of weather radar images and the required image processing and sensor fusion. Based on the analysis of meteorological working procedures, requirements for the improvement of weather radar image quality will be derived. Methods for the automatic recognition of malfunctions and transfer functions will then be developed. This will enable the viewing of weather radar images along with the data from weather satellites. The methods will then be evaluated with the aid of a software demonstration system. In another work package, methods for the automatic generation of weather information (e.g. visibility and cloud cover) will be developed on the basis of terrestrial video cameras.








### *Info box*

***Project type:*** *Co-operative project*

***Project co-ordinator:***

*JOANNEUM RESEARCH Forschungsges.m.b.H*
*Harald Ganster*
*Steyrergasse 17, A-8010 Graz*
*harald.ganster@joanneum.at, www.joanneum.at*

***Partners:***

*AIT – Austrian Institute of Technology GmbH*
*Austro Control – Austrian Civil Aviation Authority*
*MeteoServe weather service*

# VITAM

## Vienna Total Airport Management – collaborative decision making to strengthen the Vienna hub



Collaborative decision making (CDM) pursues the idea of connecting the relevant airport stakeholders: operators, airlines, ground services and air traffic control. The networking and the constant exchange of data bring a number of advantages. These include the reduction of emissions and more efficient procedures. These in turn will have direct, positive effects on the airline passengers and the utilisation of stakeholder resources.

This study aims to show the process optimisation potential for the best possible utilisation of existing resources. This is in the interest of enhancing the attractiveness of the Vienna hub and the minimisation of influences on the environmental. The CDM concepts developed within the scope of the project represent the starting point for continuing research and its implementation at the Vienna hub.

The following project goals have been defined:

- Development of a CDM target process analogous to the Eurocontrol manual. This process will recommend the procedure for the realisation of a CDM process via a milestone approach
- Generation of a catalogue of key performance indicators for the process
- Development of a joint declaration of intent as the legal basis for operative collaboration in the context of the CFM
- Design of an information networking platform as a central information hub

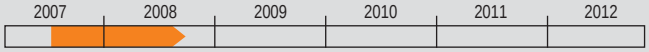
The first phase of the project was the evaluation of an analysis generated by Eurocontrol. This concerned the evaluation of gaps between the successful methodical approach and the actual situation and identified the processes affected. A process and interface analysis then followed. This described the processes affected and the interfaces in their entirety. Different optimisation scenarios were developed and analysed.

This will be followed by the test phase in which a selected scenario will be transformed to a holistic concept and tested in respect to its feasibility. Furthermore, the feasibility of a pilot project to be submitted will also be evaluated.

**Contribution to**

| | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| *Reduction in noise perceived ▽* | ☐ | ☐ | ☐ | ☐ | ☐ |
| *Reduction in $CO_2$ emission reduction ▽* | ☐ | ☐ | ☐ | ☐ | ☐ |
| *Reduction in NOx emission reduction ▽* | ☐ | ☐ | ☐ | ☐ | ☐ |
| *Aircraft accident rate reduction ▽* | ☐ | ☐ | ☐ | ☐ | ☐ |
| *Reduction in flight delays ▽* | ☐ | ☐ | ☐ | ☐ | ☐ |
| *Reduction in waiting times at departure gate ▽* | ☐ | ☐ | ☐ | ☐ | ☐ |
| *Coverage of mobility requirements* | ☐ | ☐ | ☐ | ☐ | ☐ |

**Research period**




### *Info box*

***Project type:*** *Stimulation/technical feasibility study*

***Project co-ordinator:***
*Austro Control – Austrian Civil Aviation Authority*
*Alexander Hanslik*
*Schnirchgasse 11, A-1030 Wien*
*alexander.hanslik@austrocontrol.at, www.austrocontrol.at*

***Partners:***
*Austrian Airlines*
*Vienna airport*

# PACE-AOM

## Passenger-oriented airport management – analysis of gains in efficiency using co-operative decision strategy



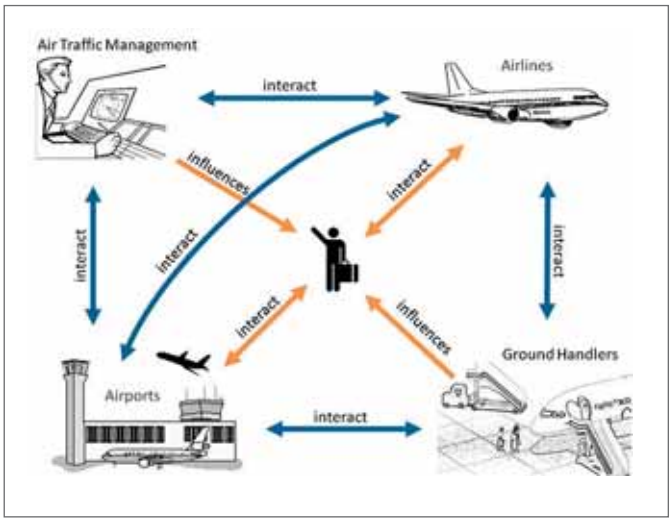
Unexpected events trigger a chain of mutually interacting decisions at an airport (airport, airlines, air traffic control, ground operations, safety operations, etc.). As a rule these events are poorly co-ordinated.

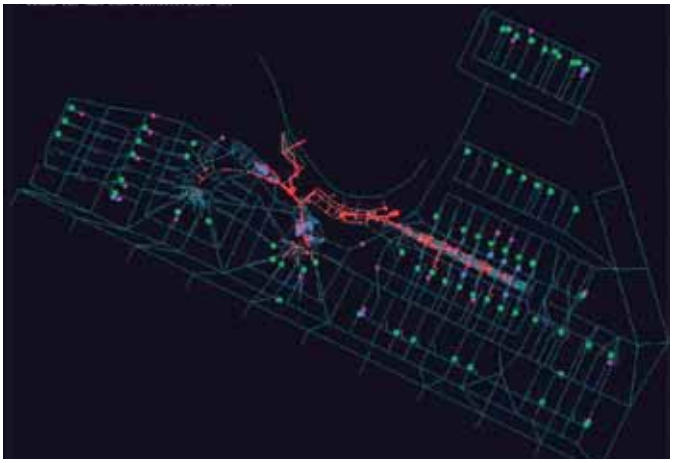
The goal of this project is to show, for a concrete application, that co-operative decision making brings advantages for all stakeholders. Co-operation begins with the exchange of the information upon which decisions are based.

Within the scope of the project, the optimisation potential for co-operative decision making were investigated. This was supported by simulations, in which – in contrast to existing systems – the focus was on the passengers. These simulations are based on relevant real data. In order to reach a decision, the simulation tool was used. This tool therefore had to be calibrated with sufficient real data and continuously updated. Methods had to be developed which could be tested in a concrete case, but which also account for normal routine. Essential here were the quantification of passenger flow (percentage transferring and flight delays) as well as the measurement of critical service times such as for border and security controls.

To a large extent, the investigations are based on a passenger flow simulation model. This model had already been developed by one of the project partners. The investigations can be roughly divided into two sub-areas:

- By using the simulation programme, means for the optimisation of passenger flow were determined. The programme shows the effects of decisions by the different stakeholders at the airport on the passengers. On the basis of the programme, the actions of those involved are optimised in relation to the respective unilateral utility functions and in relation to system optimisation.
- Every simulation programme functions on the basis of real data. In a second phase, methods for the improvement of the database will therefore be investigated.



**Contribution to**

| | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| *Reduction in noise perceived ▽* | ■ | □ | □ | □ | □ |
| *Reduction in $CO_2$ emission reduction ▽* | ■ | □ | □ | □ | □ |
| *Reduction in NOx emission reduction ▽* | ■ | □ | □ | □ | □ |
| *Aircraft accident rate reduction ▽* | ■ | □ | □ | □ | □ |
| *Reduction in flight delays ▽* | □ | □ | □ | □ | ■ |
| *Reduction in waiting times at departure gate ▽* | □ | □ | □ | □ | ■ |
| *Coverage of mobility requirements* | □ | □ | ■ | □ | □ |

**Research period**


### *Info box*

***Project type:*** *Co-operative project*

***Project co-ordinator:***

*AIT – Austrian Institute of Technology, Mobility Department*
*Dietmar Bauer*
*Giefinggasse 2, A-1210 Wien*
*Dietmar.Bauer@ait.ac.at, www.ait.ac.at*

***Partners:***

*Schild & Partner GmbH*
*BRIMATECH Services GmbH*
*Technical University of Vienna, Department of Business Mathematics*

# PACE-MODE

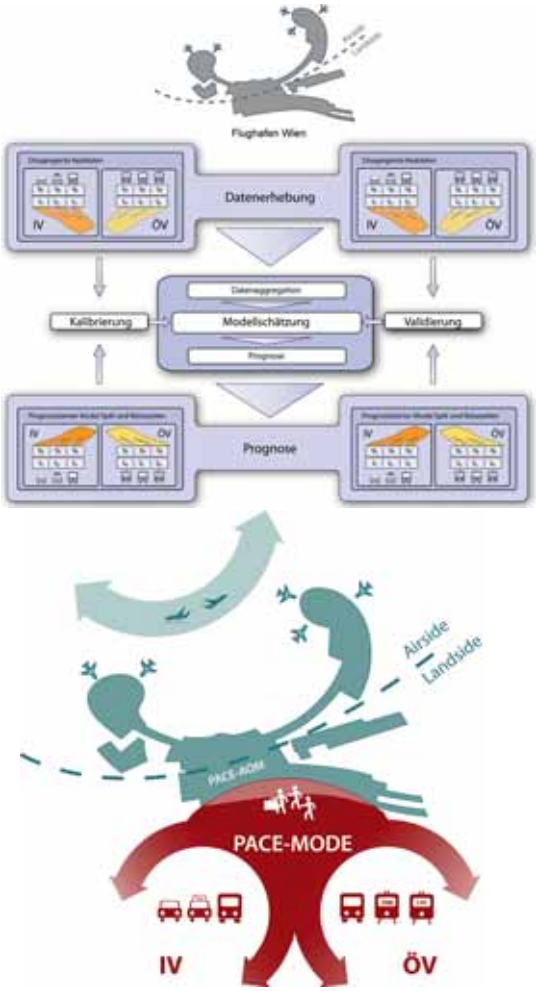
## Passenger centred behaviour-based mode choice modelling for airport ground access using detailed disaggregated data



The increasing number of air traffic passengers poses new challenges for airport management and linking ground transportation operations. The demand for transportation to and from the airport is constantly increasing, with only limited capacities and restrictions in terms of space. Information about how passengers travel to and from the airport represents an important basis for efficient planning and operation. In particular, the choice of transportation mode is of central interest. Present methods, however, do not offer much possibility for gathering extensive data. Consequently, these methods do not yield representative information. This is accordingly reflected in the quality of predictions.

The goal of this project is the development of a reference system for the empirical determination of comprehensive, detailed, passenger-oriented data. These will be used as a basis for the behaviour-based modelling of the means of transport chosen by passengers in the area serviced by the ground transportation providing transportation to the airport. Furthermore, the validity of the reference system's information value must be evaluated for a large structural change. This must consider the different interests on the part of the traffic infrastructure operators (Vienna airport, Austrian National Railway, Transport Association Region East, Motorway and Dual Carriageway Financing Company, Vienna, etc.). Within the scope of workshops, different scenarios are thus developed and simulated with the model for the choice of transportation mode. Criteria for decision making can then be derived from the results of these investigations. Information for the optimisation of passenger flow can be collected from the passengers themselves (e.g. from targeted travel information) as well as from the transportation operators and the airport.

In the PACE-MODE project, extensive disaggregated passenger-based data were gathered from the Vienna airport. The data ranged from individual and public linking transportation (private autos, taxis, railway, bus) to airport-specific ground-based passenger walking times. In addition, the data were supplemented by empirical data taken from passenger surveys. The resulting modelling of the choice of transportation mode in this level of detail represents a fundamental scientific challenge. The explicit modelling of the decision processes enables the examination of widely different alternative scenarios. This must account for such criteria as the expected travel time for a particular mode of transportation.




**Contribution to**

| | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| *Reduction in noise perceived ▽* | ■ | □ | □ | □ | □ |
| *Reduction in $CO_2$ emission reduction ▽* | □ | ■ | □ | □ | □ |
| *Reduction in NOx emission reduction ▽* | □ | ■ | □ | □ | □ |
| *Aircraft accident rate reduction ▽* | ■ | □ | □ | □ | □ |
| *Reduction in flight delays ▽* | □ | ■ | □ | □ | □ |
| *Reduction in waiting times at departure gate ▽* | ■ | □ | □ | □ | □ |
| *Coverage of mobility requirements* | □ | □ | □ | □ | ■ |

**Research period**


### *Info box*

***Project type:*** *Co-operative project*

***Project co-ordinator:***

*AIT – Austrian Institute of Technology, Mobility Department*
*Stefan Seer*
*Giefinggasse 2, A-1210 Wien*
*stefan.seer@ait.ac.at, www.ait.ac.at*

***Partners:***

*EBE solutions GmbH*
*BRIMATECH Services GmbH*

# AIRCLIP

## Airports and climate preservation



Environmental and climate protection play an important role in relation to air traffic. The goal of the study was to investigate the possibilities for implementation at Austrian airports and to develop strategies and recommendations for activities for further realisation. Successful examples from international airports were examined as the basis.

Within the scope of the study, examples of environmental protection measures from around the world for the reduction of $CO_2$ (equivalent) emissions at airports (airside and landside) were gathered in a database and analysed. Environmental managers from airports were interviewed via online surveys and internet research was conducted.

In this study, the costs and effectiveness of these measures were systematically researched and analysed. The very high response rate to an online survey relating to already performed and planned environmental protection measures at and around the airport can be seen as an indication of the great importance which airports attach to this topic. The measures were documented in a database of proven models, divided into five subject areas:

- Airfield-related measures
- Traffic and mobility
- Energy efficiency
- Renewable energies
- Administrative measures

Environmental protection measures already carried out or planned for the reduction of $CO_2$ at Austrian airports were presented in a speech to an audience of international experts. This concerned not only the implementation of international solutions in Austria but also the export of Austrian know-how.

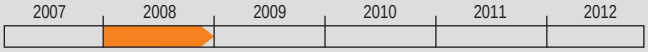
In the final report, examples of environmental protection measures realised at various airports will be discussed. These are compared and the possibilities for their implementation at Austrian airports analysed. In this study not only the immediate airport area but also the regional aspects were considered.

With the conclusion of the project, both the database and the final report will be made available online to interested professionals in this area. The airports have expressed great interest in these results.

Download the Federal Ministry of Transport, Innovation and Technology (BMVIT) studies here:
www.bmvit.gv.at/innovation/luftfahrt/studien/index.html

| Contribution to | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| Reduction in noise perceived ▽ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Reduction in $CO_2$ emission reduction ▽ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Reduction in NOx emission reduction ▽ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Aircraft accident rate reduction ▽ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Reduction in flight delays ▽ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Reduction in waiting times at departure gate ▽ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Coverage of mobility requirements | ☐ | ☐ | ☐ | ☐ | ☐ |

**Research period**




### *Info box*

***Project type:*** *Accompanying measure*

***Project co-ordinator:***

*CEIT ALANOVA gemeinnützige GmbH, Central European Institute of Technology*
*Institute of Urbanism, Transport, Environment and Information Society*
*Manfred Schrenk*
*Am Concorde Park 2, Building F, A-2320 Schwechat*
*m.schrenk@ceit.at, www.ceit.at/airclip0.html*

# H Qualification and Certification Measures

## Research Results 2007-2009



As with other economic sectors, the Austrian aeronautics industry is characterised by an increasing lack of properly qualified technically-oriented personnel. Furthermore, with the planned expansion of the Austrian aeronautics sector and industry, it is expected that there will be a need for additional personnel and an improvement in the level of the required qualifications. The TAKE OFF programme has therefore defined the goal of enlarging the pool of qualified specialists in the aeronautics (supplier) industry and in the area of education and continuing education. As a rule these are skilled workers, technicians, engineers and – young as well as experienced – university graduates in the Austrian aeronautics sector. The programme also aims to raise the level of qualification in order to contribute to improving the competitiveness of the Austrian aeronautical sector.

Besides the lack of technically-oriented people, it is becoming clear that in the near future aeronautics, aerospace manufacturers and service providers will no longer be able to take on contracts without having EN9100/AS9100 certification. In the period from March 2006 to March 2007 alone, the number of entries in the OASIS database increased worldwide from 5035 certified firms to 7482 certified firms (i.e. an increase of more than 44% in one year). In order to give Austrian companies, and in particular small and medium-sized companies, the incentive to certify their companies in accordance with EN9100 as quickly as possible, TAKE OFF supports the necessary qualification measures.

*Franz Hrachowitz, General Secretary of the Austrian Aeronautics Industries Group:*

*"Founded in 1999, the Austrian Aeronautics Industries Group (AAI) represents the interests of Austrian aviation/supply/industry as well as aviation-specific research institutions both domestically and internationally. The roughly 30 members of the AAI are strongly export-oriented and have been long-term participants in worldwide supply chains. The international network of the AAI and its members takes place primarily through membership in and co-operation with the ASD (Aerospace and Defence Industries Association of Europe). The orientation of the Austrian research support programme TAKE OFF provides an essential contribution to the intensive promotion of research and the preparation of Austrian businesses for the international aviation industry."*

## CATLUF 1 + 2 – CATIA V5 – support of continuing education for the aeronautics industry (in the field of fibre-reinforced composites )

For an internationally active, inter-disciplinary engineering concern, which in the past was intensively involved in the developing of an aeronautics and aerospace department, it has emerged that customers in the aeronautics industry prefer holistic project solutions. Customers demand that companies be able to offer expertise in planning, design and calculation along with the monitoring of project execution.

The goal of this education and further training measure was, in an initial phase, to train 15 designers currently working with AutoCAD in the use of the CATIA V5 programme system. The resulting transition from a 2D to a 3D design programme will improve competitiveness as well as efficiency.

In the follow-on project, CATLUF2, the fibre-reinforced composites design expertise of the employees was broadened. Here, increasing importance was given to the aviation sector. This was realised by training in the use of the compound materials module of the CATIA V5 programme system. Furthermore, the computational expertise in the area of fibre-reinforced composites was further expanded. A number of training programmes in the area of finite element methods were conducted using the ANSYS programme system.

### *Info box*

***Project type:*** *Qualification measure/education and continued training*

***Project participant:***
*Bernard Ingenieure ZT GmbH*
*Sebastian Bauer*
*Bahnhofstrasse 19, A-6060 Hall in Tirol*
*Sebastian.Bauer@bernard-ing.com, www.bernard-ing.com*

## Employee qualification measures for the requirements of aeronautics

An important element of the aeronautics industry is the testing and documentation of components. The goal of this project was therefore to introduce company employees to the special requirements of the aeronautics industry. In order to guarantee the best possible background for the measurement of components, one employee completed training for qualification as a measurement technician.

A second approach was concerned with new company employees, who until then had had virtually no contact with the industry. For these people an introduction to the special procedures of this industrial sector was essential. Furthermore, for supplier companies it is very important to be able to individually adapt their workflows to specific customers and their product wishes. The training therefore placed great value on being able to convey information about special project flows for different customers. The importance of aeronautics standard EN9100 was also emphasised. Added value for the education and further training measures also results in the form of the internal knowledge transfer which it enhances.

### *Info box*

***Project type:*** *Qualification measure/education and continued training*

***Project participant:***
*RO-RA Produktions GmbH*
*Josef Fellinger*
*Gewerbepark 8, A-4861 Schörfling am Attersee*
*produktion@ro-ra.com, www.ro-ra.com*

## ENGRO – Growth and development of new markets through optimised EASA Part 21J engineering expertise

As a result of the planned growth in new markets and the synergies within the corporate group, new aircraft technologies can be directly integrated in the retrofit and aircraft completion market. With the strengthening of engineering expertise, the value added over the entire supply chain in Austria can be significantly increased. The training measures within the scope of the supported project are aligned with AMES EASA Part 21J certification. This reinforces the existing expertise and also allows the undertaking of larger projects in the area of aircraft retrofitting and structural alterations. The training programme is part of the strategy that will create up to ten new jobs in the engineering area and also result in the production of new aircraft components over the next three years. The marketing of high-tech products in aeronautics is largely based on engineering expertise; this can only be successfully provided with excellent engineering education.

***Info box***

***Project type:*** *Qualification measure/education and continued training*

***Project participant:***

*AMES Aerospace and Mechanical Engineering Services Ing. Walter Starzacher GesmbH*
*Walter Starzacher*
*Grazerstr. 10, A-8130 Frohnleiten*
*Walter.starzacher@ames.co.at, www.ames.aero*

## Certification in accordance with AS/EN9100

Today, known and recognised quality is no longer a guarantee for the acquisition of new customers or the continuation of long-standing co-operation. In the aeronautics industry, the requirement for supplier companies with documented quality assurance is increasingly asserting itself and has put many companies in a difficult position. As a rule, the documentation effort for certification cannot be underestimated. This requires the meticulous description and continuous improvement of processes. The generation of a management manual, the performance of internal audits and the certification process itself are essential milestones. Even after obtaining certification, it is necessary to train employees and integrate changes in the process chain in the existing quality management system.

All companies for which TAKE OFF supports certification emphasise that, particularly in the aeronautics sector, the future of already existing business relationships would be endangered without certification. Moreover, the opening up of new markets and business areas would hardly be possible for non-certified suppliers. Even for already certified companies, actively communicating this status is important, as this secures competitive advantages and leads to positive perception on the market.

**Certifications 2007 – 2008**

Within the scope of the calls for proposals in 2007/2008, the following have been certified in accordance with AS/EN 9100:

- one production company
- one hardware development company
- two development and production companies
- one engineering services supplier

These have been entered in the OASIS database. As of October 2009, 27 Austrian suppliers are now listed in the OASIS database (Online Aeronautics Supplier Information System) of the International Aerospace Quality Group (IAQG).

# Women in Aeronautics Research

Technically-oriented women and women in research still represent a minority in research companies as well as in university and non-university research institutions. Amongst European countries, Austria ranks in the lower third and therefore needs to rectify this situation. This requires the combining of many different puzzle pieces which could contribute to improving the number of technically-focused women and women in research: from measures in kindergarten in respect to the choice of profession and place of education up to measures within companies and research establishments. All of these can make an important contribution to improving the basic conditions for women in embarking on a career in technical areas[9].

Government financial support via TAKE OFF as well as via other thematic technology programmes initiated by the Federal Ministry of Transport, Innovation and Technology is intended to develop expertise in keeping with a more just distribution by gender.

As in other areas particularly unbalanced gender distribution also exists in aeronautics technology. This is also reflected in the project-related data of the TAKE OFF programme. Only every thirteenth person working on a project funded by TAKE OFF is a woman (7%). On the other hand, the fact that at least one woman is included as a project manager or on the R&D staff for at least half of all research and development projects is very positive.

In the interim evaluation it was found that, in view of the traditionally high presence of males in technical professions, the number of women in TAKE OFF can be viewed as generally positive. Nevertheless, it would be still better if more women were interested in aeronautics and if these women were to bring new perspectives to the research landscape. These perspectives could further enhance the quality of future research and development projects.

When asked to give the reasons for deciding upon a technical career, it was found that most women showed a distinct interest in engineering and the natural sciences during their childhood. Furthermore, this interest was later encouraged by their parents or their teachers. Two questions were posed concerning working in an industry such as aeronautics, largely dominated by men, and the experience acquired from their participation in TAKE OFF projects. The following excerpts are typical of their answers.

*"The possibility of implementing new ideas in R&D projects with partners from widely different professional areas which TAKE OFF offers is impressive. Well organised projects can yield very good results, which often go beyond the goals set. The experience from the initiation of our current project shows again how important well thought out project management – and in our case a stakeholder analysis – is for the success of the project."*

Esther Berhuber,
Böhler Schmiedetechnik GmbH & Co KG – Project: MITI64

*"Above all, encounters with project partners has led to insights into many different areas of employment. It is also fascination with following the development of new technology and taking part in it."*

Marina Gnatko,
Neuman Aluminium Austria GmbH – Project: ScaLA

[9] FEMtech (editor) (2009): FEMtech Karriere. Examples of good practice. Vienna

*”It is a fact that in this industry I have met more men than women. In my project, I have worked with many nice people from Böhler Schmiedetechnik GmbH & Co KG. The collaboration has been valuable for me, and I have considerably extended my range of experience. I have seen how to practically implement the theory that I learned.“*

Petra Homporová,
Technical University of Vienna, Department of Materials Science and Materials Technology – Project: MITI64

*”In every industry there are occasional difficulties in collaboration between the sexes, but I have had no problems working with men. On the contrary, I was sometimes more supported than some male colleagues, which I soon found to be unpleasant. Particularly in an industry so dominated by men, a woman would like to be treated in the same way as male colleagues.“*

Maria Elisabeth Kelterer,
Technical University of Graz, Department of Thermal Turbomachines and Machine Dynamics – Project: CFD-TRANS

*”For eight years, I have worked together with both men and women. During this time, I have always got along well and enjoyed my work very much. I don't notice that I am one of only a few.“*

Elisabeth Knoll,
JOANNEUM University of Applied Science, Aeronautics Curriculum – Projects: ConTag, CertLink

*”During my studies at the technical university I had the possibility to become familiar with the various views of men concerning ”women in technology“ and learned to get along with these perspectives. My experience in working with men has been largely positive. I think that mutual respect for each other is the important thing. Then it is largely immaterial whether one works as a woman in a domain dominated by men or as a man in a domain dominated by women. In either case, what ultimately counts is the performance and not primarily one's sex.“*

Sabine Kunstmüller,
Austro Engine GmbH – Project: FSA

# Women in Aeronautics Research

*"I think in a man's domain a wait-and-see attitude and a certain process of evaluation prevails. What kind of a person is she? Does she know her job? Does she talk too much or does she never open her mouth? Normally however, a normal basis of conversation and a good collaborative environment develops. In the aeronautics industry, this is no different than in other technical areas dominated by men."*

Andrea Kurz,
BRIMATECH Services GmbH – Projects: PACE-MODE, PACE-AOM, Ö-Link

*"The TAKE OFF projects offer an excellent platform to combine pre-competitive research with applications-oriented development work. Personally, thanks to my participation in TAKE OFF projects I have been able to attend to and further develop my research network, above all at the national level. Moreover, during the work on these projects I have been able to find additional thematic starting points and possibilities for co-operation in further research projects, even outside the scope of the TAKE OFF programme. Particularly in the aeronautics sector, however I would also like to see greater emphasis on the support of international co-operation."*

Elisabeth Ladstätter,
Technical University of Munich, Chair for Carbon Composites (formerly FACC AG) –
Project: IGEL 2 (for FACC AG)

*"After a few years in software development, in 1998 my husband and I founded our own company. For women, in the beginning it is much more difficult to be accepted on the basis of performance; Because of men often dominating this field must depart from tradition and are confronted for the first time with the idea that there are also women in technical areas. As soon as one's expertise is reflected in results, male colleagues show complete respect and one is accordingly taken seriously."*

Gabriele Payr,
Payr Engineering GmbH – Project: Aircraft fuselage assembly

*"At the beginning, it was hard and required great effort to gain respect and acceptance. The glass ceiling is difficult to break through. But this is no different than in other industries. In any event, there is the advantage of a reasonably comparable salary level. From the human point of view, there are also advantages. Men are also happy not to have to work in an isolated world dominated by men."*

Anneliese Pönninger,
AIT – Austrian Institute of Technology – Project: AAR networks

*”Not only aeronautics is dominated by men but also many other technical research areas. It is not new for me to be one of only a few women. I always work very well with men, even if some colleagues find it difficult to adjust to the idea that women also assume leading positions in technical professions. The projects that we performed in co-operation with partners in TAKE OFF are concerned with passenger-oriented aeronautics topics. Here, it is a matter of course that the project partners work well together with female scientists and female project managers.“*

Katja Schechtner,
AIT – Austrian Institute of Technology – Projects: PACE-AOM, PACE-MODE

*”My experience in working together with men has been generally positive. Topics and problems are usually quickly addressed, allowing direct communication. In the first project meetings I was the only women present. This was a new experience for me. In the beginning, some of my male colleagues were sceptical about dealing with a woman as a colleague. However, this quickly changed and the initial scepticism gave way to excellent collaboration.“*

Martina Sebastian,
TTTech Computertechnik AG – Project: CAPTAIN

*”I have had mostly positive experience in working with male colleagues. In this area as well, there are always men who refuse to take younger women seriously and laugh at these women – but this is only a very small number. For the most part, collaboration functions very well. It took some getting used to, being the only woman present during meetings.“*

Andrea Urferer,
Austrian Airlines – Projects: ConTag, NO-WASTE

*”I work at a university, and there TAKE OFF enabled increased contact with industry and a broad overview of the aeronautics sector. TAKE OFF also gave me the possibility to get to know new female colleagues from the project partners. In the future I would like to work more closely with these people. The fact that TAKE OFF projects run over a longer period of time is positive as well. In this way doctoral positions as well as doctoral studies and post-doctoral studies can be financed.“*

Cecilia Poletti,
Technical University of Vienna, Department of Materials Science and Materials Technology – Project: MITI64

# Links

| TAKE OFF Programme Partners | Links |
|---|---|
| AIT – Austrian Institute of Technology | www.ait.ac.at |
| AIT – Austrian Institute of Technology, Mobility Department | www.ait.ac.at |
| LKR Leichtmetallkompetenzzentrum Ranshofen GmbH | www.lkr.at |
| Alulight International GmbH | www.alulight.com |
| AMAG rolling GmbH | www.amag.at |
| AMES – Aerospace and Mechanical Engineering Services Ing. Walter Starzacher GesmbH | www.ames.aero |
| AMST Systemtechnik GmbH | www.amst.co.at |
| Austrian Airlines AG | www.austrian.com |
| Austro Control – Austrian Civil Aviation Authority | www.austrocontrol.at |
| Austro Engine GmbH | www.austroengine.at |
| AviBit data processing GmbH | www.avibit.com |
| Bernard Ingenieure ZT GmbH | www.bernard-ing.com |
| Blue Sky Media (start-up underway) | www.kameradrohne.com |
| Boehlerit GmbH & Co. KG | www.boehlerit.com |
| Böhler Forging GmbH & Co KG | www.bohler-forging.com |
| BRIMATECH Services GmbH | www.brimatech.at |
| CEIT ALANOVA gemeinnützige GmbH | www.ceit.at |
| DEMA Engineering GmbH | www.dema-eng.com |
| denkstatt GmbH | www.denkstatt.at |
| Diamond Aircraft Industries GmbH | www.diamond-air.at |
| DO & CO Restaurants & Catering AG | www.doco.com |
| Danube University of Krems | www.donau-uni.ac.at |
| EBE solutions GmbH | www.ebe-solutions.at |
| ESCAD Austria GmbH | www.escad-austria.at |
| European Training and Research Institute | www.etri.at |
| FACC AG | www.facc.at |
| JOANNEUM University of Applied Science | www.fh-joanneum.at |
| FH OÖ Forschungs & Entwicklungs GmbH | www.fh-ooe.at |
| Wiener Neustadt Business and Technical College | www.fhwn.ac.at |
| Vienna Airport | www.viennaairport.com |
| FRANZ RÜBIG & SÖHNE GmbH & Co KG | www.rubig.com |
| FREQUENTIS AG | www.frequentis.com |
| Fronius International GmbH | www.fronius.com |
| Greiner PURtec GmbH | www.greiner-purtec.com |
| Hammerer Aluminium Industries GmbH | www.hai-aluminium.at |
| Hybrid Composite Products GmbH | www.hcp0.com |
| IB STEINER – Engineering office for plastics technology | www.ibsteiner.com |
| infoWERK multimedia GmbH | www.infowerk.at |
| Engineering Office Manfred Bleyer | |
| Engineering Office Wolfgang Fuchs | |
| INTALES GmbH | www.intales.com |
| Integrated Microsystems Austria GmbH | www.ima-mst.at |
| ISS Ground Services | www.at.issworld.com |
| JOANNEUM RESEARCH Forschungsges. m.b.H. | www.joanneum.at |
| Joh. Fuchs & Sohn GesmbH | www.fuso.com |

| TAKE OFF Programme Partners | Links |
|---|---|
| Johannes Kepler University of Linz, Department of Fluid Mechanics and Heat Transfer | http://fluid.jku.at |
| Karl-Franzens-University of Graz – Department of Psychology | www.kfunigraz.ac.at/psywww |
| Karl-Franzens-University of Graz – Department of Statistics and Operations Research | www.uni-graz.at/soowww |
| KTS Peter Sporrer Handelsagentur für Kabeltechnik GesmbH | www.kts-cable.com |
| Lynx Composites GmbH | www.lynx.co.at |
| MAGNA STEYR Fahrzeugtechnik AG & Co KG | www.magnasteyr.com |
| MCE-Stahl und Maschinenbau GmbH & Co | www.mce-smb.at |
| MChE Trading Handelsges. m.b.H. | www.mche.at |
| MeteoServe Wetterdienst GmbH | www.meteoserve.at |
| Michael Putz | www.putz.st |
| Neuman Aluminium Austria GmbH | www.neumann.at |
| Austrian Academy of Sciences | www.oeaw.ac.at |
| Pankl Aerospace Systems Europe GmbH | www.pankl.com |
| Paris Lodron University of Salzburg | www.uni-salzburg.at |
| Payr Engineering GmbH | www.tbm-payr.at/de |
| Payr Production GmbH & CoKG | www.tbm-payr.at/de/production |
| PÖCHHACKER Innovation Consulting GmbH | www.p-ic.at |
| PRISMA Engineering GmbH | www.prismaengineering.at |
| PROFACTOR GmbH | www.profactor.at |
| RO-RA Produktions GmbH | |
| S&I Technologies DI Erwin Reiss GmbH | www.si-tech.at |
| Schild + Partner GmbH | www.schild-partner.com |
| SECAR Technologie GmbH | www.secar.at |
| SG concepts GmbH | www.sgconcepts.at |
| Siemens Austria | www.siemens.com |
| Sigmatek G.m.b.H & Co. KG | www.sigmatek-automation.com |
| Software Competence Center Hagenberg GmbH | www.scch.at |
| Springer und Pieringer EDV OEG | |
| Technical University of Graz – Department of Fluid Mechanics and Heat Transfer | www.isw.tugraz.at |
| Technical University of Graz – Department of Thermal Turbomachines and Machine Dynamics | www.ttm.tugraz.at |
| Technical University of Vienna – Department of Thermodynamics and Energy Conversion | www.ite.tuwien.ac.at |
| Technical University of Vienna – Department of Materials Science and Materials Technology | http://info.tuwien.ac.at/E308 |
| Technical University of Vienna – Department of Business Mathematics | http://iwm.tuwien.ac.at |
| TEST-FUCHS GmbH | www.test-fuchs.com |
| Teufelberger GmbH | www.teufelberger.com |
| The Austrian Society for Metallurgy and Materials | www.asmet.at |
| TTTech Computertechnik AG | www.tttech.com |
| Association for the Advancement of Austrian Aviation Psychology (AAPA) | www. -psychology.at |
| WEDCO Handelsgesellschaft m.b.H. | www.wedco.at |
| Welser Profile AG | www.welser.com |
| Westcam Fertigungstechnik GmbH | www.westcam.at |

# Contact

## Programme responsibility

Austrian Federal Ministry for Transport, Innovation and Technology
Department for Mobility and Transport Technology
1010 Vienna, Renngasse 5
Contact Person: Elisabeth Huchler
Telephone: +43 1 71162 - 653102
Fax: +43 1 71162 - 652230
E-Mail: elisabeth.huchler@bmvit.gv.at
www.bmvit.gv.at
www.takeoff.or.at

## Programme development and management

Austrian Research Promotion Agency (FFG)
1090 Vienna, Sensengasse 1
Contact person: Vera Ellegast
Telephone: +43 57755 - 5062
Fax: +43 57755 - 95060
E-Mail: takeoff@ffg.at
www.ffg.at

## Impressum

Owner, publisher and media owner:
Austrian Federal Ministry for Transport, Innovation and Technology (BMVIT)
1010 Vienna, Renngasse 5

Responsible for contents:
Department for Mobility and Transport Technology

Layout and production:
Projektfabrik Waldhör KG,
1190 Vienna, Nedergasse 23
www.projektfabrik.at

Photos:
BMVIT-supported and financed participants

2nd edition
Vienna, March 2010