

May 2015

Newsletter 4

KhAI-ERA project is a special support action funded by the European Commission within FP7 Capacities Specific Programme and dedicated to stimulation of EU cooperation with Europe's neighbours as an important part of the European Strategic Framework for international S&T cooperation.

The KhAI-ERA project overall aim was to reinforce research cooperation capacities of the National Aerospace University "KhAI" in order to become more closely integrated into the European Research Area. The KhAI-ERA project was build upon KhAI's existing strengths as a high-quality research institution and focused on twinning with four excellent EU research and innovation organisations. The project was implemented by a team of experienced researchers from KhAI and consortium partners from December 2011 to May 2015.

It is the final project Newsletter prepared to describe how the overall project aim and specific targets were achieved, as well as to show KhAI development and progress towards integration into ERA due to the KhAI-ERA project implementation.

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KhAI-ERA Consortium expresses its grateful acknowledgment to the European Commission for the possibility to implement this project. It was an excellent opportunity for KhAI to increase its research strengths and enter the European Research Area and for EU Partners to establish long-term cooperation and knowledge exchange with one of the strongest Ukrainian Universities.

KhAI-ERA Results in Figures

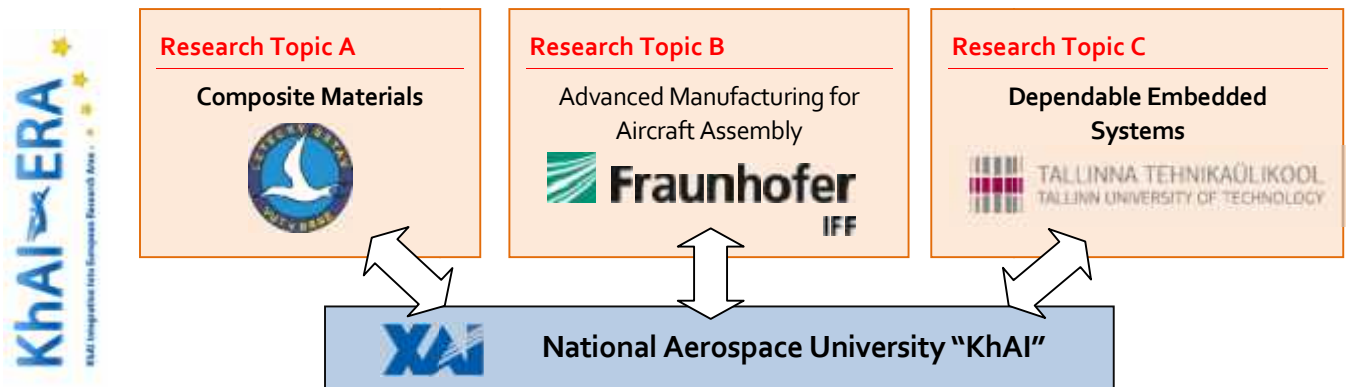
- 27 bilateral partners meetings
- 14 Research Workshops
- 3 Special Sessions of the KhAI-ERA project at International conferences
- 4 KhAI-ERA Local Workshops
- 32 Training Modules relevant to Research Topics
- 3 Training Modules relevant to FP7 projects participation
- 6 Training Module dedicated to HORIZON 2020
- 13 joint research papers + 12 joint participations in international conferences
- 40+ relevant EU conferences, workshops, etc. attended by KhAI Research Topics Teams
- 19 networking and information events dedicated to FP7 and H2020 attended by KhAI staff
- 10 relevant information and training events attended by the Transport NCP staff
- 8 FP7 and 8 H2020 proposals prepared and submitted with KhAI participation as a Partner or Coordinator
- 1 new FP7 project started in 2013 with the KhAI participation
- Publication of "Aerospace Research and Education at KhAI" Brochure and "Ukrainian Aeronautics: Research and Technology Groups Brochure"
- Comprehensive KhAI Evaluation by EU experts
- 2014-2020 KhAI Research and Development Strategy

The KhAI-ERA project is funded by the European Commission Directorate-General for Research & Innovations under the FP7 Capacities Specific Programme on International Cooperation – Grant Agreement no 294311



KhAI-ERA Research Topics Outcomes

The KhAI-ERA project was focused on capacity building activities and KhAI twinning with 3 excellent European research organizations: Institute of Aerospace Engineering, Brno University of Technology (IAE-BUT), Fraunhofer Institute for Factory Operation and Automation (Fraunhofer-IFF), Centre for Integrated Electronic Systems and Biomedical Engineering, Tallinn University of Technology (CEBE-TUT), in three research topics: Research Topic A - Composite Materials, Research Topic B - Advanced Manufacturing for Aircraft Assembly, and Research Topic C - Dependable Embedded Systems. These research topics were chosen from the strongest research areas of KhAI as they correspond closely with research priorities of the EU research & innovation development in the areas of Transport, Manufacturing Technologies, and ICT.



Research Topic A – Composite Materials

Fruitful cooperation of KhAI and IAE-BUT resulted in the development of composite wing preliminary design based on analytical simplified approaches. Wing structure consists of two spars made of carbon fibre reinforced flanges and glass-fabric reinforced webs. To provide minimum structural weight, the thickness of flanges was distributed according to strength restrictions under bending loads. Wing skin consists of sandwich panels within wing-box and homogeneous glass-fabric reinforced panels in wing nose.



Also, due to bilateral visits and knowledge exchange the partners implemented research in the field of advanced joining approaches for aircraft composite and metal structures. A set of structural concepts of metal-to-composite joints were developed. Performed fatigue tests revealed that under the small number of loading cycles (up to 10^3) the bolted joints tend to be highly concurrent against the adhesive ones. However, the hybrid joints become more efficient at higher number of cycles (from 10^4 to 10^5).

In the frame of the project Research topic A Partners developed a series of training modules that were presented at bilateral Workshops organized both at KhAI and in IAE-BUT premises:

- ✓ Composite rod design and joining
- ✓ Composite laminated panels design and optimization
- ✓ Composite sandwich panels design and solutions
- ✓ Composite beams and spars design
- ✓ Designing and strength analysis of the joints of aircraft composite structures
- ✓ Airworthiness, European Certification Requirements
- ✓ Certification and Airworthiness
- ✓ EU Regulations of Composite Structures Testing
- ✓ Compliance of Composite Aircraft Designing and Testing According to EASA Regulations
- ✓ Post-Buckling Simulations and Post-Processing
- ✓ Nonlinear Explicit FEA for Impact Problems Simulation
- ✓ FE modelling and analysis using Python
- ✓ Curing process optimization
- ✓ Method of composite patch bonding repair

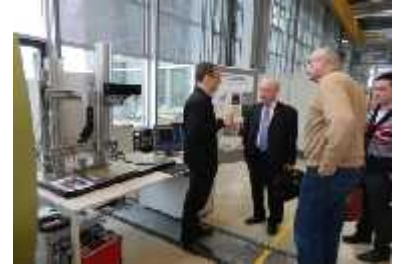
On the basis of performed joint research activities, KhAI and IAE-BUT presented joint research outcomes as follows:

- ✓ Conferences: READ 2012, NTCA 2013, 33rd Annual International Conference & Exhibition "Composite Materials in Industry", JEC Europe 2013 and 2015, 21st Engineering Mechanics 2015 Conference
- ✓ 4 research papers were published in international journals indexed by Cambridge Scientific Abstracts (CSA), Chemical Abstracts (CA), Google and Google Scholar, ISI (ISTP, CPCI, Web of Science), etc.

Also during the KhAI-ERA lifetime KhAI and IAE-BUT submitted **two proposals** dedicated to aircraft composite-to-metal components joining for FP7 "Transport" and H2020 "Smart Green and Integrated Transport" Calls.

Research Topic B – Advanced Manufacturing for Aircraft Assembly

Within the KhAI-ERA project, the Research Topic B areas of mutual research interest have been connected with advanced single-impact technologies for aircraft manufacturing, progressive aircraft assembly methods and reliable approaches for automated quality control of joints. Partners actively participated in bilateral visits, scientific knowledge exchange and joint experiments setting up. In total, partners organized 3 bilateral meetings in IFF premises, 3 - in KhAI, and 2 scientific local Workshops in KhAI dedicated to the manufacturing technologies for aircraft assembly.



Joint research was related to single-impact riveting technology application for composite aircraft structures using hand-held pneumatic tools. The main goal of parallel research was to define rational parameters for each process to ensure stable quality, high static strength, and cyclic durability of joints. To achieve these objectives advanced FEM and full-scale experimental studies were performed. On this basis, four parallel experiments were set-up to study: single-impact riveting of composite aircraft structures with high-strength titanium rivets; single-impact self-pierce riveting of lightweight aircraft aluminium and mixed structures; single-impact holes mandrelling for fatigue life increasing; single-impact installation of lock bolts in high-strength aircraft structures.

Due to fruitful collaboration the following Training modules were jointly prepared by KhAI and Fraunhofer-IFF for Young researchers, Master and Doctoral Students:

- ✓ Automated Assembly of Aircraft Structures
- ✓ Impulse Technologies for Aircraft Manufacturing
- ✓ Impulse riveting by high strength titanium rivets
- ✓ Single-impact Self-Pierce Riveting
- ✓ Single-impact Mandrelling of Holes
- ✓ Single-impact Installation of Lock Bolts

Collaborative activities were resulted in 14 research publications, including one submitted to the high-level peer-reviewed international journal "Aerospace Science and Technology", as well as the report at the XI Scientific Conference "New Trends in Aviation Development" was made by KhAI Research Topic B representative.

Research Topic C – Dependable Embedded Systems

Topic C group joint activities in KhAI-ERA project were very extensive and related to the following topics: dependable embedded systems development; IP cores for dependable FPGA-based systems; dependable networks for critical domains; multi-core architectures for mixed critical applications; embedded infrastructures for ageing failure resilience; multi-version FPGA-based systems design, assessment and SIL certification; green logic and power consumption measurement for embedded, mobile and cloud systems, FPGA security assessment and lightweight cryptography for embedded systems.



Partners organized 6 joint WSs within the KhAI-ERA project and held 3 International WSs. In the same time, they effectively collaborated beyond due to spreading common knowledge and experience at relevant events, such as international conferences dedicated to computer safety and security, digital technologies, cyber security of embedded systems and IT-infrastructure.

Partners set up and performed in parallel 5 joint experiments. The outcomes of experimental work and research activities were presented in 11 relevant international peer-reviewed conference proceedings (e.g. DT, EWDTs, EWME) and research journals (e.g. "Systems of Information Processing", "Communications"). Dr. S. Martynenko received a fellowship for 5 weeks of joint research in TUT. By working together, the partners developed 12 training modules that were introduced to KhAI educational process and presented to the wider public at Safety and Security System Club, Winter/Summer Schools of GreenCo project, trainings in Ukraine, etc.:

- ✓ Bottlenecks in Hardware Synthesis and Design Automation
- ✓ Multi-version automata development and assessment techniques
- ✓ Security of FPGA-based systems assessment and assurance and light weight cryptography for embedded applications
- ✓ Power consumption measurement in embedded and mobile HW-SW-systems
- ✓ Embedded decisions for adaptive WiFi and cloud systems
- ✓ Development of complex FPGA-based coder-decoders
- ✓ FPGA-based embedded systems security analysis
- ✓ Power consumption measurement in embedded and mobile HW/SW-systems
- ✓ Development of multi-parameterized dependable FPGA-based projects
- ✓ Distributed cloud-based architecture for dependable systems
- ✓ Lightweight cryptography for embedded systems
- ✓ Provably correct online testing of timed systems

It is worth to mention that KhAI and CEBE-TUT cooperation facilitated by KhAI-ERA also resulted in the initiation and submission of joint TEMPUS proposal on the development of MSc and PhD training courses on secure and resilient computing and communication that has been selected for funding and successfully started in December 2013.

KhAI Progress

Important part of the KhAI-ERA project was assessment and analysis of research activities of Research Topic teams and monitoring of overall KhAI progress achieved due to the project implementation.

For these purposes, **international experts** from the European consortium partners and the KhAI-ERA Steering Committee **performed a comprehensive qualitative and quantitative assessment of KhAI**, including research outputs quality, University research environment, research esteems, external research funding from national and international sources, KhAI research results recognition, etc. Based on the evaluation results, the experts **provided practical recommendations on improvement of KhAI research activity and increasing the University integration into European Research Area.**

Based on the provided recommendations, **KhAI has built an integral Research and Development Strategy for 2013-2020 that describes specific goals and activities planned for 7-years period.** Its overall aim is to augment KhAI's research excellence at regional, national, and international levels. The overall KhAI mission outlined in the Strategy is to develop scientific and industrial potential of Ukrainian aerospace and high-technology sector and intensify sustainable development of the society and knowledge-based economy. The Strategy sets up strategic priorities and a set of specific goals to be achieved by KhAI up to 2020, that finally **will lead the University towards the centre of learning, research, and innovation whose excellence is acknowledged locally, nationally and globally.**



Monitoring of KhAI Research Teams Progress

Monitoring performed within the KhAI-ERA project has two key objectives:

- ✓ To evaluate and demonstrate KhAI progress towards the KhAI-ERA goals achievement
- ✓ To identify potential areas and/or available opportunities for further KhAI research quality increasing

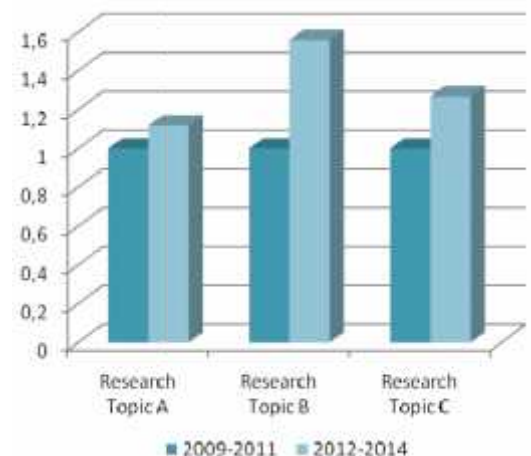
To reach abovementioned objectives and to enable easy and clear performances comparison for different periods, the **indicators-based evaluation approach was used.** This approach is focused on evaluation and monitoring of the efficiency of University staff research activity closely connected with education process. It takes into account wide variety of staff activity forms and types and provides some integral indicators to perform impartial assessment and comparison (if required). Indicators-based evaluation approach is based on preparation and analysis of personal profile that includes 63 indicators of research and educational activity that are classified in 9 categories.

Indicator Categories used

- 1 Awards and Encouragement
- 2 Professional Development
- 3 Publications and Editions
- 4 Intellectual Property, Organization and Participation in Conferences
- 5 Work with Young Scientists, Master Students, PhD Students, Post Docs
- 6 Work with Students
- 7 Contract Works and Grants
- 8 Work as Expert or Reviewer
- 9 Educational and Methodical Work

To evaluate the progress achieved by the 3 Research Topic teams involved in the KhAI-ERA project (Research Topics A, B and C), the average results achieved by different types of researchers (top-level, middle-level and young scientists) and the whole team results for 3-years period before the KhAI-ERA project start (2009-2011) and 3-years period of the KhAI-ERA project implementation (2012-2014) were compared. Figure below illustrate the progress achieved by Research Topic teams represented as the average indicators per research team for 2009-2011 and 2012-2014 years periods.

Progress monitoring demonstrates positive influence of the KhAI-ERA project implementation on research potential of all members of Research Topic A, B and C teams. Quantitatively, the **progress achieved by the Research Topic teams is equivalent to 12 %, 56 % and 37 %** respectively. Specifically, the most progress is in the number of research publications in English, wider participation in international conferences and increasing of the volume of contractual research.



KhAI Integration into ERA

KhAI activities to create new European partnerships

Within the KhAI-ERA project KhAI staff efforts were also focused on (i) KhAI visibility increasing through the KhAI involvement into EU associations, partnerships and networks; (ii) KhAI capabilities promotion through the networking at relevant conferences and workshops; and (iii) support of KhAI researchers involvement into new EU-funded collaborative research projects.

During the KhAI-ERA project lifetime, KhAI actively collaborated with:

- European Aeronautic Science Network (EASN) to be aware of the recent news in the European aeronautics world and create connections with its members.
- Partnership of a European Group of Aeronautics and Space Universities (PEGASUS) through the KhAI representatives participation in PEGASUS Council Meetings and KhAI students participation in PEGASUS-AIAA Student Conference.
- BeAware project team aimed on encouragement of partnerships between aerospace actors from Eastern and Western European countries through KhAI representatives active participation in Workshops organized by the project.
- Joint EU-Ukraine S&T Committee to contribute to establishment of EU-Ukraine S&T cooperation on governmental level.

In order to promote KhAI research capabilities, increase University international visibility, establish new links with EU research community and ensure involvement in collaborative European projects, as well as to improve knowledge on FP7 and its successor H2020 programme, KhAI staff have actively participated in different European networking and B2B events, information days and training workshops:

- InfoDays and Brokerage Events for FP7 and H2020 calls relevant to KhAI research areas (Transport, Space, NMP, CleanSky) regularly held by the EC in Brussels
- B2B events: "Aviation Industry and Research AIR DAYS 2014" Lisbon, Portugal, October 2014.
- International Conferences relevant to international cooperation in the research and education areas: "Enhancement of European International Cooperation and Eastern Partnership in R&D&I", October, 2013, Vilnius, Lithuania; "EU Eastern Partnership: Strengthening Research, Regional and Innovation Policies in the Context of Horizon 2020" held in Riga, Latvia in June 2014.

KhAI activities as Transport NCP in Ukraine

One of the KhAI-ERA project supplementary objectives is to support the development of the EU H2020 National Contact Point for Smart, Green and Integrated Transport operating on KhAI basis. To be aware of the recent news in the frame of EU Framework Programmes and transport research activities, Transport NCP representatives regularly participated in relevant trainings, workshops and webinars organized by the EC and European Transport NCP Alliance (ETNA), namely in 5 trainings regarding transport research, proposals preparation and submission, administrative and financial issues, IPR and standardization in H2020 projects; 2 Forums of Transport NCPs and 3 webinars on H2020 instruments and rules of participation.

Also NCP representatives are actively involved in H2020 promotion on Ukrainian level through participation in Ukrainian NCP network meetings, national InfoDays and Workshops as a trainee, as well as organization of local thematic training Workshops on transport priorities in Horizon 2020 Programme for Ukrainian researchers.

KhAI involvement in FP7 and H2020

During the KhAI-ERA project implementation **KhAI participated in preparation and submission of 8 FP7 proposals in AAT, Space, ENV, and R2I 2013 calls**, 6 of them have passed the evaluation threshold, and one – CORSAIR – financed and successfully started in 2013.

As for **H2020**, **KhAI took part in 8 proposals submission for FoF, MG, MSCA ITN, and TWINN calls**, 2 of them were based on KhAI research ideas and in 3 of them KhAI has a role of the Coordinator. The 4 evaluated proposal have passed evaluation threshold, while the 4 latest proposals submitted in 2015 are under evaluation now.



We are happy to announce that in March 2015 Ukraine obtained a status of Associated country in the EU Framework Programme for Research and Innovation Horizon 2020. This status provides new opportunities for KhAI, and we hope that our researchers will successfully use new chances to establish further partnerships with EU research community.

KhAI-ERA Final Workshop

The full-day KhAI-ERA Final Workshop took place on 28 May 2015 in Kyiv in the premises of Hotel "UKRAINE" and involved 60 participants from 21 Ukrainian Universities, Research Institutes and industrial enterprises.

The KhAI-ERA Final Workshop was organized with the aim to promote competencies of the National Aerospace University "KhAI" and disseminate the results of the KhAI-ERA project within the relevant Ukrainian research community.

During the Workshop the KhAI Research Topic Leaders presented their European partners and made an overview of joint twinning and training activities in the frame of the project. In addition, KhAI-ERA team representatives told about dissemination, promotion and networking activities and presented the results of KhAI evaluation by European experts, academic and research staff progress monitoring and University strategy development.

The afternoon session of the Workshop was dedicated to the discussion of new opportunities for Ukrainian researchers in EU Framework Programme for Research and Innovation Horizon 2020, specifically in the area of transport.

During this session, Mr. Yegor Dubinskiy (National NCP Coordinator in Ukraine) presented Ukrainian results in EU Framework Programmes as well as prospects and opportunities for national research community in Horizon 2020. The KhAI-ERA consortium members presented new funding schemes became available to Ukrainian researchers due to H2020 Association Agreement signature (Marie-Curie RISE call, Twinning call), European Joint Undertakings (CleanSky2, SESAR, Shift2Rail) and the draft of H2020 "Smart, Green and Integrated Transport" Work Programme for 2016-2017.



We are happy to invite you to our website, where the project is presented in full details:

<http://khai-era.khai.edu>

KhAI-ERA Partners

-  National Aerospace University "KhAI"
www.khai.edu
-  Institute of Aerospace Engineering,
Brno University of Technology
www.lu.fme.vutbr.cz
-  Fraunhofer Institute for Factory Operation and Automation
www.iff.fraunhofer.de
-  Centre for Integrated Electronic Systems and Biomedical
Engineering, Tallinn University of Technology
www.cebe.ttu.ee
-  Intelligentsia Consultants
www.intelligentsia-consultants.com

KhAI-ERA Coordinator Contacts

Mr. Igor Rybalchenko
Head of International Projects Office
National Aerospace University "KhAI"
Tel/Fax: +38 057 719-0473
E-mail: iar@khai.edu

