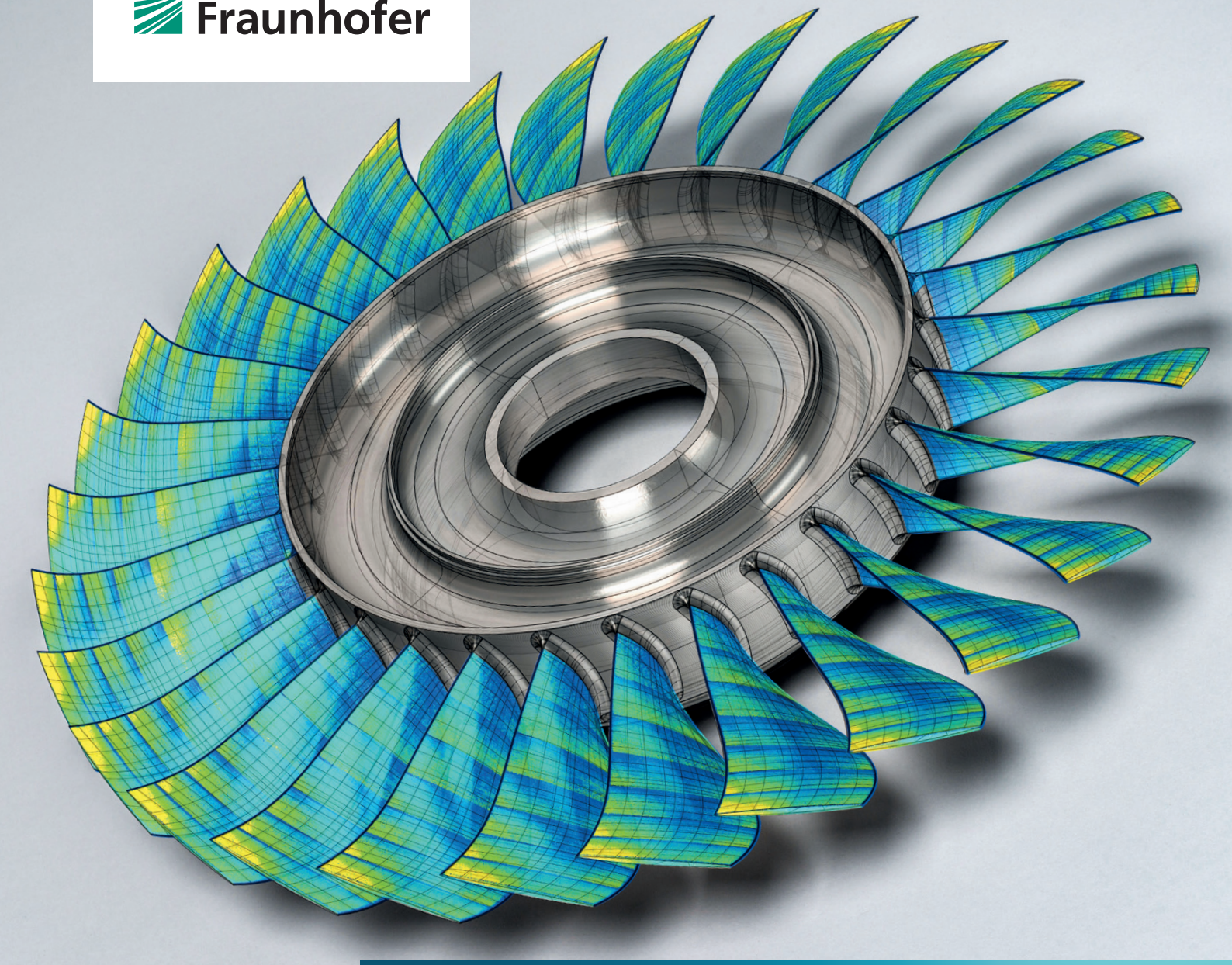
Fraunhofer



ICTM Aachen

International Center for Turbomachinery Manufacturing

RWTH AACHEN UNIVERSITY

Motivation

Industry

Achieving greater sustainability during operation and in production is the most important goal for developments in aviation and the market for stationary turbomachinery to stay competitive in future. Both evolutionary and revolutionary concepts are necessary to achieve the given objectives of saving resources and avoiding emissions.

Dealing with the impacts of the coronavirus pandemic, climate change, and digitalization on industry and society is one of the key questions for manufacturers of engines and stationary turbomachinery as well as the suppliers. Companies therefore need new approaches along the entire lifecycle to meet future challenges in manufacturing and repair. To achieve the goals given by the vision "Flightpath 2050", the "Paris Climate Agreement" 2015, the "Green New Deal" 2019 and the "European Climate Pact 2020" innovative and more complex component designs, the use of even more difficult-to-machine materials and increased demands on the part quality are required under the pretense of manufacturing more sustainably.

R&D institutions can provide support in the form of technology expertise and process development using leading edge equipment combined with implementing digital solutions for a more efficient and sustainable manufacturing. They do best if they have gained a wealth of experience from and thorough understanding of particular applications and demands of industry.

ICTM objective

The ICTM is a platform of exchange for R&D institutions and industry along the entire value chain of turbomachinery manufacturing, including original equipment manufacturers, suppliers and technology providers. It conducts high level R&D to speed up technological innovations in the area of advanced machining, additive manufacturing and digitallization. Additionally, it offers consolidated access to a wide network of experts, allowing further competencies to be called in when required.

Fraunhofer and RWTH Aachen University

Aachen is a comprehensive center of excellence for turbomachinery manufacturing. Numerous industrial cooperations have been initiated in recent years. The Institutes are involved in several national and European funded projects such as "Clean Aviation" and "PLCA". In addition, strategic and long term partnerships with individual manufacturers of turbomachinery have been established, as well as international cooperations.

For the Fraunhofer Institute for Production Technology IPT and the Institute for Laser Technology ILT as well as the Laboratory for Machine Tools and Production Engineering WZL, the Manufacturing Technology Institute MTI and the Chair for Digital Additive Production DAP of RWTH Aachen University turbomachinery is one of the major fields of activity. Focusing exclusively on the manufacture and repair of components for turbomachinery, a large number of engineers and scientists work on innovative technologies for turbo applications within Fraunhofer and at RWTH Aachen University. Their equipment is maintained to the highest level, meeting industrial standards. To meet the future challenges especially achieving an improved sustainability during operation of the turbomachine as well as during manufacturing, more integrative cooperations between research and industry are necessary.

Future challenges in turbomachinery manufacturing

- More complex component designs
- Hard to machine materials
- Implementation of “Digital Twin” to foster transparency along life-cycle
- Strong demand for sustainable production

ICTM – an integrated and interdisciplinary platform

Technological focus

Turbomachinery manufacturing is a highly interdisciplinary field. All components have to be designed for best physics in terms of flow-path and energy conversion. Advanced material is used to allow higher thermal and mechanical loads whilst maintaining light-weight characteristics. Manufacturing is a main driver in ensuring the high quality standards of parts and overall cost efficiency. Furthermore, digital solutions are developed as the digitization of production is a key enabler to improve efficiency and quality. By this, transparency regarding process specific correlations as well as ecological footprint along the entire process chain can be significantly improved and serve as basis for improvements in efficiency and sustainability.

The ICTM focuses on production and repair technologies primarily, providing its full range of competencies. It pursues R&D approaches geared to design trends and the use of advanced material taking the ecological footprint of new developments into account.

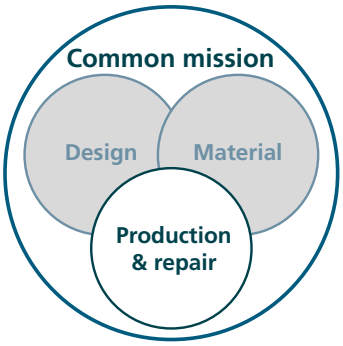
Research topics in ICTM Aachen

- Advanced machining
- Additive manufacturing
- Digitalization
- Design and assessment of process chains (technological, economical & ecological)

Structure and network of experts

The institutes involved in the ICTM are the Aachen based Fraunhofer Institutes IPT and ILT, as well as the WZL, MTI and the DAP of RWTH Aachen University. On the basis of their expertise in turbomachinery manufacturing and repair, they have collaborated intensively for several years – jointly developing leading edge innovations for industrial applications with a proven track record of success.

They represent the core of the ICTM Aachen and provide a reliable link to the entire network of both Fraunhofer and RWTH Aachen University at the same time. This fosters expansion of the network of experts, including institutions with high level of expertise in other manufacturing and repair technologies or which operate at the interfaces to design and material technology.



Benefits when joining ICTM Aachen:

- Access to full technology portfolio of institutes and to all annual collaborative R&D project results.
- Development and assessment (technical, economical, ecological) of innovative adaptive process chains using institutes state-of-the-art machine park.
- Participation in workshops on strategic topics as sustainability, quality and digitalization.
- Networking with further companies of the ICTM partner community.

Portfolio

Research and development

Excellent R&D is what the ICTM continues to provide for the turbomachinery industry. The key success criteria are its in-depth understanding of industry needs and its expertise in bringing technology to high readiness levels for industrial applications. Based on the full range of competencies at the institutes involved the ICTM Aachen is a major player in both collaborative and individual R&D activities.

Collaborative R&D and annual R&D meeting

To promote cooperation at precompetitive stages the ICTM Aachen enables a platform of exchange for collaborative R&D. It provides a continuous call for projects and interactive workshops for particular topics, integrating the specific demands for joint R&D specific developments for example in milling, ECM, EDM and additive manufacturing as well as design of process chains for all of its members. This may include, for instance, technological, economical and ecological evaluation, market analysis or other aspects which benefit significantly from cooperation.

All results of the Collaborative R&D projects are presented at the two day ICTM annual R&D meeting for all members. The meeting is also the annual milestone to give an outlook on future collaborative projects and a great opportunity for networking.

Individual R&D and roadmapping

For bilateral issues all members, of course, are able to place Individual R&D projects according to their particular demands. The ICTM Aachen represents the full range of technology expertise of the institutes involved.

Depending on the level of cooperation, the ICTM Aachen maintains a continuous roadmapping process with strategic partners, ensuring comprehensive project planning and long term continuity. A master agreement can be concluded, governing individual issues to simplify negotiations and accelerate project set-up in particular for intense and strategic partnerships.

In Aachen, industry has access to a unique research infrastructure for turbomachinery manufacturing. This enables us to conduct application-oriented projects along the value chain using our broad technology portfolio combined with digitalization solutions and top-class machinery.«

Prof. Thomas Bergs
Member of the Board of Directors, Fraunhofer Institute for Production Technology IPT

Community management

It is vital to exploit the advantages of R&D networks in order to guarantee their success and acceptance. The ICTM Aachen manages actively its network to ensure maximum benefit for all members.

Network brokering and funding management

On the basis of its overview of the entire network of partners, the ICTM Aachen establishes links between partners, allowing mutually beneficial relations to develop as early as possible. The ICTM Aachen also monitors relevant funding opportunities to obtain chances for financial support of specific R&D plans.

Steering committee

A steering committee has been set up as part of the ICTM Aachen allowing member integration into relevant issues such as selection of Collaborative R&D projects, community extension and partnering as well as monitoring and control of operations.

Key accounting and individual reporting

For intense levels of partnerships, the ICTM Aachen provides an individual key-account person to ensure consistency and a single point of contact for all requests. It oversees appropriate management reporting covering outcome and expenses of the total scope of R&D activities with the affiliated institutes of the ICTM Aachen.

Conference

Initiated in 2011, the conference of the ICTM Aachen is an established and well received event for industry and the public. Each two years current topics and latest trends are addressed in several sessions mostly focusing on advanced machining, additive manufacturing, integrated process chains as well as digitalization and sustainability approaches for the manufacture and repair of turbomachinery components. In addition to the presentations, the ICTM Conference offers an exhibition area for industry to present technology innovation and provides a platform to get in contact with companies along the entire value chain of turbomachinery manufacturing.

Steps to join the ICTM

If you are interested to participate in the ICTM – International Center for Turbomachinery Manufacturing, please contact us (see details on the back). We will provide detailed information and answer your questions.

Contracting

To join the ICTM we will provide a cooperation agreement to you according to your level of interest. Participation is possible in each case to the next ICTM annual R&D meeting taking place in November.

Academy

The ICTM Academy offers an advanced training program dedicated to turbomachinery manufacturing and repair. It covers a broad range of relevant seminars along the process chain of turbomachinery manufacturing. The seminars are open to the public, however, ICTM industry partners are admissible for booking the seminars with special conditions. Further experts of Fraunhofer, RWTH Aachen University and industry are integrated to offer courses and seminars focusing on state-of-the-art technology and new developments. Additionally, the ICTM may conduct tailor made in-house workshops to train individual skills on-site.

Access and benefits

Starter

The starter access is the entry level to join the ICTM. You will be invited to join the annual meeting and to participate in collaborative R&D projects. You have the opportunity to benefit from network brokering and you will have the option of conducting individual R&D. The commitment for the starter level is 20 000 Euro fixed budget per year to be used for collaborative R&D.

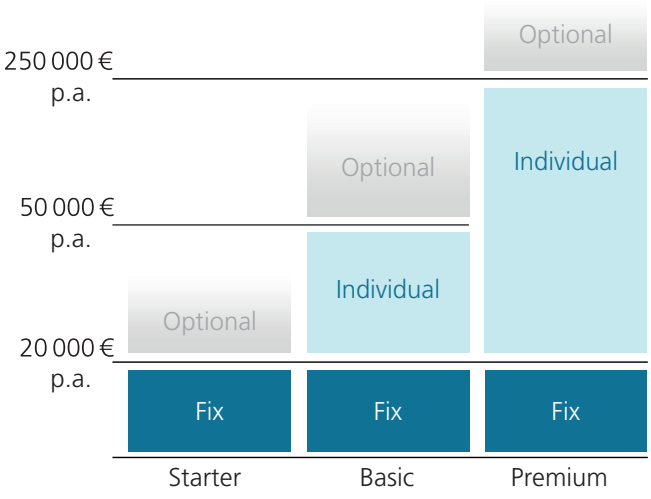
Basic

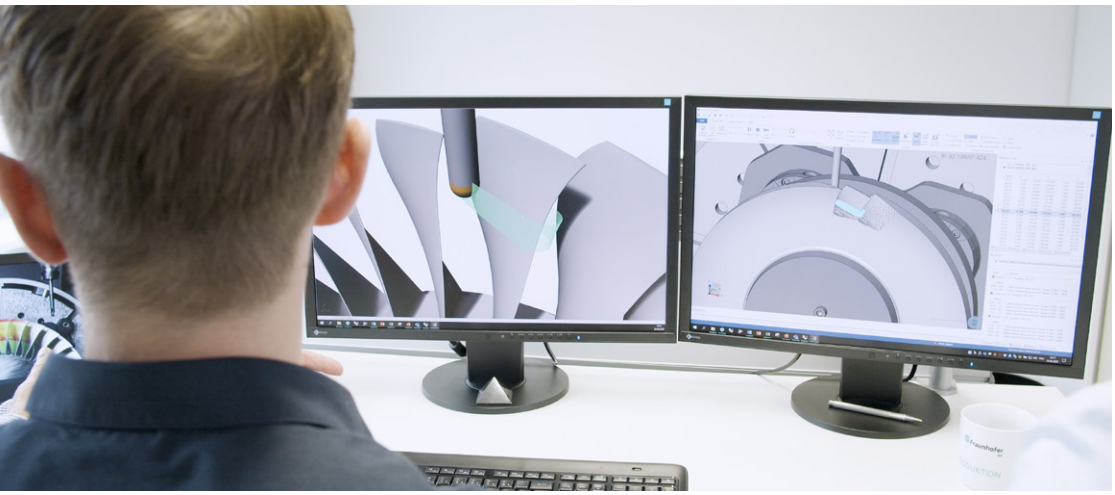
The basic access is the level of cooperation for all partners with a medium demand for individual R&D. In addition to the starter level you will be invited to take part in the R&D day and you will be included in the funding management. Representative basic partners will be considered as members of the steering committee. Commitment for the basic level is 50 000 Euro per year, split into fixed budget (collaborative R&D) and budget for additional individual R&D.

Premium

The premium access is the level of cooperation for strategic partnerships. You will be able to take advantage of the full ICTM portfolio, including collaborative and individual R&D as well as community management. In addition to all other levels of partnership, you will benefit from having a named key-account person in charge of your Individual R&D roadmap and providing you with Individual R&D reporting at management level. To accelerate project set-up and simplify cooperation a master agreement may be concluded. Commitment for the premium level is 250 000 Euro per year split into fixed budget (collaborative R&D) and budget for additional individual R&D.

	Starter	Basic	Premium
Research & Development			
Collaborative R&D	✓	✓	✓
Annual R&D meeting	✓	✓	✓
Individual R&D	Optional	Medium	High
R&D day	-	✓	✓
R&D roadmapping	-	-	✓
Community Management			
Network brokering	✓	✓	✓
Funding management	-	✓	✓
Steering committee	-	(✓)	✓
Key-account management	-	-	✓
Individual reporting	-	-	✓
Academy			
Advanced training program	Special conditions according to individual demand		
Inhouse workshops			
Conference			
Conference admissions	Special conditions according to individual demand		
Industrial exhibition			





ICTM competencies

Conventional machining

- Technology portfolio: turning, milling, drilling, broaching, grinding, polishing, gear manufacturing
- Process design and optimization for blade and filet machining as well as slotting of blisks and disks
- Machining of advanced material (e.g. Ti- and Ni-alloys, ceramics)
- Reduction of vibrations, process stability
- Tool design, optimization and coating
- Process monitoring
- Process automation and CAM module development
- Simulation, technology evaluation and benchmarking

Unconventional machining

- Technology portfolio: electro chemical machining (ECM), electrical discharge machining (EDM)
- Process design and optimization for blade machining, slotting of blisks and disks and cooling whole drilling
- Simulation, technology evaluation and benchmarking

Automated and adaptive process chains

- Post processing of additive manufactured components, forgings and friction welded parts
- Robust and adaptive design for manufacturing and repair
- Integrated solutions for fixtures, clamping and referencing
- Data management and CAx framework

Additive manufacturing

- Technology portfolio: laser metal deposition (LMD), laser powder bed fusion (LPBF)
- Qualification for most relevant alloys
- Hybrid-additive manufacturing with LMD
- Extreme high speed LMD
- Powder specification
- Process control and monitoring
- Near net shape approaches
- Design for additive manufacturing
- Process chain integration for manufacture and repair
- Simulation, technology evaluation and benchmarking

Laser machining

- Technology portfolio: laser ablation, laser drilling, laser polishing, laser structuring, laser cutting, laser welding, laser based heat treatment

Metrology and data management

- Automated data acquisition
- Optical sensor technology

Repair processes/MRO

- Customized repair by powder and wire LMD
- Re-opening of cooling holes
- Patch based repair of blisks
- Repair of heat sensitive components with extreme high speed LMD

Machine tool capability approaches

- Machine tool characterization
- Condition monitoring

Industrie 4.0/Digitalization

- Data management and cax framework
- Data consistency in the CAx process chain
- Model-based data analytics
- Smart sensor systems for machine tools
- Digital Twin
- Big Data: Processing large volumes of data efficiently
- Optimizing processes via data mining und predictive analytics

Overall issues

- Lifecycle analysis (LCA/LCE)
- Accreditation and certification
- Production management
- Quality assurance and CAQ systems
- Market analysis

Contact

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