Fraunhofer
IAPT

Fraunhofer Research Institution
for Additive Manufacturing
Technologies IAPT

Annual report 2023
Focus on sustainability

Industrializing AM 4U

www.iapt.fraunhofer.de

»For industry to respect planetary boundaries, it needs to be sustainable. It needs to develop circular processes that re-use, re-purpose and recycle natural resources, cut down on waste and reduce environmental impact.

Sustainability means reducing energy consumption and greenhouse emissions, […] Technologies like AI and additive manufacturing can play a significant role in this by optimising resource efficiency and minimising waste.[1]«

Contents

Our research in the Hamburg Metropolitan Region reaches the entire economic area of the EU.«

Prof. Ingomar Kelbassa,
institute director

From research to industry

Bridging the gap between research and industry is fundamental to the work that Fraunhofer IAPT does every day.

Whether we are working from the perspective of virtualisation, process chain automation or process qualification, or with technologies like L-PBF, Sinter AM, DED or Polymer AM in mind, we are consistently pursuing the goal of unlocking additive manufacturing for industrial use on a large scale. We are forging many different paths as we work towards this.

We are training the experts of the future and celebrating a number of doctorates. We are attending and organising conferences and events, publishing documentation and registering patents. We are finding inspiration from our advisory board, and we are cooperating with research institutions and industrial partners.

In the future fields we work in, we are in constant dialogue with the branches of industry in which the use of additive manufacturing is particularly relevant from a commercial perspective. We are developing our own initiatives that go beyond the established paths.

Annual report 2023 provide an insight into the diversity of our work at the institute, in the Hamburg Metropolitan Region and in the European Economic Area.

We hope you enjoy reading, and we invite you to share your own ideas and the challenges you have faced in your additive manufacturing journey.

Prof. Ingomar Kelbassa and the Fraunhofer IAPT team

Artist's impression of the planned new building in Bergedorf, Hamburg

Sustainability at Fraunhofer IAPT

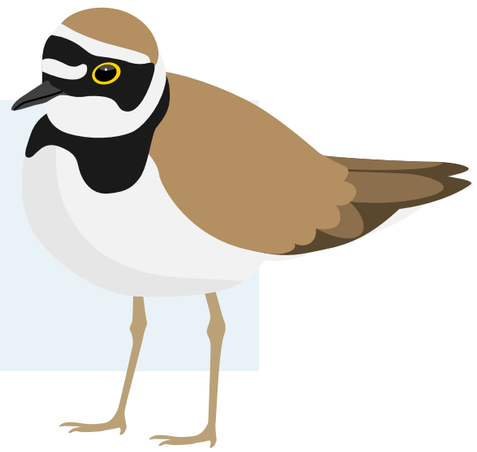
How sustainable is additive manufacturing and how sustainable are we?

These are questions that we think it is important to consider in our research and in our interactions at the institute. For example, our innovative strength and our projects – such as the IAMHH® initiative – have brought us to the point where we need a new building in which we can reproduce the entire production route. It goes without saying that we want this building to have a sustainable design.

That's why we are using sustainable materials like wood and steel instead of concrete, and why we plan to implement an intelligent electricity and consumption management system. We are using the roof areas for photovoltaic systems with a total capacity of 162 KWp and a storage capacity of 222 Ah. There will be three charging points with 22 kW to power up to six electric cars at the same time. We plan to heat the building with heat pumps and use heat recovery for ventilation and cooling.

We are also retrofitting our existing buildings with photovoltaic systems that are expected to meet around a third of the energy demand in these locations.

The little ringed plover used to live on flat shores and by unspoilt rivers. Today, it almost exclusively inhabits alternative, man-made habitats. When drawing up our development plan, we counted two breeding pairs; these will be given gravel areas on the roof of the new building with water that will not dry out in summer.



The potential of AM ranges from resource efficiency to reduced quantities of waste and a circular economy

Sustainability requires coordination

Balancing aspirations and reality: our sustainability management expert puts AM to the test.

In one of our future fields, Energy, we are researching ways to decarbonise production by minimising material and energy use, and we are seeking out solutions relating to recycling and the circular economy. We are developing and improving production processes for plastics and metals, designing innovative components with optimised functions and testing ways to process new materials.

It was in this context that we advertised the position of project coordinator for sustainability at the end of last year. We have since welcomed Vivien Großkopf as the institute's expert in sustainability management. Vivien is researching additive manufacturing throughout the product life cycle at our organisation, and engages in a number of activities in this context – these include taking measurements in the production environment, assessing and preparing measurement results, and undertaking environmental auditing.

7 questions for Vivien

What is your job?
Project coordinator for sustainability at Fraunhofer IAPT

What did you study?
For my bachelor's degree, I studied business administration at the Harz University of Applied Sciences in Wernigerode. I did my master's degree in management, specialising in sustainability, at the Westphalian University of Applied Sciences in Gelsenkirchen.

What motivates you?
I think climate change is one of the greatest challenges of our time, so ideally I hope to make a small contribution towards reducing global warming. I also think additive manufacturing is an exciting field of research when it comes to energy and resource efficiency.

How old are you?
26

City, country or suburbs?
City

Car, bicycle or train?
Electric car

What do you like to do outside work?
In my free time, I like to play the piano or accordion and go to the gym, and in summer I go stand-up paddleboarding on the Alster lake.

At the weekend, you will often find me at the Weserstadion as I'm a big Werder Bremen fan.

Industrialized Additive Manufacturing Hub Hamburg

The IAMHH® initiative

Since Ingomar Kelbassa took up his role in April 2022, Fraunhofer IAPT has joined the city of Hamburg and other major players from business and research in driving the initiative known as IAMHH®, or **Industrialized Additive Manufacturing Hub Hamburg**. Its goal is to create and establish an ecosystem for the industrialisation of 3D printing in the Hamburg Metropolitan Region. Alongside this, joint research with a project volume in the order of around €100 million is being targeted in the first five years.

The future-focused topics and application areas being addressed as part of this joint research include Life Science, Mobility, Energy and Climate Protection, as well as Security and Defence. In addition to the joint projects, there are plans for physical hubs in the Hamburg Metropolitan Region that will provide members with a space to meet and undertake joint research and development activities.

The initiative will also place a sharper focus on further education and training: new professorships in production technology fields are set to be created, alongside further education opportunities in a non-academic setting with the aim of training specialist personnel. More than 70 letters of intent from industry and research have been submitted for the initiative.

The next steps to be taken with regard to launching initial pilot projects and founding an association will be finalised in 2024. This follows the IAMHH® initiative being presented to the administrators of the Hamburg Science, Research, Equality and Districts Authority (BWFGB) and the Authority for Economy and Innovation (BWI) at Hamburg City Hall on November 20, 2023, where it was warmly received.

INDUSTRIALIZED
ADDITIVE MANUFACTURING
HUB HAMBURG

Fraunhofer IAPT is industrialising additive manufacturing and designing production environments to create value in a way that ensures resilience and sustainability

Shaping the future together

Industrialising AM 4U

At Fraunhofer IAPT, we are optimising industrial production while contributing to the common good. Fuelled by expertise, creativity and courage, we are finding answers to the urgent questions of the future.

We are industrialising additive manufacturing and designing production environments to create value in a way that ensures resilience and sustainability. We are currently focusing on the future fields of Life Science, Mobility, Energy and Security and Defence.

We consider the transfer of knowledge to industry to be just as important as our research. Here, we illustrate our approach with the following selection of projects from our future fields.

Improving quality of life

Mobility in the hands and feet can be reduced by a range of joint conditions. The existing treatment options primarily use drugs or arthrodesis to stiffen the joint. Both reduce quality of life and generate high follow-up costs due to the amount of care and therapy involved.

If an implant needs to be used, there are currently two options available on the market: silicone types, which in most cases quickly come loose and require a second intervention, or simply made standard implants, which are only available in certain sizes and restrict movement.

In the FingerKIt project, Fraunhofer IAPT, IKTS, ITEM, IWM and MEVIS have succeeded in manufacturing perfectly fitting implants that do not slip and can re-establish previous levels of mobility. The individually adjusted joint implants open up a new form of treatment for rheumatoid arthritis or traumas.

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Patient-specific finger joint implant made from alumina toughened zirconia (ATZ)

The FingerKIt project

The aim is to make customised finger joint implants quickly and safely in a certified, automated process chain that uses metallic or ceramic materials. For this purpose, Fraunhofer MEVIS has created AI-supported software that calculates three-dimensional models of the finger bones based on two-dimensional X-rays and corrects potentially incorrect finger positions.

Drawing on the finger model, researchers at Fraunhofer IAPT created the individual implant design using AI and brought it to life with 3D printing. Due to the extremely fine and delicate structures involved, the researchers used metal binder jetting to build up the layers of the components, which were then sintered – in other words, compacted and strengthened.

Fraunhofer IKTS produced the implants in a near net shape manufacturing process so that they were as close as possible to the final shape design and required only a small amount of reworking. Thanks to the expertise provided by Fraunhofer IKTS, ceramic materials could also be used: these are processed using slip casting, a special ceramic forming technique.

Fraunhofer ITEM takes care of any issues relating to biological compatibility and certification of the implants, while Fraunhofer IWM is responsible for simulating the mechanical loads.

Perfectly fitting implants re-establish previous finger mobility without slipping

Innovations at Fraunhofer IAPT

The researchers at Fraunhofer IAPT have developed several innovations in the course of the project. These include AI-based calculation of a three-dimensional implant design based on 2D templates, something that now has a patent pending. The process technology is another special development: as the structure of the implant shaft is very delicate, the team at Fraunhofer IAPT has chosen to use metal binder jetting for titanium as the 3D printing method. This enables the small and complex implants to be manufactured with high precision. At the same time, the surface of the shaft can be structured in a way that incorporates into the bone more easily. In addition, the method minimises any reworking of the articular surfaces, which must be as smooth and frictionless as possible.

The world's only centre of its kind

With the goal of rapid transfer to clinical and industrial practice in mind, all of the institutes worked together to develop cross-institute, standardised digital documentation of their processes during the project. This resulted in the establishment of a centre – the only one of its kind in the Fraunhofer-Gesellschaft and in the world – for the AI-based development and certification-compliant evaluation of custom implants.

The FingerKIt project has created significant processes and methods that can be used both for the development of individual finger implants and for various other implant developments.«

Prof. Mark Lenz
Clinic for Trauma, Hand and Reconstructive Surgery, Jena University Hospital

A continuous process chain for manufacturing patient-specific implants was automated for the first time

Higher-quality treatment at a lower cost

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Patient-specific implants

In oral and maxillofacial surgery, treatment with implants is standard practice. But commercially available standardised implants fail to take account of the complex anatomical characteristics demonstrated by facial bones, and show some significant shortcomings in geometry, fit and quality. For many indications, individually designed implants made through additive manufacturing offer a more sustainable way to treat patients.

In the DigiMed project, Fraunhofer IAPT worked with the University Medical Center Hamburg-Eppendorf (UKE) and the Helmut Schmidt University/University of the Federal Armed Forces Hamburg (HSU/UniBw H) to develop a workflow aimed at significantly improving the fit of implants as well as the quality of treatment experienced by patients. In addition, a continuous process chain for manufacturing patient-specific implants was automated for the first time, using the reconstruction of the orbital floor as an example.

Project overview

The DigiMed project involved developing AI software solutions that extract the relevant information about the defect from medical image data (CBCT data) and generate a 3D model of the skull. Based on this model, the orbital floor is reconstructed and an intact model of the skull with the implant is generated. Automatic generation is a two-stage process: virtual reconstruction uses a statistical shape model (SSM), while the process of generating the implant design uses anatomical characteristics.

The new workflow allows the digital process of generating the implant to be partially automated. The entire digital value chain for the production of implants was demonstrated using a hypothetical medical application scenario in a laboratory environment. The process behind the digital value chain was presented at the same time as the physical process chain. Data from the UKE and public databases was used to create a statistical shape model for this purpose.

Fraunhofer IAPT is creating a new basis for improving the quality and reproducibility of components made through additive manufacturing by automating the development of process parameters for additive manufacturing while taking account of the individual implant geometry. This means adaptive process parameters can be applied to individual layers. In the area of component reworking, it has also been possible to create a fully automated concept for surface post-treatment.

In another field of work, an MDR-compliant qualification and certification concept for the entire value chain was successfully developed. Both the digital and physical process chains and their interfaces, as well as the individual processes, were examined in the overall context and linked together based on the requirements for a certification route.

Improving quality and efficiency

Digital value chains outperform conventional approaches by some distance when it comes to efficiency and quality, achieving reductions of up to 50% in current preparation times of 10 days from imaging to operation. Additionally, the cost and duration of the production process are reduced by up to 40% and quality is improved significantly due to the optimised fit, making it possible to reduce surgery time by as much as 20%.

Patients benefit from more rapid treatment as well as higher implant quality and a better fit. In hospitals, the new workflow makes life easier for staff when it comes to making a diagnosis, preparing implants and planning operations.

Patient-specific reconstruction of the orbital floor

Digitalisation, 3D manufacturing and innovative materials are bringing about a paradigm shift in the medical world. We are moving away from standardised implant geometries and towards patient-specific treatment solutions.«

Phillip Gromzig
Head of NextGen Life Science,
Fraunhofer IAPT

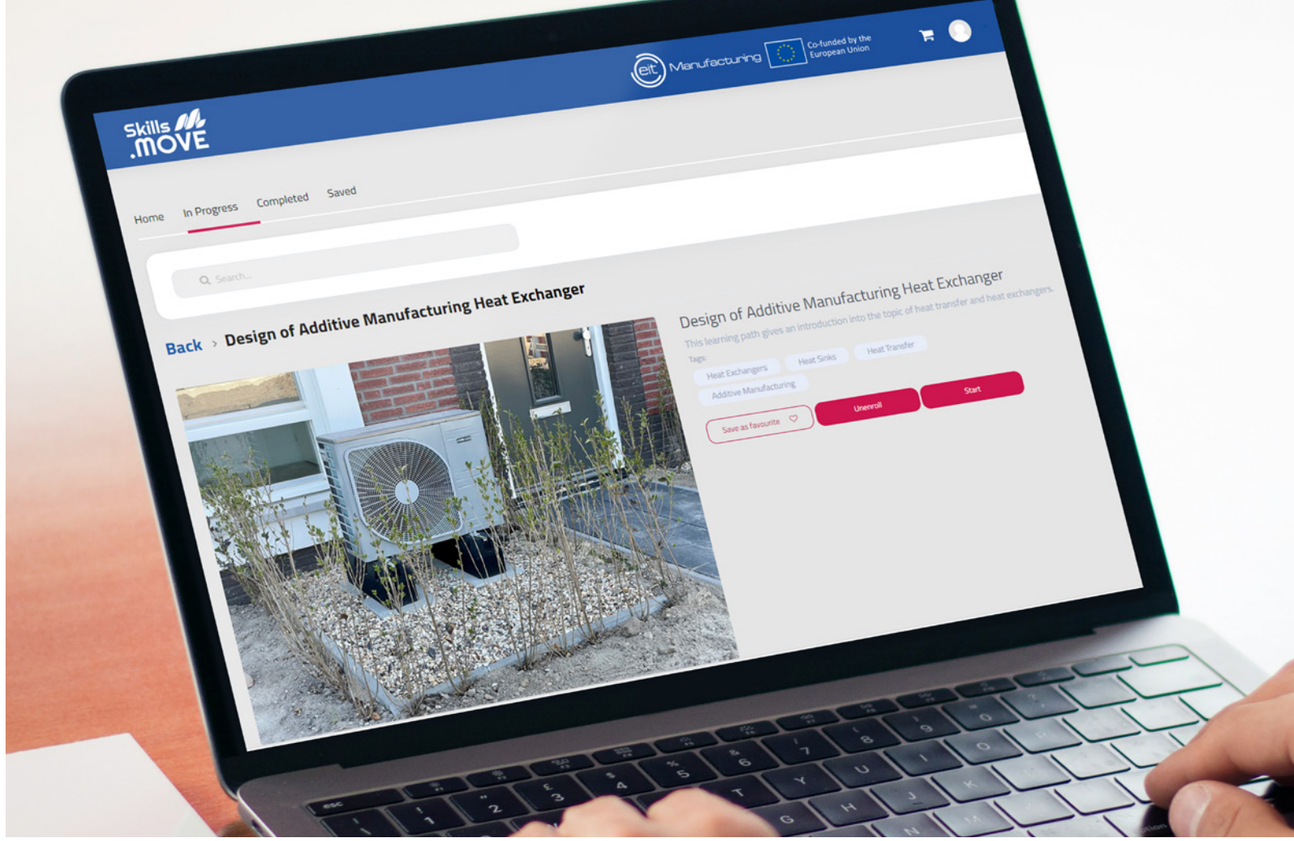
Transfer to industry via online training

Funded by:
EIT Manufacturing (no. 23171)

Learning paths for more sustainable products

The German federal government is promoting a shift to more sustainable production processes. »To ensure we can continue to live well in the future,« it says, »our consumption and our production techniques must change.«[2] But how is it possible to make changes while production processes are actively taking place?

Relevant expertise and qualified employees are a vital element in seizing the opportunities presented by cutting-edge technology and making production processes more sustainable on a continuous basis. Comprehensive knowledge of the potential and limitations inherent in more efficient technologies, such as additive manufacturing, enables innovations to be translated into products that are functional and conserve resources.



Online qualification for advanced learners: additive manufacturing for new designs of heat exchangers

New products: sustainable and cost-effective

Fraunhofer IAPT has taken an important step towards teaching sustainable production techniques in the ADAA – Advanced Design for Advanced Applications project. The University of Bologna, INEGI and Prima Additive have developed a highly specialised training programme with funding from EIT Manufacturing and under the leadership of Fraunhofer IAPT. There are nine learning paths in total, aimed primarily at designers and product managers. The programme gives them the skills they need to identify suitable assemblies and develop sustainable, cost-effective products using additive manufacturing.

In addition, any interested learners can apply their knowledge in practice and discover more in a workshop led by experts from the institutions involved.

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Learning paths: Additive Manufacturing for Product Designers

- Topology Optimization for AM
- Biomimetic Design with AM
- Compliant Mechanisms
- Multi-Material Design with AM
- Optimized Acoustics by AM
- Design of AM Heat Exchangers
- Design for Fiber-reinforced Printing
- 4D Printing of Materials
- Design of AM Soft Robotics

Application scenario: heat pumps

The learning path entitled Design of Additive Manufacturing Heat Exchangers teaches designers the fundamentals of heat exchangers and covers application areas in the next-generation research area of Energy, such as heat pumps. Additive manufacturing of heat exchangers can improve the efficiency of heat pumps throughout their life cycle. After completing the learning path, learners can take the approaches that they have learned and use them to optimise their own products.

Awarded the EITM Non-Degree Label

The learning paths entitled Topology Optimization for Additive Manufacturing, Design of Additive Manufacturing Heat Exchangers and Multi-Material Design with Additive Manufacturing, plus the practical workshop, have been awarded the EITM Non-Degree Label by the European Institute of Innovation and Technology. Learners receive a certificate of participation after completing each learning path.

In the highly competitive AM environment, companies will benefit hugely from training in technical and commercial innovations.«

John Stavridis
PhD Additive Applications Manager & Business Development, Prima Additive

Availability

In the pilot phase, around 100 learners from all over the world successfully completed the programme. The Additive Academy® at Fraunhofer IAPT offers the courses as standalone elements or as part of a training programme compiled to meet individual needs.

If you want to grow your team's expertise, feel free to get in touch with us at academy@iapt.fraunhofer.de.

The mobile container production unit can be used at different locations as a standalone, plug-and-play production cell

Rapid repair

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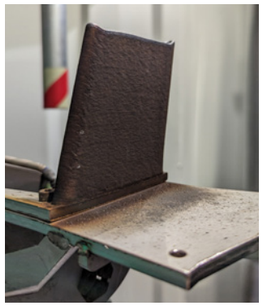
The success of military operations in crisis-hit regions relies on equipment being available for use at all times. The operating conditions make it possible to foresee which faults and equipment failures might arise as a result of use or damage, for instance. If repairs can be made in the field in these cases, there is no need to make long journeys and use up valuable logistical resources – and the time gained in the process can be an operational advantage.

At the AM Village 2023, a five-day workshop organised by the European Defence Agency (EDA) and held in Ede in the Netherlands, Fraunhofer IAPT presented the Additive Mobile Factory® and demonstrated its performance in military settings.

Rapid repair of faulty equipment in the field using the Additive Mobile Factory® helps to reduce what is known as the logistical footprint and increase the availability of materials.

The EDA's EU Capability Development Priorities (CDP) identify additive manufacturing as a key technology with the potential to give armed forces a crucial advantage in the field of military logistics. AM is therefore seen as a technology with game-changing potential[3].

At the AM Village initiated by the EDA, Fraunhofer IAPT and AM experts from the military solved different repair problems every day using the Additive Mobile Factory® and identified the benefits of AM for military operations.



Layer-by-layer structure of the prong on the robotic arm of the Additive Mobile Factory®

Prong for the mine clearance machine, printed using the cladding method

Use cases in battle damage repair (BDR)

The Additive Mobile Factory® is a mobile container production unit with a modular design that can be used at different locations as a standalone, plug-and-play production cell. All of the equipment is integrated in a standard container and was easy to transport overland to the AM Village in the Netherlands. Once it had arrived, all the container needed was a standard power connection – and the Additive Mobile Factory® was ready for operation.

Each day, the AM Village presented users from the military and the institute with new challenges that soldiers typically face during military operations. This includes damage to vehicles such as mine clearance machines or to crankshaft heads, and faulty door fittings on a combat vehicle. In each of these application scenarios and others besides, it was possible to complete the repair with the Additive Mobile Factory® within a few hours.

Role allocation for efficient operations

The team first measured the faulty part and followed something known as the reachback method by sending the initial measuring results to Fraunhofer IAPT in Germany, which adopted the role of operations base with AM engineering expertise. Here, computer-aided design (CAD) was used to turn the measured values into a target geometry, which was used as a basis for developing the production strategy.

The qualified team of operators on site then received a completed AM-ready file and started the repair using the 3D printing method of cladding, also known as WAAM. The Additive Mobile Factory® comes with integrated milling equipment for reworking the manufactured item, complementing the additive manufacturing techniques with subtractive ones.

Repairs in the field eliminate long transport routes

As the application scenarios at the AM Village show, the Additive Mobile Factory® reduces the logistical work that would otherwise be needed to supply spare parts and transport faulty – then repaired – components over long distances. In crisis-hit regions and war zones, highly efficient and timely repairs to military equipment can be carried out in the field. The Additive Mobile Factory® enables armed forces to use AM methods wherever they need to complete their mission.

Ready-to-use equipment is essential to the success of military operations. Through the rapid repair of equipment in the field, the Additive Mobile Factory® supports soldiers in completing their mission.«

Martin Huber
Project Manager, Deploy and Logistics,
European Defence Agency

AM in the automotive

Formnext 2023 white paper

As an institute of the Fraunhofer-Gesellschaft, our goal is to bring technological innovations into the circular flow of the economy for the benefit of society. In an industrial context, additive manufacturing technologies contribute to increased productivity, resource conservation, resilience and prosperity. This is true in particular of the future field of Mobility. However, the benefits of additive manufacturing can only be fully realised if the industry possesses the necessary expertise.

Knowledge transfer across industrial production is the goal of a project being pursued by Mesago Messe Frankfurt (in the role of publisher) and in our future field of Mobility (with responsibility for content).

A white paper for the automotive industry was drawn up on the occasion of last year's Formnext trade show. At around 20 pages long, the document begins with an overview of additive manufacturing as an addition to conventional production methods and brings three key benefits into focus:

- Shorter innovation cycles
- Freedom in design
- Demand-based production

A guideline takes readers from the theory to the successful use of additive manufacturing in practice. In ten steps, manufacturing companies can learn what they need to consider and what the key success factors are.

20 pages on additive manufacturing in the automotive industry

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As a trade show organiser, we want to reach specific target groups for the technologies that our exhibitors offer. With this white paper, we have been able to bring additive manufacturing business cases and the Formnext trade show to the attention of experts from the automotive industry.«

Sascha F. Wenzler
Vice President Formnext,
Mesago Messe Frankfurt GmbH

AM potential and success stories

Another major section of the content provides specific details of application areas in production throughout the automotive life cycle. From prototypes made using additive manufacturing to spare parts, and from production resources to tools made in a 3D printer, the white paper identifies the potential for AM, outlines the state of development in each case, and highlights the amount of work required for implementation. AM theses from renowned experts in the automotive industry and additive success stories from AUDI AG, Brose and Daimler Truck round off the insights from the perspective of companies that use AM.

The white paper takes the example of the automotive industry to show how additive manufacturing supports productivity and sustainability goals, and how it strengthens the position of manufacturing companies against the international competition. The document is available to download free of charge from the Fraunhofer IAPT website.

Free download

Advisory board members

Fraunhofer IAPT would like to thank its advisory board for its hard work. We are thrilled with the excellent partnership we have built, and could not find any better words to describe it than those of advisory board member Stefanie Brickwede on LinkedIn:

Stefanie Brickwede
Managing Director,
Mobility goes Additive e.V.

»As a member of the advisory board, I am delighted to see such a fantastic overview of the projects that are currently being undertaken. It is incredible what Ingomar Kelbassa's team is doing for additive manufacturing by driving forward specific projects and founding some promising start-ups.«

Dr. Karsten Heuser
Vice President Additive Manufacturing,
Siemens AG

Dr. Klaus Kleine
Director Laser Application,
Coherent Inc., USA

Dr. Tina Schlingmann
Regional Director EMEA: DACH & Benelux,
EOS GmbH Electro Optical Systems

Christoph Hauck
Member of the Executive Board,
toolcraft AG

Other advisory board members in the reporting period

Klaus von Lepel
Science, Research,
Equality and Districts Authority (BWFGB)
Head of Research department / W2

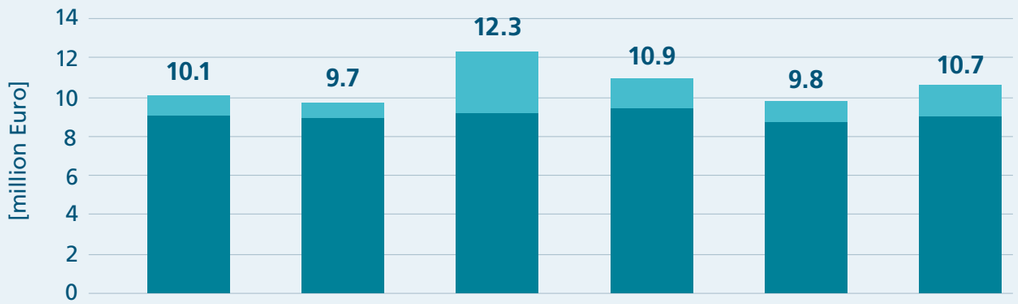
Angela Titzrath
Hamburger Hafen und Logistik AG
Chair of the Executive Board

Prof. Andreas Timm-Giel
Hamburg University of Technology
President

The institute in figures

The institute in figures

Overall budget



22.1 %
Business income

External revenue

2.0 Economic income
0.7 Contribution from Hamburg
3.8 German federal government
0.4 EU
0.08 Miscellaneous

As of May 2nd, 2024

Institutional funding

1.6 Basic funding
0.4 Internal Fraunhofer programs
2.1 Special allowances
0.2 Special circumstances

Expenses

6.4 Staff
2.6 Material
1.8 Investments

Employees

54 engineers and scientists
8 technical employees
15 internal services
46 students

Scientific publications

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- JANZEN, K., KALLIES, K. (2023): »*Fabrication of patient-specific finger joint implants from Ti-6Al-4V using metal binder jetting*«, Transactions on Additive Manufacturing Meets Medicine.
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Research for members

The Additive Alliance® opens up the best of Fraunhofer IAPT for the AM community to access – covering everything from one-to-one discussions with experts, specialists and users through to training sessions and demand-based research. Every year, this process also results in three Deep Dives, each examining one AM-related subject. The members of the Additive Alliance® vote to decide which topics our researchers will focus on. Fraunhofer IAPT carries out the studies and shares the results exclusively with members of the Additive Alliance® in Deep Dives in the Member Area.

Deep Dives 2023

- HELMHOLTZ, Johannes and Maximilian VOGT, 2023. Artificial Intelligence in additive production: applications and opportunities. In: Additive Alliance. Hamburg, 2023. Hamburg: Fraunhofer IAPT.
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- LAU, Robert and Hannes ZAPF, 2023. Sustainability in AM – Data generation and evaluation using standardized methods. In: Additive Alliance. Hamburg, 2023. Hamburg: Fraunhofer IAPT.

Making production more sustainable

Reducing carbon emissions with Directed Energy Deposition (DED)

Industrial manufacturing is a major contributor to rising global carbon emissions. Metal-based additive manufacturing technologies such as Directed Energy Deposition (DED) open up a resource-friendly, energy-efficient alternative to conventional production. Additive manufacturing reduces material waste, makes it possible to execute energy-saving concepts in lightweight construction and, by keeping production local, eliminates the carbon emissions that result from long journeys.

Additive manufacturing also reduces the carbon emissions of products throughout their life cycle. But how do we achieve a successful transition to more sustainable production methods?

Focus on success factors

The process starts by gaining a better understanding of the specific factors affecting the consumption of resources and energy. Analysing any data that is available makes it possible to determine whether future optimisations will be successful – however, the stock of data available for AM processes in particular has been poor to date.

As one of last year's three Deep Dives, the members of the Additive Alliance® chose a subject that focuses on investigating DED processes. The Deep Dive provides an overview of the life cycle assessment (LCA) methods as well as a presentation of material and process data, an impact analysis and a comparison with conventional manufacturing. For members of the Additive Alliance®, the Deep Dive is paving the way for more sustainable production with DED.

Key content of the Deep Dives

- Life cycle assessment methods
- Data on material processing and DED manufacturing
- Impact analysis and comparison with conventional manufacturing

The Deep Dive is available for members of the Additive Alliance® to download in the Member Area.

Patents granted

2023

Resorbable implants with controlled degradation

DE102021103786A1
Inventor: Janzen, Kevin; Imgrund, Philipp; Buresch, Hendrik; Ebel, Thomas

There were also six patent registrations and two invention disclosures.

Partnerships

Fraunhofer partnerships

Fraunhofer Group for Production
Fraunhofer IAPT is a member of the Fraunhofer Group for Production (www.produktion.fraunhofer.de), a collaborative grouping of 11 Fraunhofer institutes and research units. Founded in 1988, the purpose of the group is to engage in joint research and development with a close relationship to production. By using the latest findings from production management, engineering and IT, the group offers a range of services that cover the entire product life cycle or value chain. It ensures that research and industry are closely networked, taking an interdisciplinary approach. The group provides German and international customers with comprehensive system solutions by combining the wide-ranging skills and experience offered by the individual members. In this way, they make companies fit for the production environments of the future. As a key member of the group, Fraunhofer IAPT provides it with expertise in the fields of industrial and autonomous solutions for additive manufacturing technologies.

Fraunhofer-Gesellschaft Competence Field Additive Manufacturing
The Fraunhofer Competence Field Additive Manufacturing (www.additiv.fraunhofer.de) integrates 19 institutes across Germany, meaning it reproduces the entire additive manufacturing process chain. This includes the development, application and implementation of additive manufacturing methods and processes. Its services are aimed at sectors such as handling and assembly, medical engineering, mobility, microsystems engineering and toolmaking, but can also be used across industries. Since it was founded in 2018, Fraunhofer IAPT has been a member of the Fraunhofer Competence Field Additive Manufacturing and contributes to joint contract research projects and trade show appearances.

Research partnerships

University Medical Center Hamburg-Eppendorf
The Life Science department at Fraunhofer IAPT works on various areas of research in conjunction with the Department of Oral and Maxillofacial Surgery (MKG) at the University Medical Center Hamburg-Eppendorf (UKE). The background to this partnership is the integration of additive manufacturing in the clinical workflow and its further development for specific applications.

The various focal points of the research are coordinated at the UKE by Prof. Ralf Smeets, who heads the Regenerative Orofacial Medicine division in the MKG. Prof. Smeets also works in an advisory capacity at Fraunhofer IAPT, with the aim of translating the ideas of medical practitioners into the language of engineers. The joint research activities range from digital image capture and processing to the application of AI for reconstructing medical anatomies, as well as the development of new additive processes and materials. Working together with the Helmut Schmidt University, the DigiMed project (grant number ERDF/REACT-EU 51164122) was successfully concluded in 2023 and highlighted a new digital and physical production chain for optimised patient care. Further cooperative projects focusing on the development of smart wound dressings and 3D-printed facial prostheses are planned for 2024.

Helmut Schmidt University/University of the Federal Armed Forces Hamburg (HSU/UniBw H)
The Professorship Computer Science in Engineering at Helmut Schmidt University Hamburg (HSU) (www.hsu-hh.de) engages in a close strategic partnership with Fraunhofer IAPT. The department has more than 20 employees and is led by Institute Director Prof. Oliver Niggemann. It offers a broad range of expertise relating to methods of machine learning (ML) and artificial intelligence (AI) for cyber-physical production systems. The joint research activities combine the skills offered by the two research units and promote digitalisation in additive manufacturing. Interdisciplinary projects support active knowledge transfer between employees at Fraunhofer IAPT and HSU.

The collaboration aims to increasingly explore joint projects in the context of HSU and other Hamburg partners in order to strengthen the local research landscape.

Networks

Additive Alliance®
The Additive Alliance® is the industrial research network for additive manufacturing at the Fraunhofer-Gesellschaft, with Fraunhofer IAPT acting as its organiser. Within the Additive Alliance®, Fraunhofer IAPT stages events and teaches companies about the opportunities presented by additive manufacturing. The concept combines talks and training sessions given by Fraunhofer IAPT with user reports and networking opportunities. 2021 and 2022 each saw two events take place. In addition, researchers at Fraunhofer IAPT have conducted research into three of the challenges presented by additive manufacturing; these were chosen by the members. The resulting Deep Dives are available exclusively to members of the Additive Alliance® in the first year after publication. Mesago Messe Frankfurt, organiser of Formnext, has been the official sponsor and collaboration partner of the Additive Alliance® and of Fraunhofer IAPT since 2020.

3D-Druck Nord
3D-Druck Nord is the 3D printing network for the Hamburg Metropolitan Region and aims to promote the development of additive manufacturing in northern Germany. In 2018, the network was founded as 3DMRHH by the Hamburg Chamber of Commerce. Following a hiatus due to the pandemic, it returned in August 2021 with a new name and a new administration, but the same goal.

Fraunhofer IAPT works together with Hamburg-based partners Fehrmann Alloys, Deutsches Elektronen-Synchrotron (DESY), Hamburg Chamber of Commerce, Hamburg Chamber of Craft Trades and the Industry Association of Hamburg (IVH), plus Lübeck Chamber of Industry and Commerce, Technikzentrum Lübeck (TZL) and Fraunhofer IMTE. Its goal is to network research and business in the AM sector in northern Germany, facilitate dialogue and increase the visibility of the Hamburg Metropolitan Region as a leading international hub of expertise in the field of additive manufacturing.

Mobility goes Additive
As a founding member, Fraunhofer IAPT has been actively involved in the Mobility goes Additive e. V. network for over five years. Originating from an initiative by Deutsche Bahn, the network aims to industrialize additive manufacturing, especially for the mobility sector. Fraunhofer IAPT leads the »Education« working group, probably the most significant international 3D printing network, and develops concepts for technology-related training and education. Additionally, Fraunhofer IAPT supports the approval of additively manufactured components for rail transport and the development of new materials, such as fire-resistant ones, in the »Approval« and »Materials« working groups. Since 2019, Fraunhofer IAPT has also been active in the newly formed sister network »Medical goes Additive,« striving to identify and implement innovative medical applications for 3D printing.

MN3D
Fraunhofer IAPT is a member of the steering committee in MN3D, the maritime network for 3D printing. Its members aim to unlock the potential of additive manufacturing in shipbuilding and other maritime applications, as well as initiate joint research and development projects in this area. The MN3D network operates in close collaboration with the Maritime Cluster Northern Germany (MCN).

Industry partnerships

3D Spark GmbH
3D Spark (www.3DSpark.de) was founded in June 2021 by three former employees of Fraunhofer IAPT. The company develops and markets software for identifying and quantifying cost savings in companies' production processes. To this end, it has analysed CAD data, ERP data and technical drawings using AI-powered algorithms and identified the exact components that 3D printing can make more cost-effectively than methods that have been used previously. Fraunhofer IAPT and 3D Spark are collaborating in the field of software-based part screening in order to open up new applications for 3D printing and give customers the best possible advice when it comes to introducing 3D printing.

AMPOWER GmbH & Co. KG
For many years, Fraunhofer IAPT has maintained a close partnership with Hamburg-based consulting firm AMPOWER (https://am-power.de). As part of a joint training concept, the two combine their expertise in the field of binder jetting and offer a hands-on workshop that benefits customers by incorporating not only AMPOWER's comprehensive knowledge of the technology and market, but also Fraunhofer IAPT's knowledge of processes and machinery. In addition, joint projects are undertaken to develop materials including process design guidelines and qualification strategies.

Fraunhofer Industrial Application Center Quantum Computing Hamburg (Fraunhofer IQHH)
In 2023, Fraunhofer IAPT joined the Fraunhofer institutes ITMP, IAP and CML in founding the Fraunhofer Industrial Application Center Quantum Computing Hamburg (Fraunhofer IQHH) in the form of a virtual organisation. The four partners are working together to develop resources and capacities in the new field of quantum technology.

Quantum computers can rapidly make calculations that conventional computers would take years to complete. Their capacity is redefining what it is possible to compute, and they are opening up huge opportunities for researchers and businesses to design and optimise products and production processes on the basis of innovative materials and logistics processes and systems. Fraunhofer IQHH represents a unique, applied source of skills and knowledge for the Hamburg economy.

Fraunhofer IQHH is also working with other networks, such as the Hamburg Quantum Innovation Capital (hqic) and the Fraunhofer Competence Network Quantum Computing. This allows the IQHH application centre to access the extensive knowledge and expertise offered by the 12 Fraunhofer institutes in the Fraunhofer Competence Network Quantum Computing whenever necessary. As part of a national partnership with IBM, Fraunhofer has also obtained preferential access to IBM Quantum System One, which is currently the only quantum computer that can be used with secure IP access.

Publishing notes

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In certain cases, our wording does not use masculine and feminine forms of speech at the same time. This is to ensure better readability. However, this does not imply any discrimination towards the female gender; rather, it is intended to be a gender-neutral approach that aims to simplify the language.

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