
Additive4Industrie
Combining forces for effective business development
A stepping stone towards long-term strategic international collaboration with Bavarian's Germany's Mechatronics and Automation cluster
cluster mechatronik & automation
BRAINPORT EINDHOVEN

Innovation collaboration stepping stone for effective business development

Additive4Industry is a pilot aimed at establishing cross-border collaboration between companies and organisations from the German cluster Mechatronics and Automation in Bayern and parties in the Brainport Eindhoven region and the Dutch High Tech Systems and Materials cluster. In the short run the pilot is aimed at achieving innovation collaboration between both countries in the field of additive manufacturing. Additive manufacturing as launching pad for other fields of technology

The Additive4Industry project focusses on innovation collaboration in the field of industrial additive manufacturing (3D printing) between German and Dutch knowledge institutions and companies.

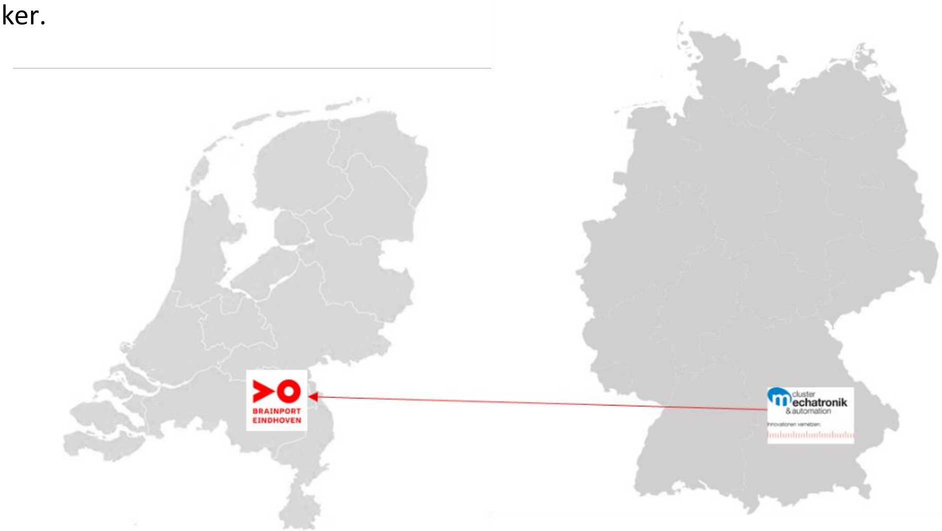
Jointly, 3 innovation projects will be identified and set-up to address particular R&D challenges in the field of additive manufacturing.

Through these projects the long term relationship between the Mechatronics and Automation cluster in Bayern and Brainport Eindhoven & the High Tech Systems and Materials cluster will be strengthened.

Why did we start this journey?

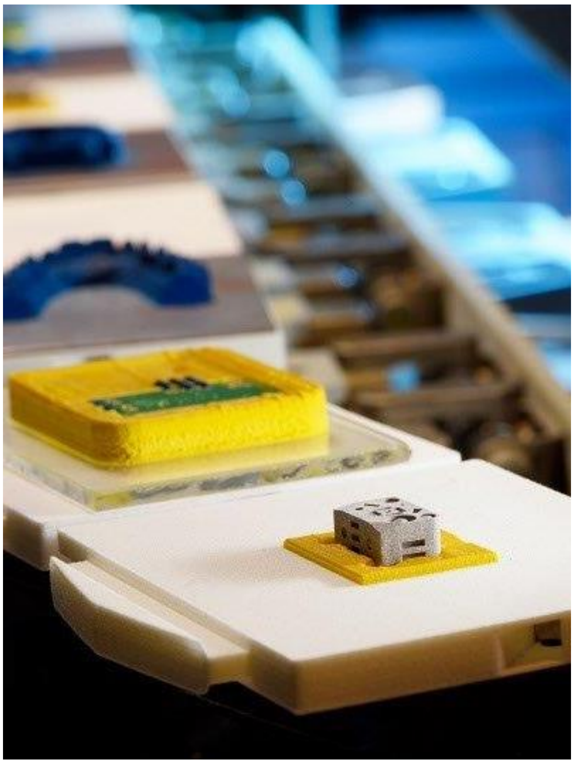
Competences of both high tech clusters in the field of AM are outstanding, both regions complement and reinforce each other on knowledge and expertise in this field.

Cluster M&A in Bavaria and Brainport Eindhoven have a strong motivation for joint investments in technology development. We share the vision that the innovation cycle needs to be opened up across the border. The project helps both clusters gain rapid insight in each other's competences, like a pressure cooker.



Advantages for companies

- Direct access to high level business-industry network, knowledge and expertise in Bavaria;
- Support for R&D driven companies and knowledge institutes to speed up innovation process or an innovation project;
- Direct access to knowledge and skills and expertise outside your own ecosystem.



“This project is interesting because it opens the doors of outstanding research institutes, professionals and leading companies in Bavaria this field, for now and for the longer term.”

Arno Gramsma, director Addfab

Additive manufacturing as launching pad for other fields of technology

Additive manufacturing or 3D printing is a highly developed technology in Brainport Eindhoven and in the Dutch high tech systems sector in general. Both Dutch companies and research institutes have a lot of knowledge expertise and experience in this field.

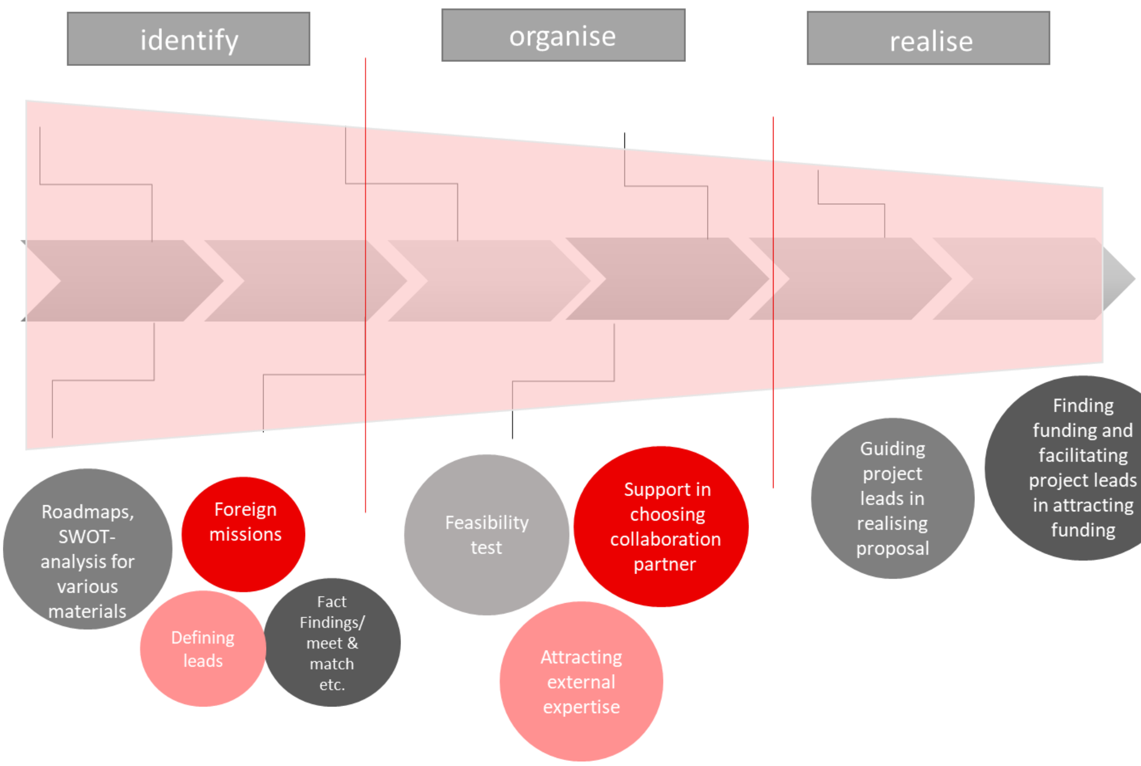
By the insights we gain from the Additive4Industry project the Dutch High Tech Systems and Materials cluster can shape its Germany strategy and expand collaboration to other sectors like:

- Automotive
- Space
- Integrated photonics
- Medical technology

Successful business development requires effective innovation funnel

In order for our business development to be successful and achieve long-term goals an effective innovation funnel is required. This innovation funnel is used by the Brainport consortium and M&A cluster to establish collaboration.

Each phase of the funnel requires government supported actions that need to be coordinated and streamlined centrally. Making sure that the right persons and right organisation are connected at the right time in the process. As you go further in the funnel, support increases in intensity. These separate actions have to be taken by all parties involved with the end-goal in mind.



Meet the Dutch team

- Brainport Development (initiator and project management)
- Brainport Industries and Addfab
- Eindhoven University of Technology via AMSYSTEMS Center (TNO/ TU/e joint innovation center to accelerate AM in various industries)

Brainport Industries members:

Supported by

- Dutch topsector High Tech Systems and Materials
- Dutch Government via De Werkplaats
- Consulate General München

Meet the German team

- The M&A cluster in Bayern consists of 200 companies and knowledge institutes
- Strong SME base

Important short term results & where we stand

- Identifying and defining 3 successful innovation projects between companies or organisations in Brainport Eindhoven and Bayern before the end of 2018
- Attracting funding for these 3 Innovation and R&D projects; project size appr. 4 million euros per project.
- German co-funding is secured
- Netherlands BIC Innovation Project is aligned.
- Other possibilities regarding funding are being investigated.

Where we stand now

- Support for developing innovation projects in funnel at government level via De Werkplaats
- 17-18 May first workshops to define project leads → 3 projects were defined to be worked out in next months
- Workshop June 26th Nürnberg Discussion of use cases
- Before September 15th; Approach companies with Letter of Interest (LOI) and finalise project sketches

Figure 1 Workshop May @Brainport

Additive4Industrie – the projects

Project 1: Printing of predictable World Class Metal (Spare)Parts

Lead partners:

Project 2: Printing of functional mechatronic components

Lead partners:

Project 3: Rapid Additive Manufacturing of High Power Contacting Elements for Electric Drives

Lead partners:

Project 1: Printing of predictable World Class Metal (Spare)Parts

Fraunhofer IGCV

Universität Bayreuth

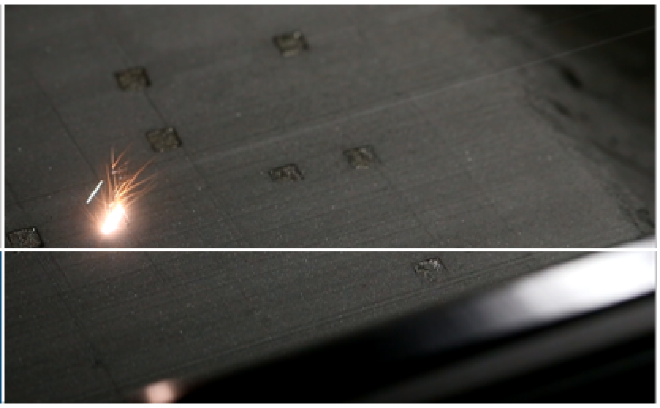
Technische Hochschule München

Cluster Mechatronik &Automation

AddFab

NTS System Development

Brainport Industries



Printing of predictable World Class Metal Parts (Spareparts,….)

With Powder bed Laser Fusion Processes

Project Partners

Challenges in printing World Class metal Parts: Process Quality versus Part Quality

Additive Manufacturing of metals is increasingly gaining the attention of the producing industry due to the innovative product designs made possible. One of the challenging benefits would be that spareparts can be made on direct demand for delivery.

Spareparts have high requirements for economical reasons. So reliability for the function of the part is very important.
To come to spareparts printed on demand redesigns of existing parts (other manyfacturing technology approach) need to be made.

Quality Management from your functional design towards the requirements of the printed and post-processed part needs:

- Design prediction (Digital Twin)
- Material input
- Production process monitoring
- Part inspection/qualification
- Validate the digital twin with the part for QM release

Approach towards the challenges

In order to overcome the technical challenges, a close cooperation between research insitutes and industrial users is required. In an integrated approach, experts in mechatronic design and development, materials qualification, process technology will work together with industrial partners.
During the project, the full potential of design for Industrial Additive Manufacturing is broken down.
At the same time, the range of possible applications is being extended by showing industrial business cases in the area of printed spareparts.
The whole supply chain (from design to part) needs to be linked to different Quality Management systems for releasing parts for first article inspection (FAI), and release for volume..

Contact

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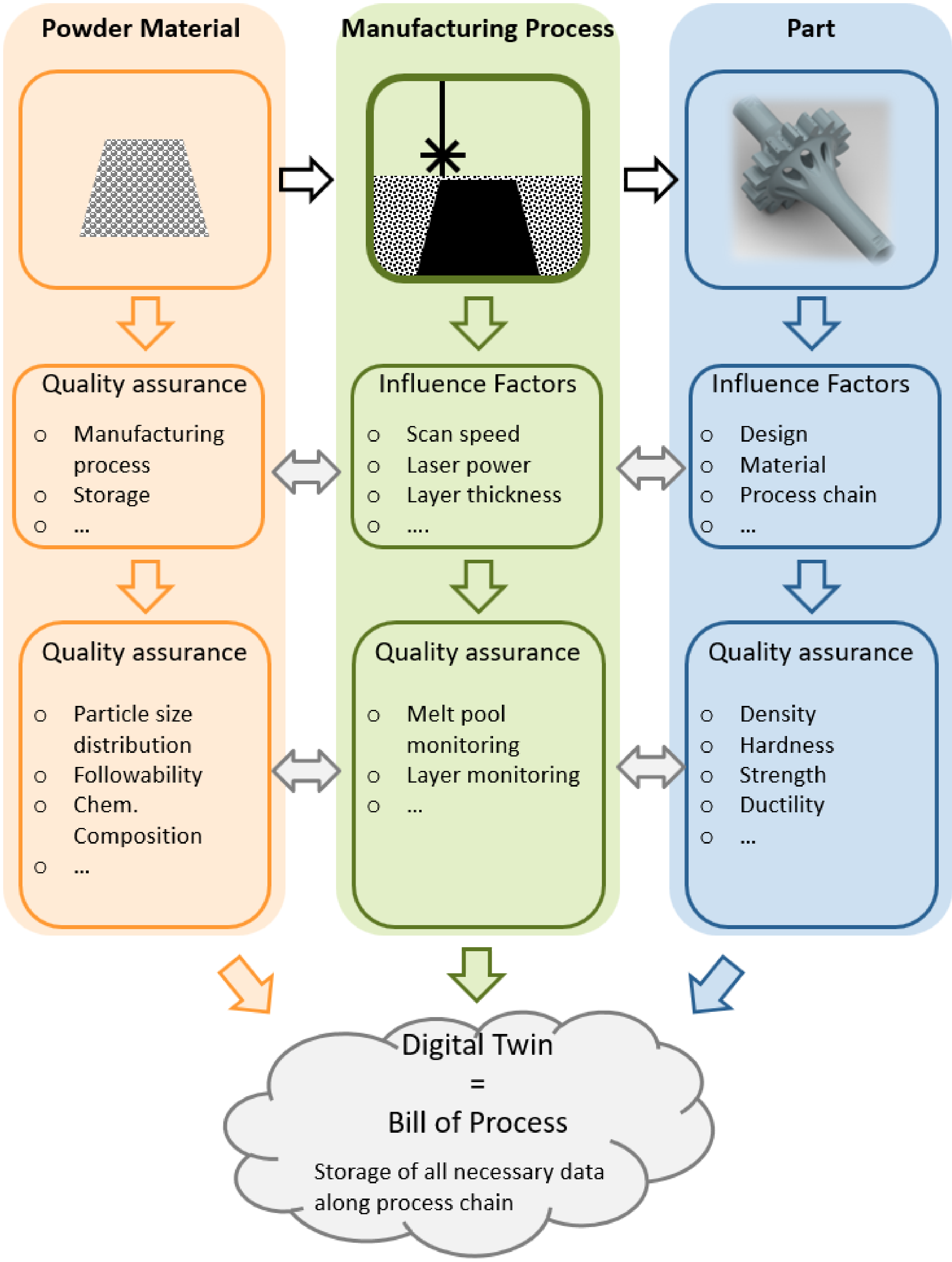
Printing of predictable World Class Metal Parts



Targeted Work Packages and Industrial Support

WP 1: Design and Development

Define use cases: (Aerospace, Automotive, Tooling, …..,……)
Define functional requirements per area
Analyse the Process chain
Identify gaps in QM (process versus spareparts)

Industrial Support:

- OEM
- Design and Development

WP 2: Qualification of functional parts

To enable Additive Manufacturing of metal spareparts materials and processing strategies have to be aligned to ensure functionality.
How to identify functionality of a spareparts (related to design, material and process)

Industrial Support:

- LBM Equipment Manufacturer
- Powder Metallurgy Specialist
- Material Testing and Characterization
- Design and Development

WP 3: QMS Materials

Come towards a Quality Management control via SPC to identify influences of the powder specifications on the end result of your part (need the parameters of you machine and build to be changed based on the differences of the batches of powder).
Activities:
Influences of powder characteristics on process parameters (High/Low impact)
Influence of powder on the Process monitoring QMS
SPC supply document from powder supplier to customer with influences on process

Industrial Support:

- Powder Manufacturer
- Powder Metallurgy Specialist
- Material Testing and Characterization

WP 4 QMS Bill of Process

Defining:
Store scan-strategies
Powder Quality
Post-processing (heat treatment, subtracting,..)

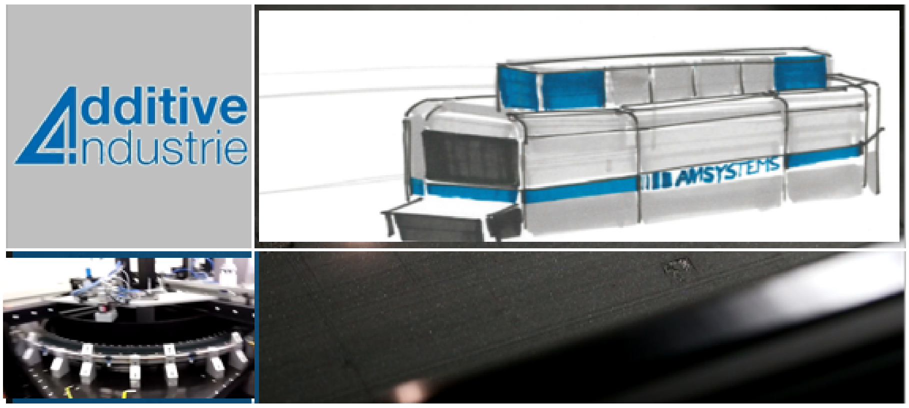
Verifying:
Store process monitoring
Store sensor data
Store evidence (strength, composition, density, etc,….)

Releasing:
Analysing all data for release

Industrial Support:

- OEM
- Design and Development
- Software (PLM, ERP, ..)

Project 2: Printing of functional mechatronic components



Printing of functional mechatronic components (smart prosthesis, power electronics and grippers)

Project Partners

Polymer powder bed fusion based hybrid processes

Challenges in printing of functional polymer based mechatronic components

Additive Manufacturing (AM) of polymers is state of the art and showing revenues for industry in many applications. The added value can be even further enlarged when the technology is combined with electronics integration, resulting in active and smart products. This will enable the producing industry to economically produce next generation innovative product designs. Case studies proposed are: a) smart prosthesis, b) power electronics and c) grippers. One of the challenging benefits would be that tailor made parts can be made in series of one on direct demand for delivery.

Challenges to be overcome are:

1. (re) design of the hybrid parts: combining 3D CAD and electronic designs is needed
2. Manufacturing systems that enable integration of electronics during the printing (pick and place or other)
3. Materials used need to be qualified, compatible and functional (mechanical, thermal, COE, electrical and "printable")
4. Printing of reliable (thermal, pressure) sensors in a cost effective manner
5. Thermal management (power electronics): optimal cooling with thermally designed Additive Manufacturing cooling ribs
6. Reliability (mechanical, electrical) for the function of the part needs to be secured
7. Quality management*) served in P1
8. Finding the business case*) is this part of the study?

Approach towards the challenges

In order to overcome the technical challenges, a close cooperation between research institutes and industrial users is needed. In an integrated approach, experts in 3D printing, mechatronic design and development, materials development and qualification, process technology and thermal modeling will work together with industrial partners.

During the project, the full potential of Printing of functional mechatronic components will be addressed, with focus areas as defined by partners priorities and industrial case studies.
The project structure and workpackages cover critical challenges and key elements of the manufacturing chain of functional mechatronic parts. Where appropriate, links will be made to relevant A4I projects focused on quality control (P1).

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Targeted Work Packages and Industrial Support

WP 1: Design & use case study definition

Define relevant*) use cases: smart prosthesis, power electronics, grippers. Setting of functional requirements per use case. This will also set the requirements for the manufacturing system itself (cost per part -> machine/module speed & cost, ..).
Redesign of the use case towards an active and smart product manufacturable by AM.
Design optimization might comprise:

- Thermal management (optical heat/cool performance, use of lattice structures)
- Materials selection and lightweighting
- Flow dynamics (air cooling, manifolds, heat losses,..)
- Electronic design integrated with 3DCAD

*) a good case study is accompanied with a positive basic business case outcome.

Industrial Support:

- OEMs
- Design and Development

WP 2: Manufacturing modules toolbox development

To enable manufacturing of functional mechatronic components, many processing steps and modules need to be combined in a hybrid process. Modules to be set-up comprise:

- Polymer powder bed fusion based process (laserbased, scalable, cost effective) base system
- Pick and place of electronic/optical components while printing
- Assembly of parts and components while printing
- Printing of sensors (pressure, thermal, ..)
- (non printed) substrate preparation
- Unpacking and cleaning
- Quality control **) in collaboration with P1

Industrial Support:

- Equipment Manufacturer (mech + electr. engineering)
- Conductive tracks mat & printing experts

WP 3: Integration and piloting

All modules and components from WP2 will be integrated into one pilot manufacturing machine/system which will be fully functionally tested (cf WP1 req.).
Prototype production of use case products, feedback loops, multiple iteration steps.
Manufacture of final functional use cases.
Testing of use cases (mechanical, electrical, ..) towards WP1 set of requirements.

Industrial Support:

- OEM
- Equipment Manufacturer
- Material Testing and Characterization

WP 4 Dissemination and exploitation

Protection of results (where appropriate)
Presentation and sharing of results (after IP protection)
Refining the business case
Exploitation of (sub) results by industry (machine, product, module, ...)
Defining next steps
Reporting to relevant bodies

Industrial Support:

- OEM
- Equipment Manufacturer

Project 3: Rapid Additive Manufacturing of High Power Contacting Elements for Electric Drives

Today, electric drives in modern automobiles are essential components of an increasingly complex system. In addition to the electrical generation of the propulsion torque, a large number of elementary functions such as ABS and ESP systems, brake boosters or air conditioning functions can hardly be implemented without electric motors, with the trend towards electrification of further functions continuing unabated. This significantly reduces the installation space available for an individual drive. As a result, compact yet powerful drive systems must be integrated into the vehicle's extremely limited construction space. The associated increase in power density of the drives has the cons equence that the voltage levels of the supply voltage as well as the current amplitudes within the motors are increased significantly above the normally used values.

The high power density in electric drives is indispensable linked to appropriate thermal management. Due to high currents and small installation space, the safe dissipation of unavoidable thermal losses is absolutely essential in order to guarantee the lifespan and reliability of the drive systems with automotive-compatible safety. In many cases, the amount of heat generated can no longer be dissipated via conventional convection cooling and must instead be dissipated via liquid cooling media. Ideally, these are used where the greatest power loss occurs: in the area of the current-carrying parts of the machine. The area between power semiconductors and winding is considered particularly critical.

Due to the technically unavoidable contact resistance to the windings, there are hot s pots which can damage the insulation of the individual wires as well as the metal sheets. At the same time, it is only possible with great effort to integrate direct, integrated liqu id cooling in existing production technologies. Through the use of new, additive manufacturing processes, the possibility of generating complex geometries without the geometric limitations of conventional processes has already been demonstrated using a wide variety of products from the fields of mold construction, aerospace or medical technology. The direct, tool-free production of the final contour eliminates the need for subsequent cutting of cooling ducts or complex insertion processes for media lines. At the same time, the potential of these processes for the production of mechatronically functionalized components has so far been largely unexplored, as the development of new functions and processes is currently focused on conventional construction materials. In order to explore the potentials and advantages of highly productive additive processes for the production of electrical drive systems and to make them usable, the objectives of the research project are:

- Design of a fluid-cooled high-current contact unit for complex interconnection of the winding system with the power supply system including power electronics, taking into account the innovative possibilities of additive production (Mechatronic Design for Additive Manufacturing)
- Development of a highly productive additive production process which is able to process the contact material copper oxide free with integrated cooling
- Testing and industrialization of the process
- Development of a technology demonstrator
- Economical qualification of the developed process The successful realization of the project requires intensive cooperation between industry and science throughout the entire process chain. The aim is to build up and expand competencies from the raw material to the finished product.

Project partners

Contact

Institute ELSYS

Prof. Dr.-Ing. Armin Dietz

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Letter of Support.

(on own letterhead company logo)

YOUR LOGO

To the A4I Project Co-ordinator

Mr. Frits Feenstra and Mr. Arno Gramsma
Eindhoven, The Netherlands

Additive4Industries@addfab.nl

RE: Letter of Support as a industrial partner for the Additive 4 Industries Project

Dear Mr. Feenstra and Mr. Gramsma,

We hereby express our firm interest to support the A4I as a member of the dutch partner:

A4I:

The main industrial activities of this project will be performed by small and medium sized enterprises. As a *non*-SME company we will take part in the Additive 4 Industrie (A4I).

With this Letter of Support we agree and assure that:

- We are informed about the overall objectives and goals of the A4I project.
- Where possible, we will provide the consortium with relevant industrial/scientific input to support the planned research.
- We intend to respond to surveys and be actively involved in dissemination events carried out within the project and where feasible, involve relevant stakeholders e.g.
- It is understood, that we cannot charge personnel or other costs to the project..
- The Project-Co-ordinator is authorised to mention our organisation's name in the proposal and may also attach this Letter of Support as an annex.
- We understand that the proposal and its main activities are of confidential nature.

We expect that the proposed project undertaken by the consortium will make a significant contribution to the goals described in the proposal in terms of speeding up the innovation process or an innovation project. These goals can only be achieved when the M&A industry and other experts closely work together.

Place and Date:

Signature:

Name:

Title and stamp of organisation: