

The Challenge of Large Scale **Additive Manufacturing in Construction**





Challenges of Additive Manufacturing – Technical Regulations and Qualification Requirements

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As a first step and according to the gap in theory, C07 considers a fundamental framework to evaluate the new processes from design to production in AM to analyse the new operation factors and to allocate them to the required processtechnological and qualification-related parameters. Subsequently, the results are categorised and transferred into 1) regulatory concepts (RC) and 2) qualification

concepts (QC). RC focus on correlating design and production parameters to final product properties and the correlated quality assessment while QC are aligned to the associated profiles of competences and qualifications and to related processes of and access to learning and development in the context of AM.

Research Questions



The purpose of project C07 is to collect and analyse data in other TRR 277 projects as a common starting point and to draw conclusions with special regard to perspectives of RC and QC. The data analysis aims to:

- Identify properties of AM products and its correlating production parameters. This includes the dependencies of underlying digital models and examines the methods, which allow adequate monitoring and ensure a quality management with both a reasonable level of safety and confidence of the respective products (Goal I).

Preliminary Work

PL Stefan Winter:

- Broad research in construction products and adhesive technologies
- CEO of the MFPA Leipzig (2001-2010) and the timber department of the MPA BAU of TUM (since 2003)
- Member and chair of several standardisation committees such as CEN/TC 250/SC 5 (chairman since 2014) – at national (DIN) and international level (CEN)

PL Daniel Pittich:

• Modelling and diagnostics of competences at different levels of the didactic

• Generate theoretically and empirically based concepts for learning and qualifications in AM at an adequate level of Engineer Education and Vocational Education and Training (Goal II).

development of digitalisation, Industry 4.0 and learning factories in the field of production technology

• Co-editor of the Journal of Technical Education (JOTED)

WP 1 Synergetic linking and matching of RC and QC

and the other TRR 277 projects		
WP 2 Exploration, Identification and Evaluation of AM – Technology, Parameters and Processes	WP 3 Analysing and Transforming the empirical data for Specific Concepts	
WP 2.1 Requirement Specifications – complete sample of user and regulator requirements to AM building construction products – briefing of anticipated projects	WP 3.1 Development of test and verification procedures WP 3.3 Analysis of required skills and qualification	WP 3.5 Reconciliation the current states of other projects with optional adjustment and modification WP 3.4 Supplementation, modification and clarifica- tion of the framework for further steps in QC
 WP 2.2 Identification of relevant parameter, material and process analysis in iterative data generation WP 2.4 Identification of skill and qualification requirements within production processes in iterative data generation WP 2.3 Identification of test procedures to evaluate product properties, geometry etc. in iterative data generation WP 2.5 Identification requirements in product chain design-product chain design-product chain design-product on-sales-use in iterative data generation 	WP4 Regulatory concepts and quality assessment	WP5 Aspects of qualification concepts in AM
	WP 4.1 Safety and risk assessment of AM- products – level of requirements	WP 5.1 Iterative development and clarification of the framework for competence profiles of individuals
	WP 4.2 Allocation of AM-products to AVCP- systems	WP 5.2 Iterative development and clarification of the framework for handling, learning and problem-solving processes WP 5.3 Iterative development and clarification of
	Factory production and third party control - design of control plans	
WP 2.6	WP 4.4 Framework for approvals and standardisation	
Summary, commitment and reflection of information within	Coordination with regulators and	

C07

Role within TRR 277

As linking project, C07 is directly collaborating with focus area A of TRR 277 to evaluate influencing and necessary parameters, accompanying monitoring and testing methods and needs regarding qualification profiles. Since path planning for monitoring methods could also be a factor, co-working with B04 is targeted. Exchange with C01 will support the research on geometry based verification methods. Further on, C07 collaborates with C04 and C06 regarding digital design and processes. To ensure accordance with proper Construction Product Regulations (CPR) C03 and C05 cooperate with C07. Finally, extensive studies on QC and RC are planned with the projects A04, A06 and A08.



standardisation bodies

Geometry

Methods

TRR 277 projects A01-A08, B01-B05 and C01-C06

Project C07 follows an explorative approach and researches the technological and process-related developments of the other TRRprojects within the two target perspectives. This is achieved by using an empirical design with a multi-perspective survey and analysis approaches.

- A primary focus on technology- and process-related methods.
- Another focus on (material) analytical, observational and introspective research methods.

• Approaches comprise briefings, notes, interviews, surveys, workshops, a Delphi-study and safety and risk analysis but also activity and process analyses.

• An analyse of the generated empirical database is based on the existing state-of-the-art regulation and qualification requirements.

• As a result proposals will be made on a) AM building construction products in the framework of legal requirements and b) on different qualification levels throughout the chain of design-production-use.



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