

**5th Call for Research Applications at LIT**  
***Additional Information about the LIT Factory***

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LIT – the Linz Institute of Technology – aims to augment and intensify research already being conducted at the JKU. LIT is currently focusing on the LIT Factory and Artificial Intelligence.

Based on the approved infrastructure call, this document is intended to provide applicants with supplemental information about the LIT Factory's focus.

**SYNOPSIS:** The LIT Factory at the JKU is an industry-focused, open platform for smart production. Designed to be holistic and cross-applicable, the platform aims to innovate, demonstrate, and educate as well as explore ways to best benefit mankind, the environment, and the economy. The approved acquisitions include integrated systems engineering, process engineering plants to prepare polymers, and processing systems to manufacture light-weight structures.

**ACQUIRING AN R&D INFRASTRUCTURE:** Instead of conventional production technologies (in an attempt to avoid saying *average technologies*) to support the digitalization process, the LIT Factory is exploring the use of new and undeveloped I4.0 Technologies that are currently considered prototypical frontier production technologies. These have great potential in high process engineering and digital innovation and would also form the basis for subsequent, interesting academic and industry-related research activities. This would include digital tools for integrated systems engineering, process engineering plants for polymer processing, production processing of polymer lightweight structures and composites, including recycling and re-compounds as well as their digital networking to cyber-physical systems production systems (CPPS).

**OBJECTIVES, BENEFITS AND APPLICATIONS:** As an open platform, the LIT Factory aims to explore, develop, demonstrate, and teach crossover solutions in support of products and production, boosting existing strengths, translating R&D results into innovations, shortening the 'time-to-market' period, entering into close cooperation with industry and SMEs, and creating sustainable benefits for people, the environment and the economy. I4.0 core technologies address: Virtualization & Modeling, Digitized Processing (Smart

Data Mining, PAT<sup>1</sup>, PCA<sup>2</sup>), CPPS, Communication (HMI<sup>3</sup>, M2M<sup>4</sup>) and Networks (IIoT<sup>5</sup>, Security, SCM<sup>6</sup>) including the accompanying research (HR<sup>7</sup>, strategy, business models, law).

**FDI FIELDS:** The research and development and innovation projects planned are presented in the following two figures, whereby there are three different levels to consider:

- *Digitization Level:* Determining which I4.0 core technologies the pilot factory will employ
- *System Level:* Determining which I4.0 core technologies subsystem will use (such as in individual mechatronic components or in the whole factory)
- *End Product Level:* Determining which end products are to be researched, taught and demonstrated as part of the I4.0 core technologies

The I4.0 core technologies of digitization (D1 to D7) address:

- D1) Virtualization and Modeling of Products and Production, Digital design, Augmented Reality
- D2) Process Digitalization, Process Analytical Technology (PAT), Principal Component Analysis (PCA), Predictive Data Analytics, Self Adaptation and Optimization
- D3) Cyber Physical Production Systems (CPPS)
- D4) Machine Learning and Data, Artificial Intelligence
- D5) Human Machine Interface (HMI) & Machine to Machine (M2M)
- D6) Industrial Internet of Things (IIoT), Cloud & Fog Computing, Supply Chain Management (SCM), Intelligent Networks, Security and Safety
- D7) Miscellaneous

The potential in the digitization process will be applied to system areas (S1 to S6), meaning either for

- S1) Individual, smart digital/mechatronic components,
- S2) Complete process engineering systems,
- S3) The whole factory and value-adding network or for
- S4) Smart-end products,
- S5) As part of the plan to conduct accompanying research, research will include exploring issues in digitization with regard to benefitting mankind, the environment, and business.
- S6) Miscellaneous

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<sup>1</sup> PAT ... Process Analytical Technology

<sup>2</sup> PCA ... Principal Component Analysis

<sup>3</sup> HMI ... Human Machine Interface

<sup>4</sup> M2M ... Machine to Machine

<sup>5</sup> IIoT ... Industrial Internet of Things

<sup>6</sup> SCM ... Supply Chain Management

<sup>7</sup> HR ... Human Resources

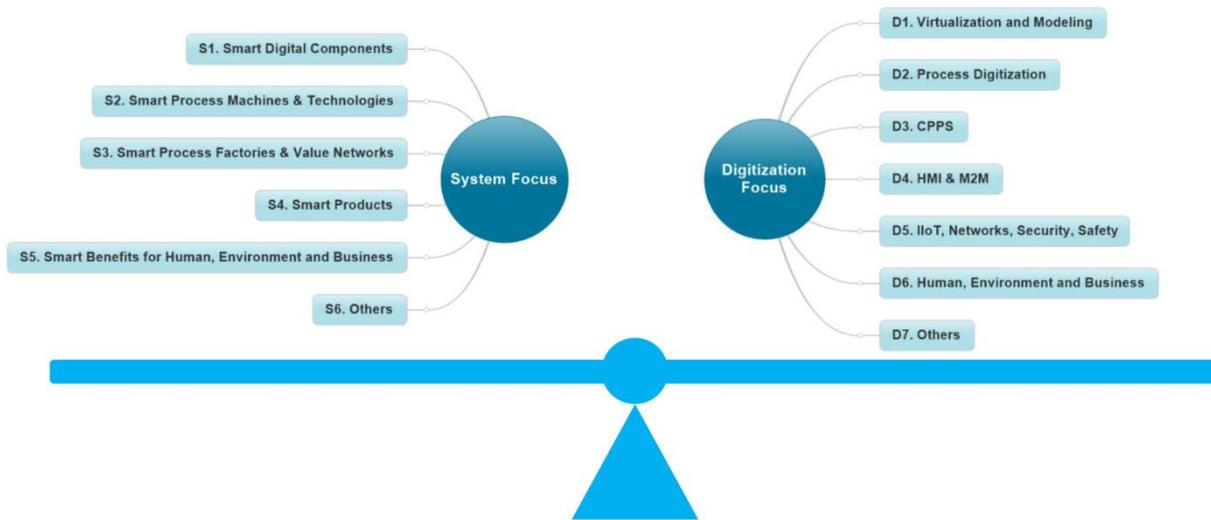


Figure 1: Balancing the focus of research and project classification. On one hand, value-added system aspects, such as process engineering, mechatronics, and on the other, accompanying research (S1 to S6) and digitization aspects (D1 to D7).

The application and demonstration of I4.0-technologies in concrete end-products is essential for the pilot factory. The goal is to develop a flexible process engineering pilot factory and develop end-products for a wide range of industries. The following figures show details of the system level S4 “Smart Products” in 7 application areas (P1 to P7).

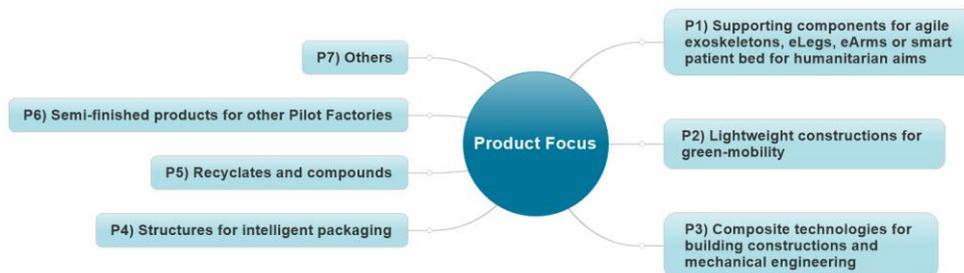


Figure 2: The LIT Factory’s production focus.

In order to take the holistic approach I4.0 needs for interdisciplinary cooperation into account, the FDI fields are based on these three levels of digitization, systems, end-products.

**NETWORKING ARCHITECTURE:** The following figure shows the LIT Factory’s planned networking structure. Networking will create a useful value and new digitization techniques must be developed and applied.

**LIT FACTORY**  
**Networking Architecture**



Figure 3: The LIT Factory's networking structure.

**WORKING PACKAGES (WP):** The LIT Factory's approved infrastructure call includes, among other things, the following working packages:

- **Smart System Engineering:** The goal is to develop a comprehensive Product Life Cycle Management Systems incl. Smart Data Mining and Predictive Data Analytics Tools for smart component and process engineering. The working package specifically includes the following content and work steps: a) Integrative Simulation: multi-scale and multi-physics modeling; b) smart component engineering: prediction of the microstructure in anisotropics, multi-layered fiber components, determining dimensional stability and predicting relevant mechanical properties, production-compatible component design for small and large series applications and c) smart process engineering: Smart Data Mining, Predictive Data Analytics, Process Analytical Technology (PAT), Principal Component Analysis (PCA), Computer Fluid Dynamics (CFD)
- **Smart Lightweight Processing Technologies incl. Recycling (Extrusion, Compounding and Injection Moulding):** The goal is to explore, demonstrate, and teach I4.0 technologies at a still young, new, currently prototypic frontier production technologies with high process engineering and digital innovation potential in order to create an academically and scientifically interesting basis for future research. We need to enable a cross-sector data broker as well as a new online platform that allows for the continual use of cross-technological machines and company information (all aspects of company organization and documentation) and create a specially adapted MES for the plastics branch for planning, QS, process optimization, assistance, etc.

**USE CASES:** The LIT Factory's development includes the following corresponding use cases that are a part of the 4th Call for Research Applications and should be addressed at LIT:

- Multi-scale material, process and structural modeling for process flows of polymer melting and technical components made of plastic taking multi-component systems<sup>8</sup> into consideration for the above-mentioned application areas P1 to P7
- Inline and online measurement and quality assurance concepts for process engineering systems (S1 to S3) in plastics processing and preparation and especially taking multi-component systems into account
- Processing technologies to manufacture multi-component semi-finished products and mouldings especially taking fiber spreading, fiber impregnation, tool design, laying out dry reinforcing materials, predictive inline trimming optimization, foaming, in-situ polymerization into account
- Digital construction and design principles for the above mentioned application areas P1 to P7
- Module components for the LIT Factory's "Digital Twin"

**ACCOMPANYING RESEARCH:** Given the social importance of digitization, the LIT Factory also aims to conduct accompanying research in the fields of social and occupational research. The objective is – to the best extent possible - to explore an interdisciplinary approach (technology, business, and law) including the impact and effects of digitization and the innovative production processes on company strategies and (digital) business models, working forms, work processes, employees, and issues involving data protection and legal issues. The accompanying research should link innovative production processes with innovative strategies and business models as well as future-oriented solutions in the field of human resource management and intellectual property and labor law. During the development phase, the strategic development regarding the use of future RDI projects is of particular interest for the LIT Factory.

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<sup>8</sup> Blends, co-polymer, co-extrusion und co-injection, compounds, fibers, fillers and reinforcing materials as well as UD tapes in the system with polymeric materials