An initiative for an SFI on additive manufacturing (AM)

With this flyer we invite partners from the industry and public enterprises, as well as academia, to join an initiative to apply for a research center on additive manufacturing, with long-term funding from the Research Council of Norway.

The Research Council of Norway has issued a call for applications for new Centers for Research-based Innovation (SFI) (https://bit.ly/2TaVXl1). The purpose of an SFI is to build up and strengthen Norwegian research groups that work in close collaboration with partners from innovative industry and public enterprises. An SFI provides a long-term, targeted research activity – SFIs are financed for 8 years. Note that an SFI is also open for partners outside Norway. A mandatory outline must be submitted by 4th April 2019, and the deadline for the final grant application is 25th September 2019.

A number of Norwegian research groups at SINTEF and NTNU want to take this opportunity to apply for an SFI on additive manufacturing. With such a national center, which allows for continuity (8 years), we want to strengthen and integrate the AM competence base in Norway, and energize the innovation capacity and value creation in the industry and in public enterprises.

The R&D topics in the AM-SFI application will be selected based on dialogue with the partners, and existing strong fields of expertise in the research groups involved, which again are mostly based on earlier national and international industry-focused R&D projects. Some keywords about possible research areas and R&D topics are indicated below:

- **Feedstock**: The main materials in the R&D work will be commercial metal alloys and polymer-based materials and composites. However, possible R&D tasks may include development/modification of feedstock for AM, e.g. ceramic materials for functional devices, bio-based materials for the architecture/ construction sector, and Si-based materials. Demonstrators will be manufactured with such new feedstocks.

- **AM processes**: The SFI will use the AM facilities in the labs of the partners (including industry), as well as those of international collaborators. R&D tasks directed towards the AM processes may include aspects of process monitoring/control and artificial intelligence. New commercial processes or process steps, claiming higher productivity or better part quality, will be benchmarked, also with research tools as mentioned below.

- **Material-process-microstructure-property relationships**: Fundamental relationships will be studied experimentally and numerically in order to establish a firm basis for using AM parts in demanding applications. Robust and repeatable AM processes, and predictable mechanical performance, are essential factors for industrial use of AM. R&D tasks may include fatigue and fracture mechanics studies. Non-destructive methods will be studied, since such methods are important for quality control of critical parts.

- **Numerical tools**: In order to utilize the geometrical freedom and fast turnaround offered by AM, virtual product development in the form of numerical simulations is an important tool. Many commercial software packages for AM have been introduced in later years, claiming to simulate everything from A to Z. However, we have some ideas for improving models and material data in order to improve the predictions of AM process simulations (e.g. to simulate the warpage and

possible defects of the final part, built in a certain way) and topology optimization routines (e.g. to reduce part weight with a given mechanical loading). The R&D partners also have a strong background in multiphysics-based generative design of AM components, in particular for process intensification applications such as chemical reactors. This simulation framework will also be developed further in the AM-SFI.

- **Digitalization**: The "digital thread" is of course central for the AM value chain, from the product development phase to the approval and supply of products. Possible R&D tasks will include development of new numerical geometry representations. This could give benefits in the simulation of complex geometries, such as non-uniform lattice structures, and also lead to solutions for more effective usage and sharing of the geometry model in the various phases (design/FEA, production, quality control). Finally, the AM-SFI will include R&D on digital twins, which is important for developing more effective AM value chains.

- **New business models and product innovations**: In the SFI, the research groups at the research organizations and universities will collaborate with partners from industry and public enterprises – both in the R&D tasks and via case studies. The case studies will deal with product innovations and business models such as *spare parts on demand* and *mobile AM solutions*. New business models will also be analyzed with regard to sustainability.

Schematic AM-SFI concept (NB: provisional)
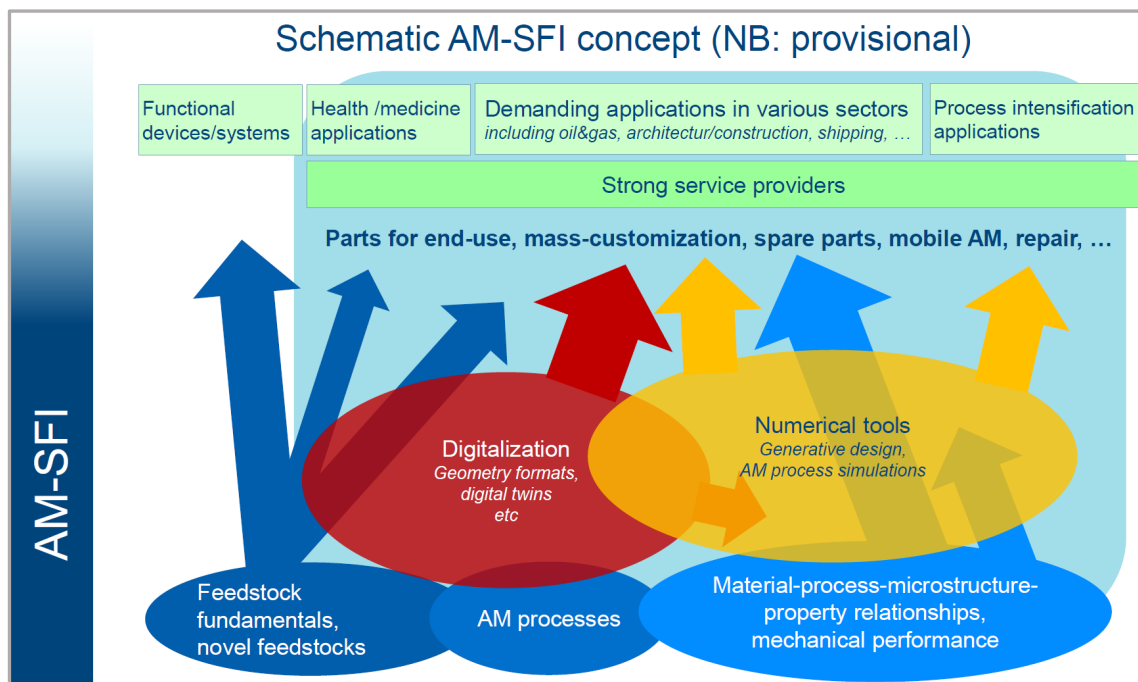
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