# Future Challenges and Needs – a technology roadmap for Digitalisation of production flows

Framtida utmaningar och behov – en teknisk road map för digitalisering av produktionsflöden

Prepared by DINA project partners

Presented by Ola Isaksson Chalmers Ola.isaksson@chalmers.se



A deliverable from the DINA pilot project "Digitised production flow". Part of the Vinnova's government mission to promote digitalisation in Swedish Industry "Digitaliserat produktionsflöde för additiv tillverkning – DINA"





### **Establishing Digital Manufacturing – AM example**





## Creating the path to an Increasingly Competitive Industry by the Digital Manufacturing Ecosystem





# Trends and Effects of digtialisation

### Novel mix of technology, business models and organisations

High potential - radical changes



6 | DINA Roadmap | Ver 2017-01-26

### **Standards enabling growth**

 Physical production connected to enterprise level via standards



http://www.batchcontrol.com/s95/images/S95\_levels.gif

Enterprise and plant schedules *From months to shifts* 

Work flows in production plants *From days to seconds.* 

Control of the manufacturing process

On line

The production process

(ANSI/ISA-95)



## The future for Additive Metal Manufacturing

#### Wow

AM is an established industrial manufacturing process, radically improving sustainability and competitiveness

#### How

Promising optimal

- Weight, Lead Time, Shape
- Reduction of components
- Instant spare part manufacturing

20-80% gain compared to traditional manufacturing

Additive Manufacuring challenge and require step changes digitaliation capabilities



Source: EDAG INSIGHTS 1/14 GENESIS





## Instant design

#### Wow

Instant design, evaluation and verification, takes customer demands into new innovative solutions

Automation in digital product design platforms

- Design for AM
- Digital twins for evaluation
- Instant prototyping
- Seamless integration to resource planning systems

#### How





## **Seamless virtual manufacturing**

#### Wow

All engineering and manufacturing methods and tools, are seamlessly integrated in virtual and real systems

Integrate all preparatory steps in digital manufacturing flows

#### How

- Standardised file formats
- Open APIs
- Creating complete models and parameter settings





## Adaptable planning and production flow

#### Wow

Timely deliverable by flexible and continously optimized manufacturing and logistic resources in the whole supply chain

#### How

Use digital connected resources to

- Monitor and manage "health" status of machines
- Connect the supply chain
- Adapt to rapid changes and optimise use of resources





## Total process control – Machine level

#### Wow

Every process operation is correctly executed under monitoring and control. Relevant information flows back and forward

#### How

Sensor and control technologies generate information on every level of the process – used to control, adapt and improve

Need the ability to

- Analyze and benefit from data captured
- Feed forward techniques to down stream
- Feed back to control, adjust and improve



Learn and adapt



## Quality by traceability and analysis of data

#### Wow

The quality is assured and improved by data delivered and analysed from manufacturing and from use

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#### How

"Big data" is captured from sensors during the complete life cycle of manufactured metal products. Data is statistically analysed for feedback to the planning and control of

- The AM Process
- The production system incl. Supply chain
- The data in use and maintain





## Knowledge capturing for improvements

#### Wow

Knowledge from all parts of the Digital Manufacturing Ecosystem, are used for continuous improvements, decisions, learning, education and new R&D initiatives

#### How

- Capture, learn, share and build competence in industry
  - Product to Product
  - Process to Process
  - In the supply chain
  - Between companies in Sweden
- Facilitate shift in competence to sustainable and digital competences in parallel to implementation
- Challenge: Competence and responsibility to handle the extreme flexibility available in the manufacturing systems



## Summary and recommendations

#### Wow

Increasingly competitive industry The Swedish innovation system is a niche global leader for the Digital Manufacturing Ecosystem

#### How

#### From Research to Demonstrated Effect

- Understanding and innovation
- Make use of arenas for industry/academy collaboration
- Building capability over time
- From Knowledge to Skill

Instant

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Digitalisation

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Total process control

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Adaptable

planning and production

- Intensify educational initiatives to ensure competence transition
- Facilitate Mobility and Technology Transfer
- From Curious to Professional
  - Stimulate industrial engagement
  - Different needs and abilities

From Successful Pilots to Manufacturing System require advancements in industrial digital capabilities

Join coming initiatives and

## Create the path to an Increasingly Competitive Industry by the Digital Manufacturing Ecosystem

