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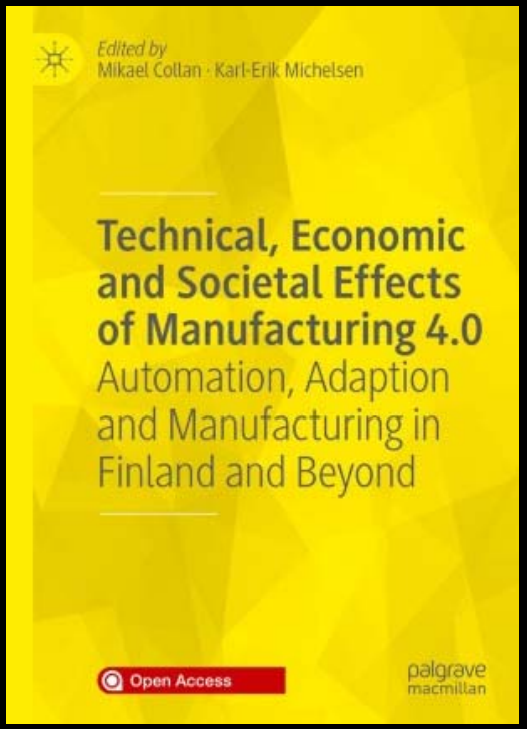
3D TULOSTUKSEN AJANKOHTAISSEMINAARI 2.12.2020

TECHNICAL, ECONOMIC AND SOCIETAL EFFECTS OF MANUFACTURING 4.0

Automation, Adaption and Manufacturing in Finland and Beyond



Mikael Collan, LUT University

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AGENDA

1. Shortly about the book
2. Manufacturing 4.0 - more than just technology development
3. Two AM cases from the book (ch. 6)

SHORTLY ABOUT THE BOOK

- Book about the future of manufacturing written as a collaboration between LUT, UTU, JYU, HU, and U. Trento
- Discussion about not only technology of manufacturing, but also about the economic and societal changes that may take place, when manufacturing changes

TECHNICAL PART

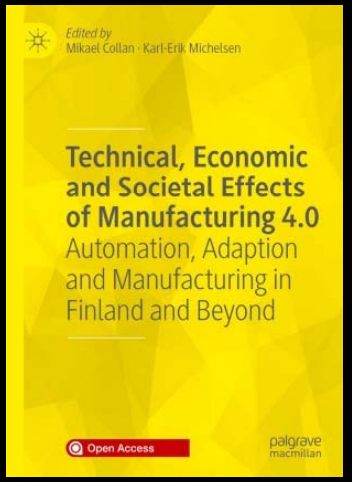
- Additive manufacturing (past, present future), AM from the point of view of materials research, Robotics in manufacturing, Maintenance management

ECONOMICS PART

- AM business models (lit. review), AM cases and a vision for predictive maintenance, Economic feasibility of AM, Change capabilities needed in companies

SOCIETAL CHANGE PART

- Changes in working life (light survey), Division of added value gained through MFG change, Coping with technological change



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MANUFACTURING 4.0 - MORE THAN JUST TECHNOLOGY DEVELOPMENT

- The point the book makes is that the transformation of manufacturing to smart and digital is more than just a technology issue – it is at least as much a BUSINESS issue and because of that also a SOCIETAL issue
- The transformation is driven by both technology development and business models development
- The big change can only happen if the whole way of doing the business of manufacturing changes
  - Move from single factories to a networked manufacturing model
  - “Urban Manufacturing” as it is called in Germany (Fraunhofer)
  - Digital control and management of the network in a way that
    - Matches and optimizes demand with supply
    - Orchestrates and optimizes the supply chain and logistics
    - Automates contracts, payments, and profit distribution
- The need for capable workforce is key for the changes to occur
- What happens when the transformation takes place in the society?

AM CASES

CASE 1: AM used in enhancing heart surgery

- Background: AM in healthcare is a 6.1 billion USD market industry (2016) and it is expected to grow to $20B+ in 2020. Cardiovascular diseases cause millions of deaths yearly and they are the focal area here
- Atrial fibrillation can be treated with an operation called left atrial appendage occlusion that stops the creation of blood clots
  - It is a non open-heart surgery that seals the left attrial appendage with a prosthesis and can be used for patients who cannot be treated with anti-coagulants = the procedure is to install an implant in the heart that seals the left attrial appendage (cavity)
- What is done with AM?
  - First a 3D Computer Tomography scan of a patient heart is made, then a 3D model of the heart is printed
  - Implants are mass produced in several shapes and sizes (at a ”low” cost)
  - Implant fit is tested with the model-heart and the procedure is pre-planned

  See: https://yle.fi/aihe/artikkeli/2014/10/15/eteisvarinan-leikkaushoito-kehittyy

Patrick J. Lynch, medical i
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Business?

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AM CASES

CASE 2: Refurbishing metal dies with a hybrid workstation

- Background: Metal dies are used in the mechanical manufacturing of shapes and with use they experience wear and tear and must be refurbished
  - Refurbishing done, because new dies are very expensive
  - Dies typically have a ”saddle” with with they are attached to a machining tool and the die part (made of industrial grade hard metal)
  - Refurbishing typically done manually, which is time consuming and suffers from problems in reaching the nominal original geometry
  - Procedure manually: Clean the ”broken” part of the die, fill the die manually, machine the die to original geometry
    - Includes at least twice calibrating the piece to a machining bench (time consuming, error prone)
- Using a hybrid machine allows to do the procedure with ”one set-up”
  - The machine allows the addition of material directly to the ”cleaned cavity” and then the machining of the extra part within the same process with one set-up (calibration)
  - Ability to inject even multiple metals in one run, ability to use very high grade (hard) alloys needed
  - Machines are still limited by capacity = size constraints are ”real” (in the machine used 500*400mm and 600kg)

AM CASES

CASE 2: Refurbishing metal dies

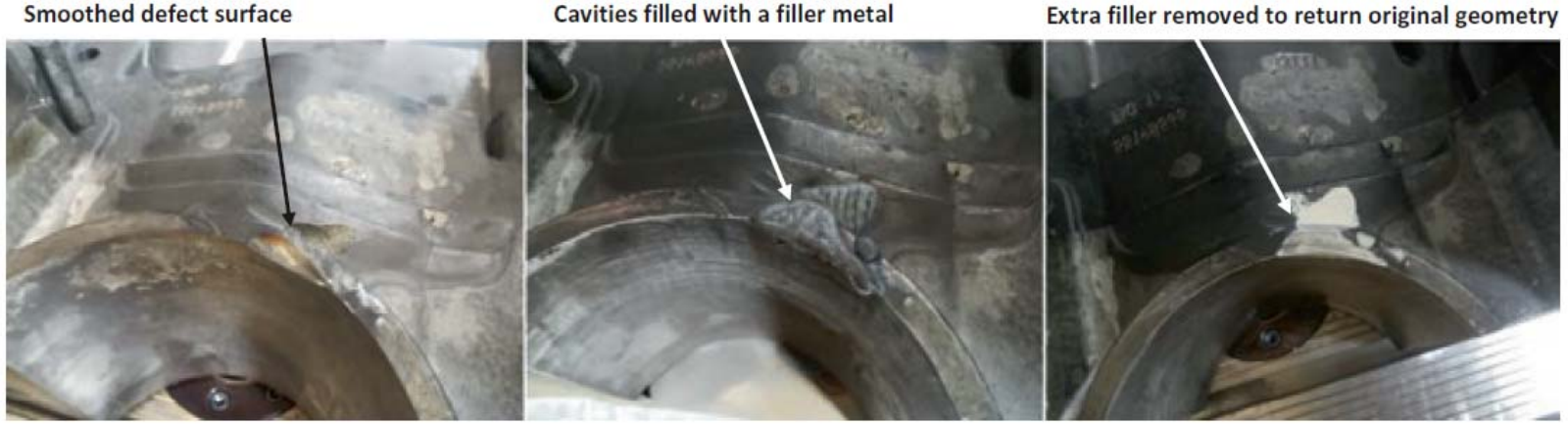

Fig. 1 The three main phases of refurbishing metal dies. (Original photos Matteo Perini)

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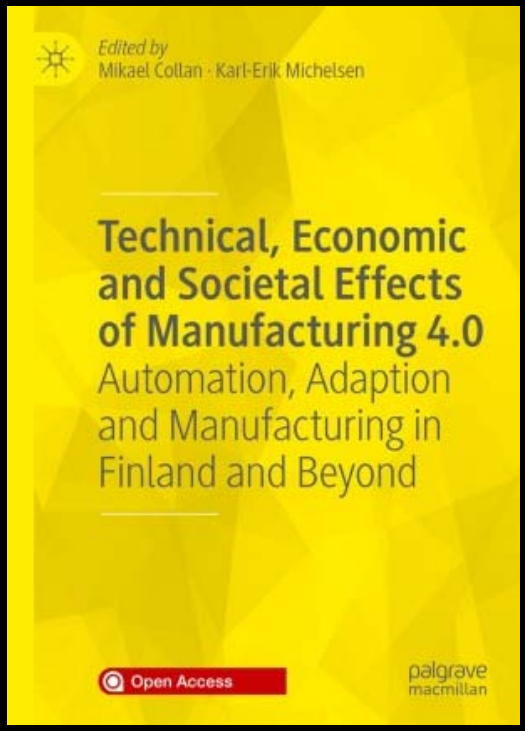
BUSINESS MODEL ALTERNATIVES

1. Hybrid machine as a ”repairshop” for dies
   - When a die brakes it is brought to a machine-shop and it is repaired
   - Demand based on breakage (can be somehow forecasted)
2. ”Die as a service”
   - Production of dies for the customer according to specifications
   - Dies are owned by the same shop that owns the hybrid machine
   - Customer pays rent for the die (cost + cost of repair + margin) – does not have to keep the expensive dies in their own balance sheet and make investments => contracted period for dies
   - Continuous cash-flow
3. ”Die as a service” + predictive maintenance
   - Like 2 + smart ”active” predictive maintenance in play = ”zero unplanned idle days due to broken dies”
   - Extra cash-flow for the mainenance part OR extra value for customer that makes the sale

DOWNLOAD THE BOOK FOR FREE

https://link.springer.com/book/10.1007%2F978-3-030-46103-4

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