Digitizing Industry and the Circular Economy: European Priorities

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The Laboratory for Manufacturing Systems & Automation (LMS) is oriented on research and development in cutting edge scientific and technological fields. LMS is involved in a number of research projects funded by the CEU and European industrial partners. Particular emphasis is given to the co-operation with the European industry as well as with a number of "hi-tech" firms. LMS employs approximately 70 researchers.

- Participation in more than 150 R&D Projects
- Organization of more than 10 International conferences.
- Publication of more than 500 Scientific articles
LMS: Areas of Expertise

LMS is organized in Three Different Groups

Manufacturing Processes
- Additive Manufacturing
- Advanced Material Removal Processes
- Advanced Joining Processes
- Advanced Forming Processes
- Advanced Surface Treatment Processes

Manufacturing Automation, Robots & Virtual Reality Applications
- Collaborative Robots in MFG Environments
- Human-Robot Collaboration in MFG
- Process Control & Automation
- Virtual Prototyping
- Digital Human Simulation
- Process Simulation
- Virtual Collaborative Environments

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Manufacturing Systems
- Industry 4.0, Automation & Product-Service Systems
- Design & Planning of Manufacturing Systems & Networks
- Mass Customization & Personalization
- Machine and shop-floor Monitoring
- Adaptive Planning and Control
- Mobile Apps Technology for Planning & Control
- Modelling and Measurement of Flexibility & Complexity
The FUTURING Project

FUTURING defined a strategy for Europe’s Circular Economy
in the context also of digitizing manufacturing
FUTURING Objectives

- Vision for a Smart, Clean, Human-Centred EU Industry.
- Definition of relevant building blocks.
- Policy support and recommendations.
Methodology

Framework Conditions

Areas with business case potential in circular economy

Baseline Vision of EU in the Circular Economy

Concrete Policy Actions

Evidence-based Analysis & Benchmarking

Results

1

2

3

Science & Technology

Policy & Finance

Environmental Responsibility

Education & Training

Human & Society

Business & Innovation
Realization Structure
## Research questions of transition-oriented analysis to Circular Economy

<table>
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<tr>
<th>FUTURING’s Building Blocks</th>
<th>Research questions</th>
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<tbody>
<tr>
<td>Science &amp; Technology</td>
<td>What digital technologies support the transition to a circular economy?</td>
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<tr>
<td>Business &amp; Innovation</td>
<td>What digital business models support the transition to a circular economy?</td>
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<td>Policy &amp; Finance</td>
<td>How can policy and finance ensure the transition to a digital circular economy?</td>
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<td>Human &amp; Society</td>
<td>How can individuals and society as a system support the transition to a digital circular economy?</td>
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<td>Environmental sustainability</td>
<td>How can the environment be sustained by the transition to a digital circular economy?</td>
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<td>Education &amp; Training</td>
<td>How can education and training support the transition to a digital circular economy?</td>
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Enablers of digitization in circular economy

Science & Technology

- **Industry 4.0**
  - **Cloud Computing**
    - Apps
    - Big Data
    - Real-time data
    - 5G, NFC, IPv6
  - **Cyber Physical Systems**
    - Smart products
    - Sensors & Actuators
    - Machine2Machine
  - **Smart Factory**
    - Digital twins
    - Human2Machine interaction
    - Plug & Produce

**Pillar Actions**

- Share, Loop
- Regenerate, Exchange
- Optimize, Virtualize

(indicatively addressed)
Enablers of digitization in circular economy

Business & Innovation

Digital Business models

- **Value as Service**
  - Logistics as a service
  - Mobility as a service
  - Assembly as a service
  - Maintenance as a service

- **Platform as Service**
  - App store
  - Manufacturing Platform
  - Dynamic Networks

- **Infrastructure as Service**
  - Cloud computing
  - Mobile Communication
  - Grids

Pillar Actions (indicatively addressed)

- Optimize, Share
- Virtualize, Exchange
- Optimize, Loop
Enablers of digitization in circular economy

Policy & Finance

“Digital” legislations

- Data protection and copyright legislations
- Incentives & Regulations
- National and international standardization
- Insurance related legislations
Enablers of digitization in circular economy

Human & Society

Maintaining physical and psychological health of employees

- Stressful work to be carried out by intelligent machines
  - Exchange

- Decision-making mechanisms to support employees
  - Virtualize

- Digitization supports flexibility and networking
  - Optimize

Pillar Actions
(indicatively addressed)
## Enablers of digitization in circular economy

### Environmental Responsibility

### Enabling technologies

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<tbody>
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<td>Technologies for “self-assembly”</td>
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<td>Innovative micro/nano-manufacturing processes</td>
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<td>Additive manufacturing</td>
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<td>Flexible Sheet-to-Sheet (S2S) and Roll-to-Roll (R2R)</td>
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<td>Innovative physical, chemical and physicochemical processes</td>
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<td>Integration of non-conventional technologies and conventional technologies</td>
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<td>Methods for handling of parts, metrology and inspection</td>
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<td>Photonics-based materials processing technologies</td>
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<td>Collecting, dismantling, sorting and recycling processes</td>
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<td>Shaping technology for difficult to shape materials</td>
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<td>ICT solutions for factory floor and physical world inclusion</td>
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<td>ICT solutions for modelling, simulation and management tools</td>
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<td>Control technologies, Robots and Automation</td>
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Enablers of digitization in circular economy

Education & Training

Use of advanced ICT in the Teaching Factory paradigm
Circular Economy in FUTURING

Ecological + Societal + Economical

Sources:
- Ellen MacArthur Foundation, SUN, and McKinsey Center for Business and Environment; Drawing from Baumgart & McDonough, Cradle to Cradle (C2)
- LMS, FESTO
- FUTURING Consortium
FUTURING Consortium
Thank you for your attention!