Technologies in Industry 4.0

Why they are connected to circular economy

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CER principles

Reduce Input Consumption (RIC) such as materials, energy and water: smarter product use and manufacturing.
Rejecting redundant products, rethinking their design (multifunctional products), their manufacture (simplifying and minimizing resource use) and their use (more intensive, e.g. by sharing products).

Reuse: Directly extend the useful life of a product.
Reuse of products or components in the same type of product discarded by another consumer, when they fulfill their original functions.

Recovery: Actions to extend the useful life of products and their parts.
Repair (repairing or maintaining defective products), reconditioning (restoring old products and bringing them up to date), remanufacturing (using components in the same type of products) and components reuse (using components or discarded products in other types of products).

Recycling: Useful application of the material.
The process should focus on obtaining a high degree of quality

Reduce waste and emissions (RWE): Focus on resource recovery.
At the end of the process, CE requires a waste and emissions management strategy that should seek to reinforce the recirculation of resources, minimizing environmental consequences.

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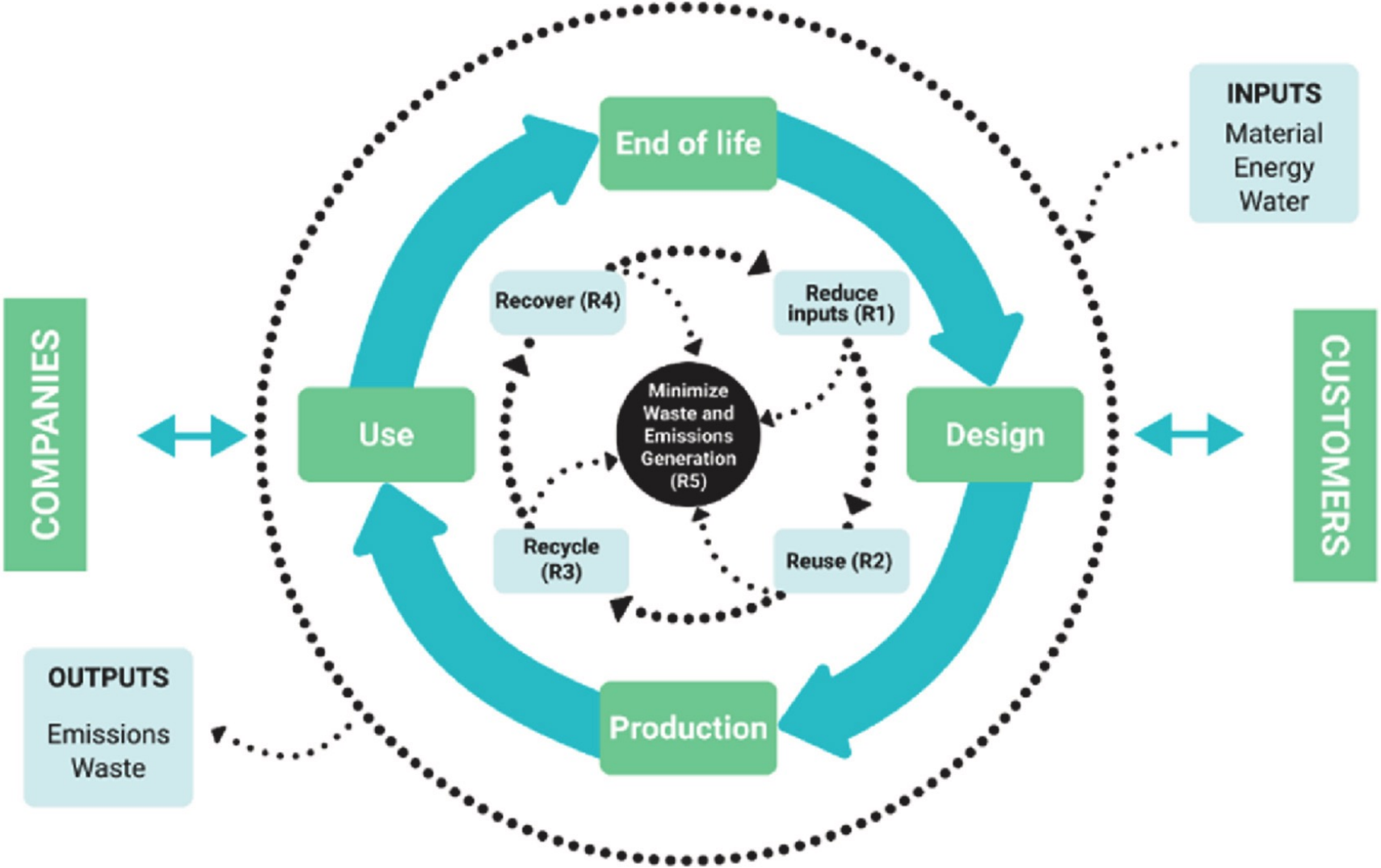
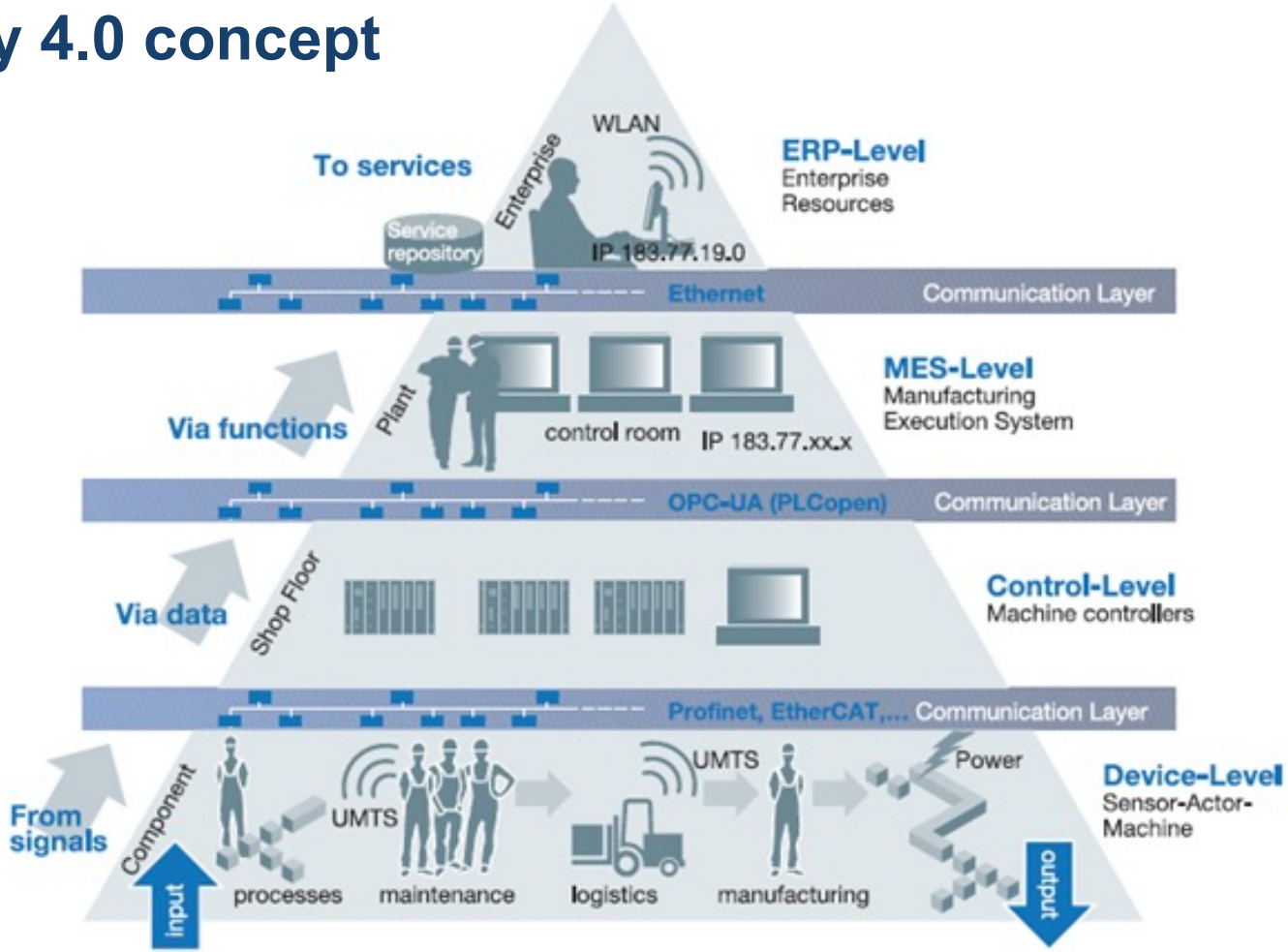

INPUTS
Material
Energy
Water
End of life
Recover (R4)
Reduce inputs (R1)
COMPANIES
Use
Minimize Waste and Emissions Generation (R5)
Design
CUSTOMERS
Recycle (R3)
Reuse (R2)
Production
OUTPUTS
Emissions
Waste

Circular Economy generates 4 technological needs:

1. advanced collection, sorting and recycling
   apps, sensors, robots,..
2. efficient materials processing
   machine learning, artificial intelligence,..
3. production to support design for circularity
   3D printing, disassembly, repairability,..
4. interactive platforms
   apps, websites, databases, IoT,…

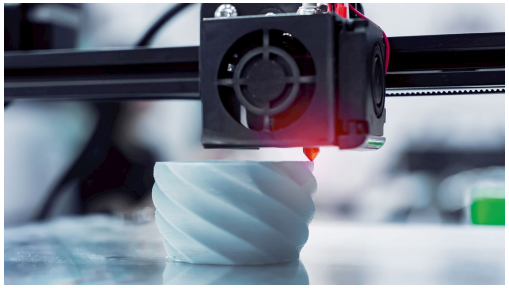
The necessary digital technologies exist. The challenge is to make them available and integrate them
into the systemic approach that leads to sustainability.

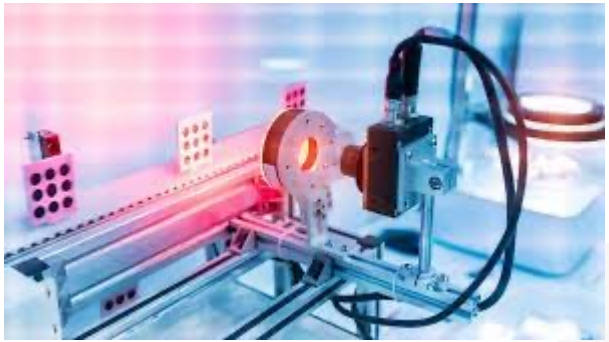
Industry 4.0 concept

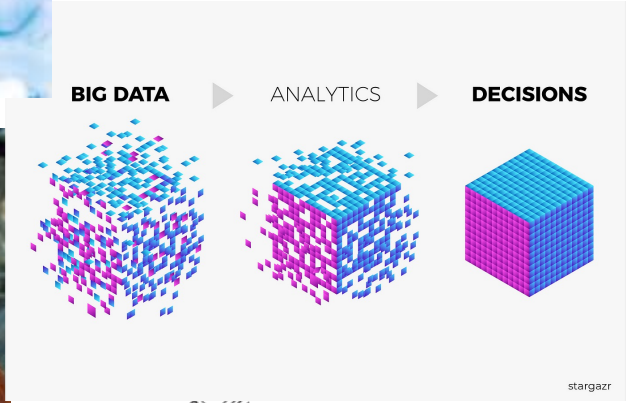


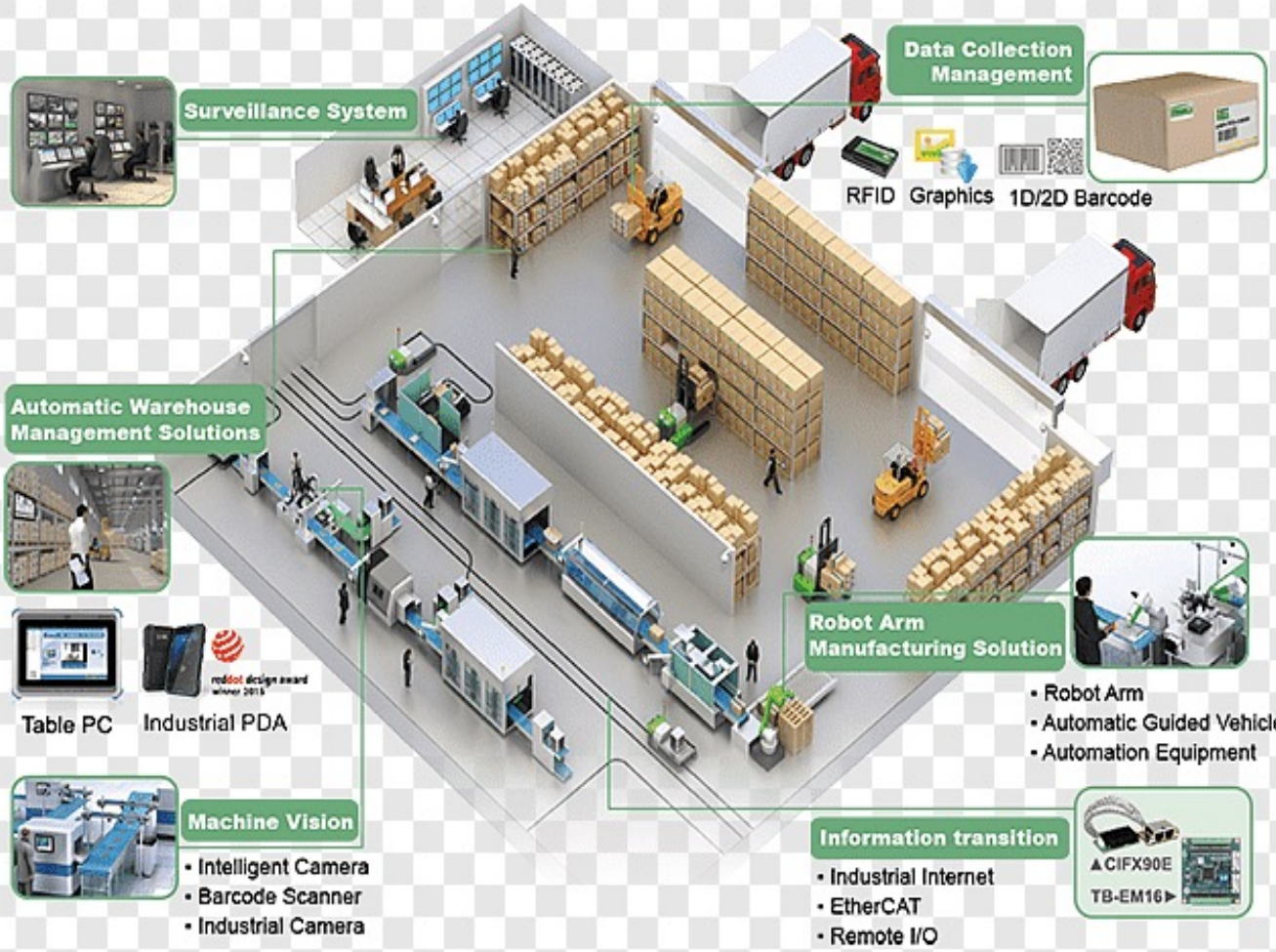
Industry 4.0 Technologies

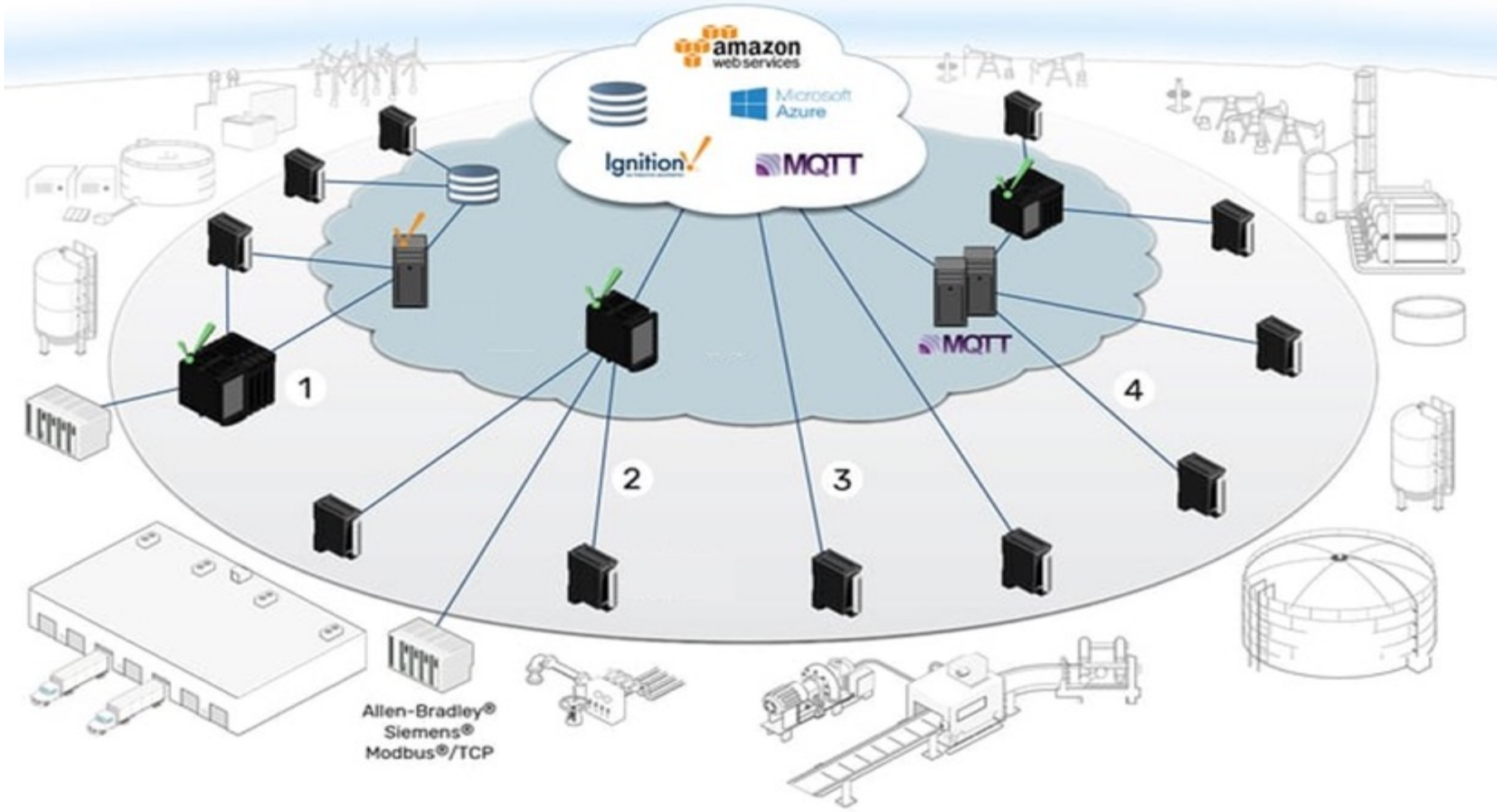
- Additive manufacturing (AM)
- Artificial Intelligence (AI)
- Artificial Vision (AV)
- Big Data and Advance Analysis (BDAA)
- Cybersecurity (CS)
- Internet of Things (IoT)
- Robotics (RB)
- Virtual and Augmented Reality (VAR)
- Blockchain








Surveillance System
Data Collection Management
RFID
Graphics
1D/2D Barcode
Automatic Warehouse Management Solutions
Table PC
Industrial PDA
Robot Arm Manufacturing Solution
• Robot Arm
• Automatic Guided Vehicle
• Automation Equipment
Machine Vision
• Intelligent Camera
• Barcode Scanner
• Industrial Camera
Information transition
• Industrial Internet
• EtherCAT
• Remote I/O
▲CIFX90E
TB-EM16►


amazon
web services
Microsoft
Azure
Ignition
MQTT
MQTT
1
2
3
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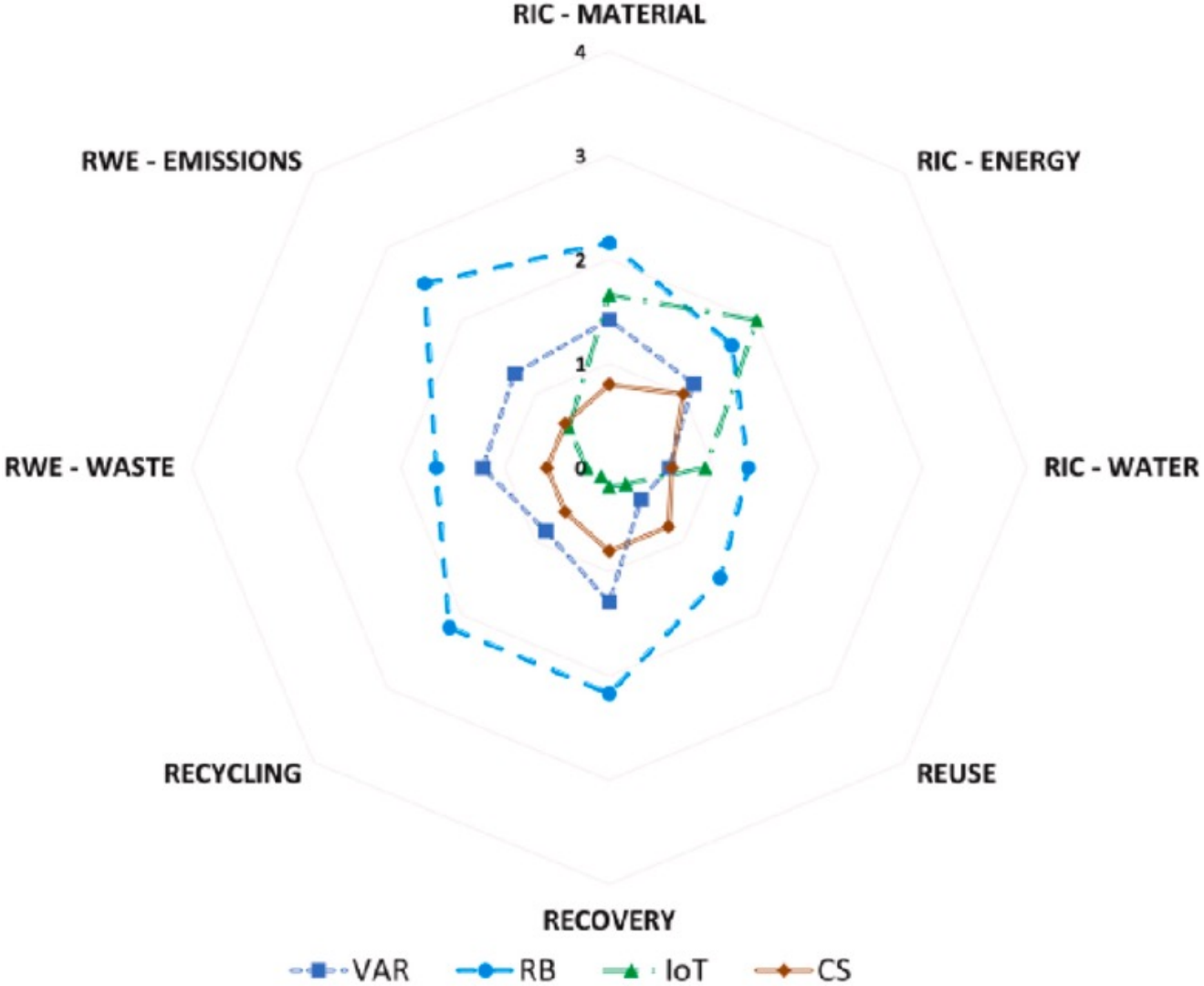
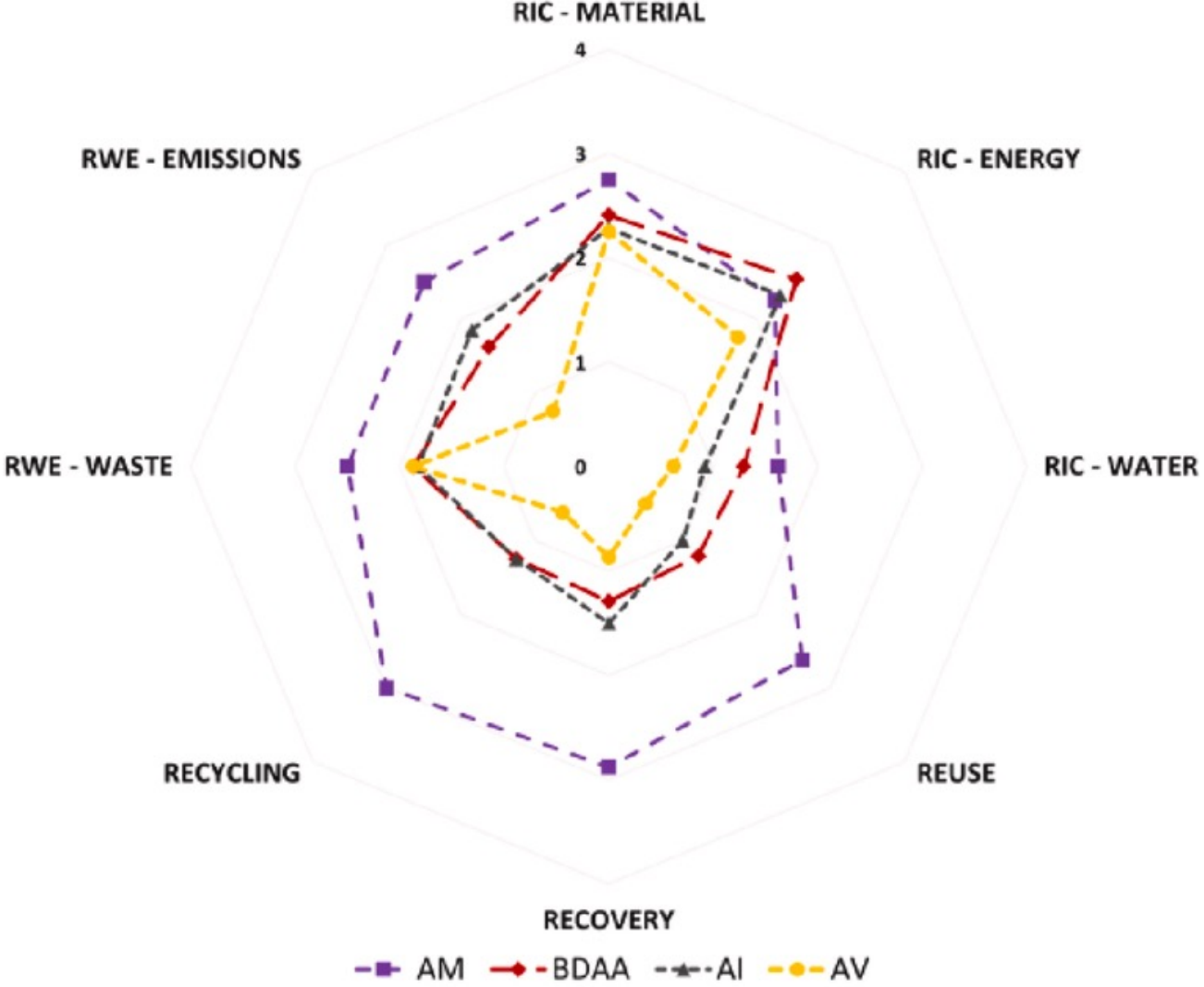
Allen-Bradley®
Siemens®
Modbus®/TCP


RIC - MATERIAL
RIC - ENERGY
RIC - WATER
REUSE
RECOVERY
RECYCLING
RWE - WASTE
RWE - EMISSIONS
4
3
2
1
0
VAR
RB
IoT
CS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4
3
2
1
0
AM
BDAA
AI
AV

Industry 4.0 Technologies - impact

- Additive manufacturing (AM) – **20% to 80%**
- Artificial Intelligence (AI) – **up to 100% paper, energy savings up to 50%**
- Artificial Vision (AV) – **less than 2% in stable process, more than 10% after process adjustment**
- Big Data and Advance Analysis (BDAA) – **10% to 20% material, up to 100% paper, 7% to 15% operation time**
- Cybersecurity (CS)
- Internet of Things (IoT) – **5% to 30% energy and material, 5% to 10% fuel**
- Robotics (RB) – **3% to 18% quality, 0.5% to 10% energy and material**
- Virtual and Augmented Reality (VAR) – **100% paper, 30%-80% risk, 6% to 17% downtime**
- Blockchain

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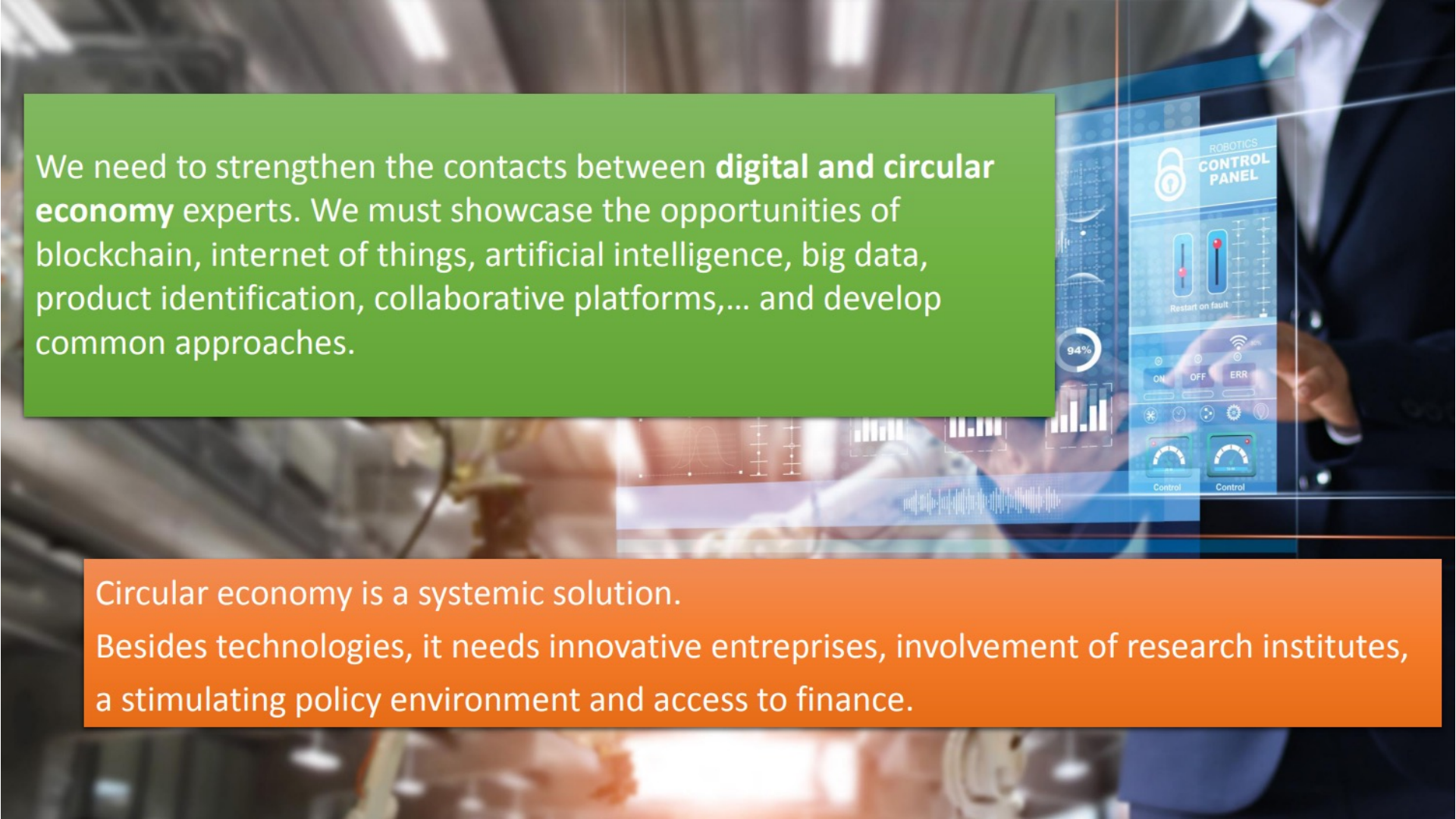
We need to strengthen the contacts between **digital and circular economy** experts. We must showcase the opportunities of blockchain, internet of things, artificial intelligence, big data, product identification, collaborative platforms,… and develop common approaches.



Circular economy is a systemic solution.

Besides technologies, it needs innovative entreprises, involvement of research institutes, a stimulating policy environment and access to finance.

Thank you!

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