Panel: (Conference name)
Can Emerging Technologies enable the Circular Economy?

Panel Chair:
Benjamin Leiding (TU Clausthal, Germany)

Panel Members:
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Related background

- *Post-doc* at Institute for Software and Systems Engineering, TU Clausthal
- Research Group: Sustainable Ecosystems Engineering
- Website: www.benjaminleiding.com
- Research areas:
  - Circular Economy
  - Machine-to-Everything (M2X) Economy
  - Self-organized Systems
  - Blockchain Technology and Smart Contracts
  - Identity Solutions

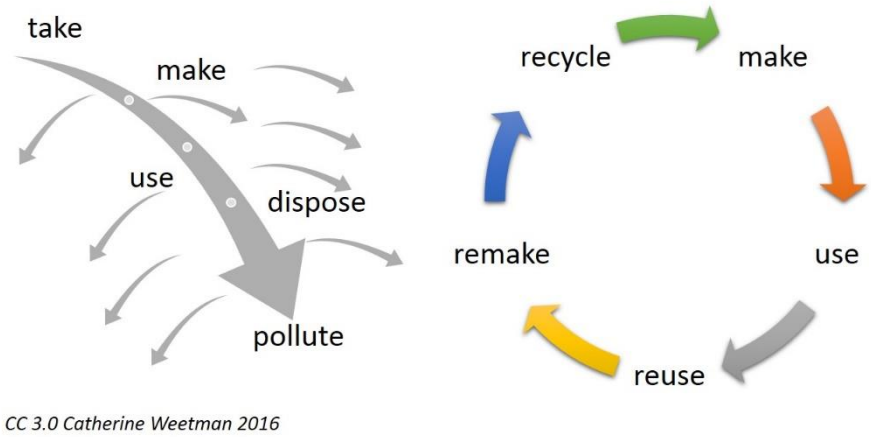
Motivation

- The global population continues to grow rapidly, increasing the demand for raw materials.
- Our current “take, make, dispose” economic model and its inclination towards simply using and dumping materials is a critical problem for an ecosystem with finite resources.
- Challenges such as climate change, increasing volumes of e-waste, and the continuous forward shifting of Earth Overshoot Day concerns all of us.
- Thus, todays linear economic model is not adequate for providing an ecological balance for a sustainable future and a new economic model is required.

Image by Rilsonav from pixabay

The Circular Economy

- Circular Economy (CE) is one such economic model that focuses on eliminating waste and retaining virgin materials.
- But although the idea of a Circular Economy has been around since the 1990s, a widespread adoption has not been achieved, yet.
- There are many reasons for this such as :
  - Lack of economic incentives
  - Consumer knowledge gaps
  - Lack of information flows between different stakeholders
  - Inefficient recycling practices
  - Etc.



CC 3.0 Catherine Weetman 2016

The Nature of Technology

- In the past many new technologies have emerged and disrupted existing economical models.

- B. Arthur stipulates that an *economy is an expression of its technologies*

  → Thus, it can be argued that the current unsatisfying state of the Circular Economy reflects a lack of sufficiently developed technologies that express themselves within the CE.

  → Or, more precisely – difficulties of the stakeholders in combining the technologies that are required to enable the CE.

Arthur, Brian (2011) – The Nature of Technology: What It Is and How It Evolves.

Can Emerging Technologies enable the Circular Economy?

Panel

Can the Emerging Technologies Enable the Circular Economy?

(society benefits, environmental protection, process optimization, waste reduction, economics)

ComputationWorld 2021

Panellist Position

Information is the key to symbiosis

Prof Dr. Per Servais, IARIA, EU/Sweden, per.servais@lnu.se

Emerging technologies is the quest for the circular economy. In order to have the circle to work lots of data and information interchange is needed. One of obstacles towards the implementation of the circular economy are the willingness to participate in information flows and a lack of willingness to share information. Hence, the best technologies will not be implemented if not the barriers are encountered.

→ circular information and data flows is pivot to the circular economy

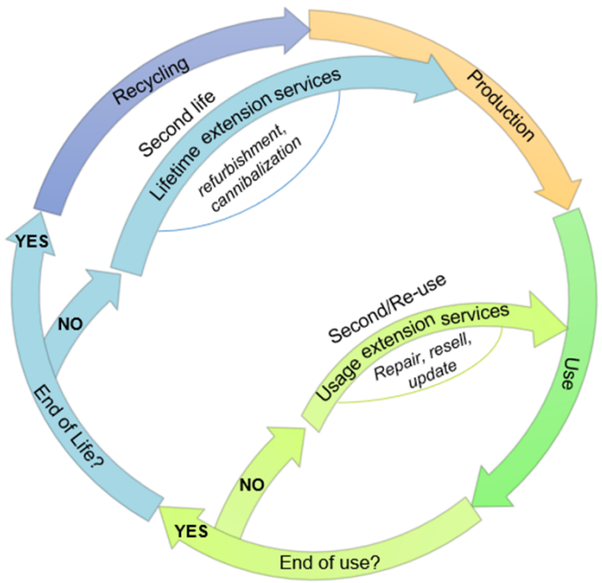
→ Knowledge sharing is a key challenge

→ Creating a symbiosis framework/incentives for exchanging data and information could be a way forward

Circular Economy is here to stay…

Per Servais, Ph.D.
Professor
Head of research ”GlobalMind”

The first cycle in the net of circles



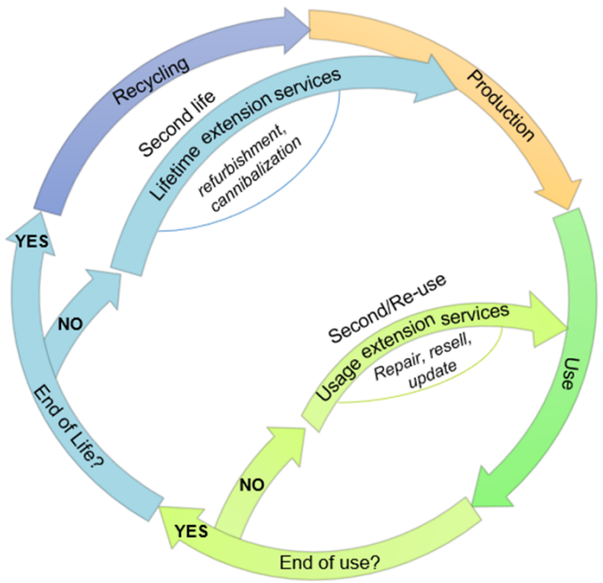
This Alternative Framework to aims to keep *Things* as long as possible in the life-cycle

Things are products, components, materials and so on.

This usage extension is not innovated yet, but will need to encompass repair/updates. This reuse cycle will be based on Bricolage innovation – the recycling takes place within the firm,

This will typical be the second use where very few new resources will be involved

Second cycle in the net of cycles



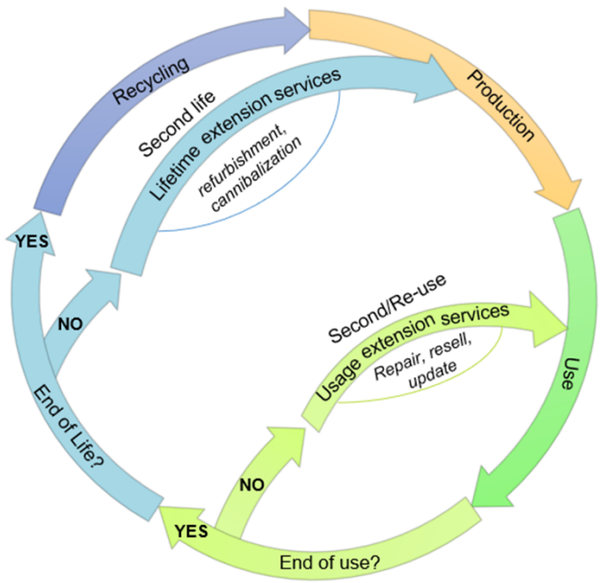
This Alternative Framework to aims to keep *Things* as long as possible in the life-cycle

Things are products, components, materials and so on.

This Lifetime extension is not innovated yet, but will need to encompass total refurbishment or cannibalization. This reuse cycle will be based on Decoupage innovation – the recycling takes place within the firm,

This will typical be the second where some new resources will be involved

Passing on to the next cycle



Recycling means bringing the thing outside the firm and into the next circle (end of use and end of life)

The thing becomes the object in industrial Symbiosis (“living together") described as a type of a close and long-term interaction between at least two or more different organizations.

The Symbiosis can take place within an industry, but could also a local network/cluster.

Recycling

What are the incentives for commitment to a network? – who leads the entrepreneurial process?

In the perfect Circular Economy, complete information transparency exists. Due to the two internal processes perfect information and documentation exists , which is vital pillar in the circular economy.

Managing these external networks is difficult and calls for synchronization in and between networks.

- Several problems resides; Information validity and reliability.
- Stakeholders are gatekeeping information
- Incentives for sharing and storing is missing
- Is the managerial capacity present?

Conclusion

S. Lawrenz., A. Rausch, 2021, Don`t Buy A Pig In A Poke A Framework for Checking Consumer Requirements In A Data Marketplace, Proceedings of the 54h Hawaii International Conference on System Sciences

An effective circular economy is a must for a sustainable future

Emerging technologies can support elements in the circular economy.

Valid and reliable data and information is a must.

Exchange of data and information must happened smoothly, things must be traced.

Many resources must be invested in synchronized innovation processes

These processes must happen locally and will create local development.

Panel

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Panellist Position

It`s all about Information!

Sebastian Lawrenz, IARIA, EU/Germany sebastian.Lawrenz@tu-clausthal.de

Emerging technologies can be a great enabler for the circular economy. However, the base for these technologies is data and information. The biggest obstacles towards the implementation of the circular economy are insufficient information flows and a lack of information. Accordingly, the best technologies are useless, unless these information lacks are not bridged.

→ emerging technologies can support the circular economy

→ Bridging the lack of information is a key challenge

→ A bridge could be a fair framework for trading data and information

TU Clausthal

Institute for Software and Systems Engineering

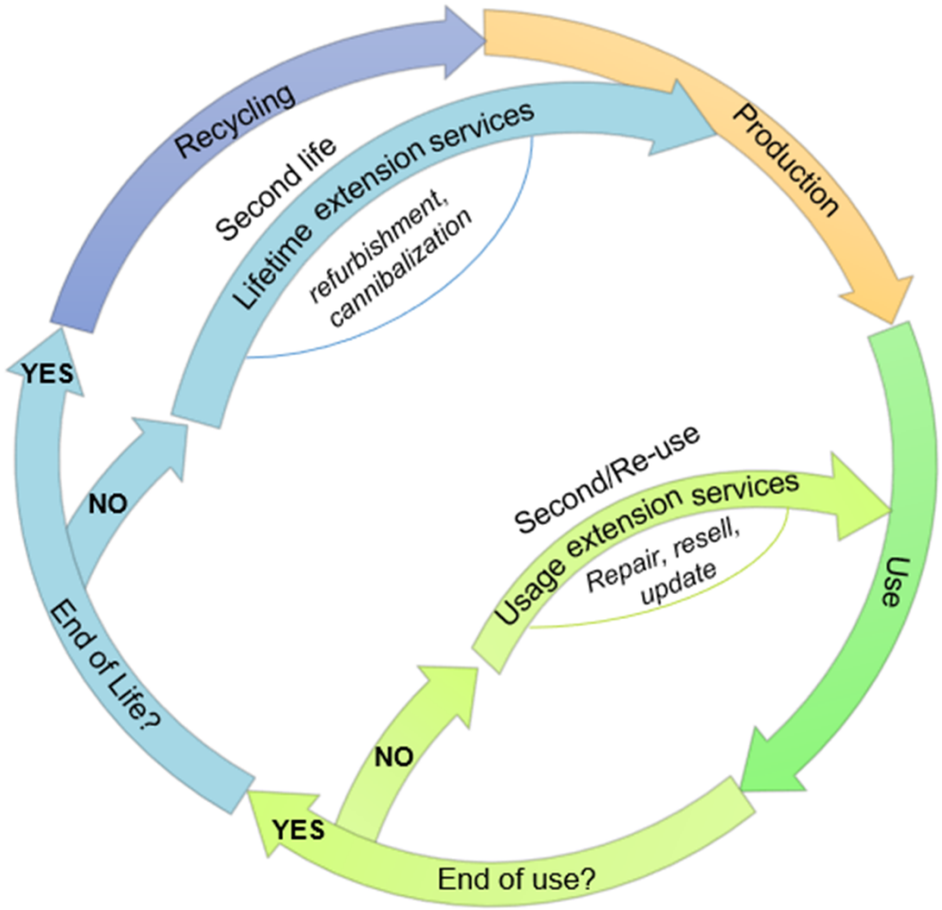
It is all about Information!

Data and Information (Trading) as a Key Towards the Circular Economy

Sebastian Lawrenz

sebastian.lawrenz@tu-clausthal.de

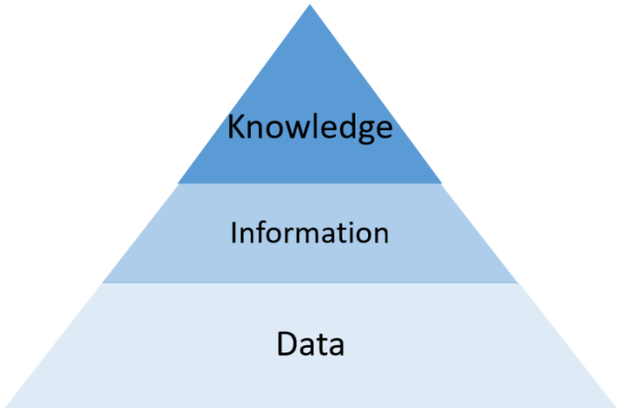
Circular Economy Framework



© Lawrenz, Rausch, Sharma

- Alternative Framework which aims to keep *Things* as long as possible in the life-cycle
- *Things* such as products, components, materials and so on
- Every *Thing* creates different information during his life-cycle
- Decisions for the Things has to be taken based on data and information

Data and Information

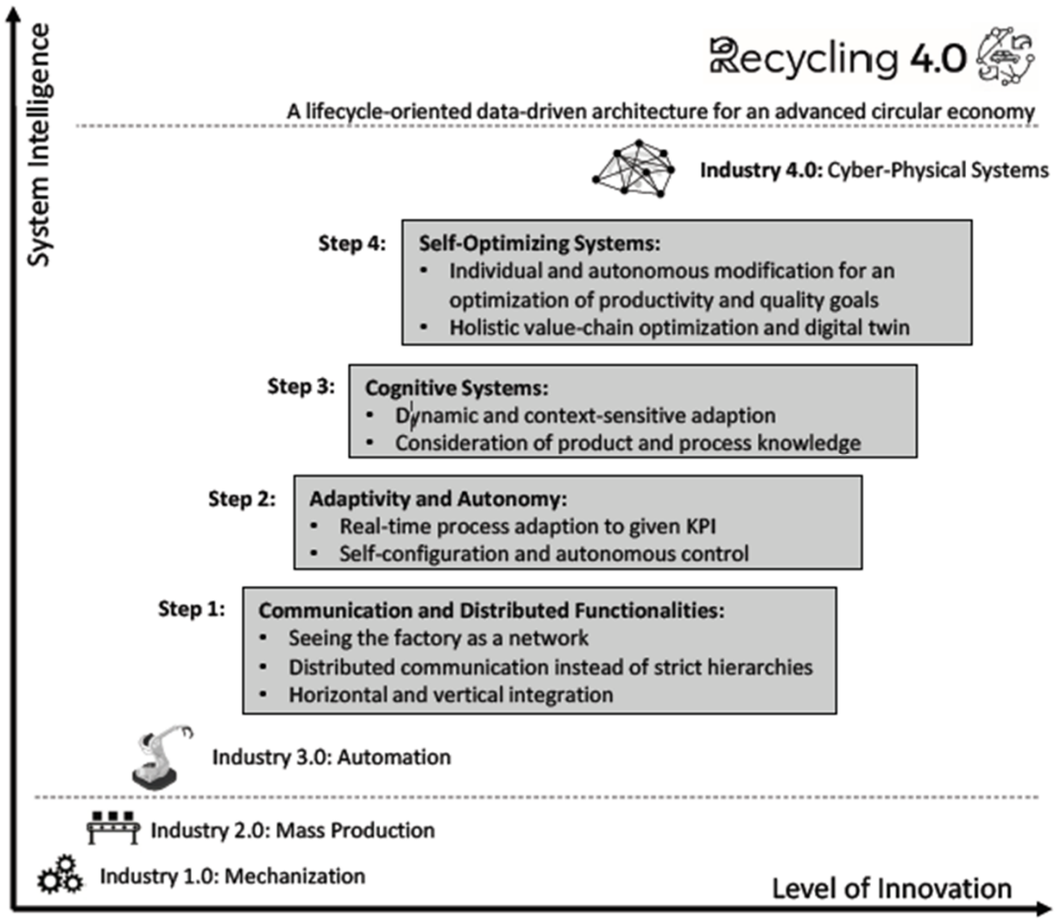


Source: Rowley, 2007

- **Data**: Data is symbols that represent the properties of objects. They are just a collection of symbols, for example Strings or integer values.
- **Information:** Information is data that is processed to be useful, providing answers to '**w**ho', '**w**hat', '**w**here', and '**w**hen' questions.
- **Knowledge:** Describes the interpretation of information and explains the use of it. To get knowledge it is very important to answer the 'how' questions about the data.

Metadata is Information about Data. It answers the **w**-Questions about the origin of a Dataset (collection of Data) and is required to generate Knowledge.

The Key Role of Data and Information

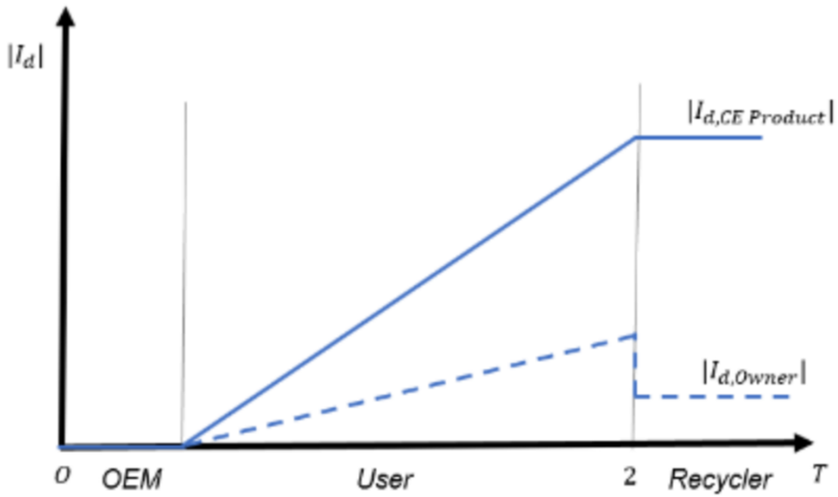


Source: Kintscher, 2021

- *Data and Information are the new oil*
- Decisons are based on Data and Information
- Dynamic, and adaptive Systems are based on Data and Information
- Emerging technologies are based on Data and Information
- Design Data, Process Data, Repair Information, Recycling Data […]
- Data Information play a key role!

Problem Statement

- *Vision*: In an ideal Circular Economy, complete information transparency is present, whcih enables emerging technologies, and supports decisions inline with the circular economy
- *Problems*:
  - Information are not recorded / traced / stored
  - Stakeholders are not willing to share their data and information
  - Data and Information are lost over time
  - Incentives are missing
  - A legal framework for the exchange of data and information is missing as well



Source: Lawrenz, 2021

Conclusion and Outline

- There is no alternative to the circular economy for a sustainable future
- Emerging technologies can support the Circular Economy
- **But**, not without the right data and information

- A data and information marketplace provides a legal framework for the information exchange – first step towards the circular economy
- *Things* in the Circular Economy needs to be traced, and data and information to be recorded

- It is still a long journey towards an advanced Circular Economy

References / additional Materials

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  - Rowley, J.. "The wisdom hierarchy: representations of the DIKW hierarchy." Journal of information science 33.2 (2007): 163-180.

- Additional materials:

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Panel

Can the Emerging Technologies Enable the Circular Economy?

(society benefits, environmental protection, process optimization, waste reduction, economics)

ComputationWorld 2021

Panellist

Networking, Participation and Creativity

Thomas M. Prinz, Course Evaluation Service, Friedrich Schiller University Jena, EU Thomas.Prinz@uni-jena.de

- Connectivity of systems
- Participation of anyone, anywhere
- Creativity and productivity instead of consumption

→ A long road to a circular economy

→ Strong interaction between all research disciplines required

→ Perhaps a near circular economy

Position

Networking, Participation and Creativity

Thomas M. Prinz, Course Evaluation Service, FSU Jena, Germany Thomas.Prinz@uni-jena.de

Photo: Anne Günther (University Jena)

Background:

- Diploma in computer science (2010)
- Ph.D. in computer science (Dr. rer. nat., 2017)
- Since 2017, postdoc and software architect at the Course Evaluation Service
- Research in:
  - Compiler construction
  - Business process verification and management
  - Software engineering
  - Human Computer Interaction (HCI)
  - Evaluation theory

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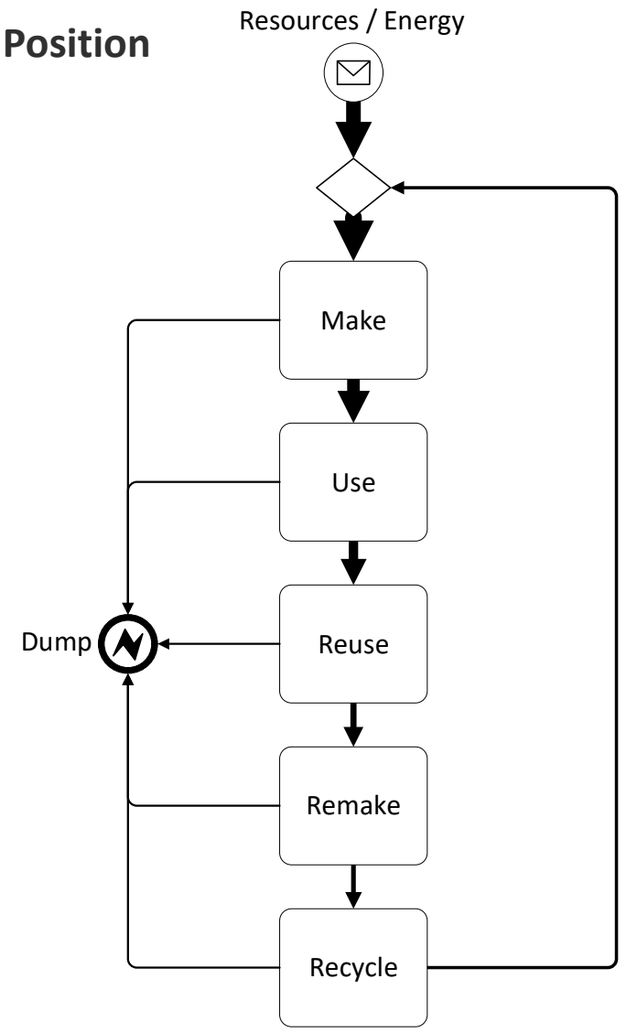

TODAY

- ✓ Fast
- ✓ Cheep
- ✓ Prototype-driven
  (if the first version has some disadvantages, we make it better in the next version)

- – A lot of trash
- – Cheep only because of exploitation of workers and nature for resources
- – Unfinished/unstable products are sold

Photo: Anne Günther (University Jena)

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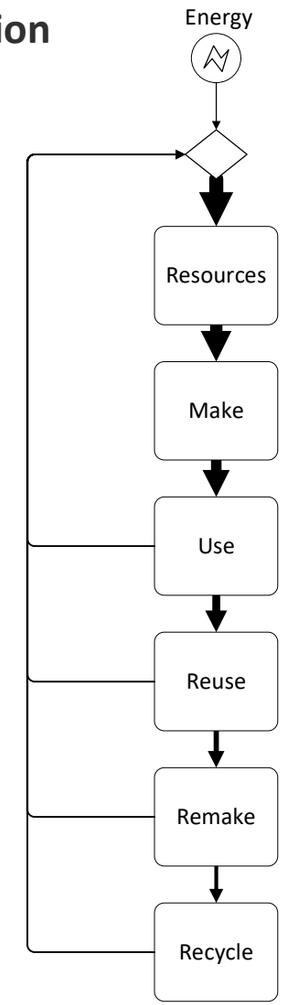

PERFECT (?)

- ✓ Everything that was made is used
- ✓ Everything that was made is a new resource and can be reused, improved or repaired
- ✓ No dump of resources

- – (Energy consumption?)
- – (Initially?) more expensive
- – (Initially?) slower (for generating new products)

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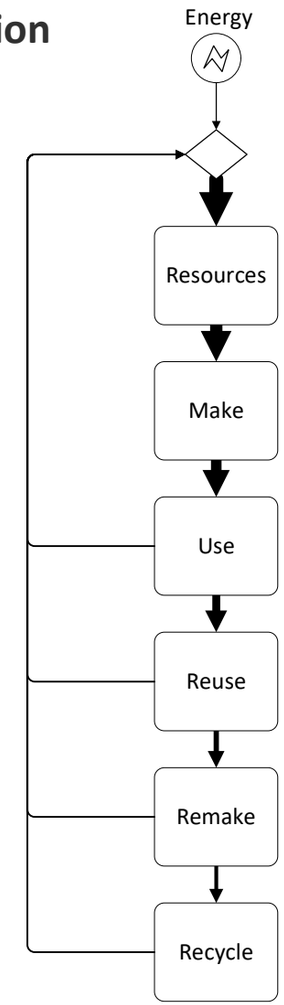

IS IT POSSIBLE TO ACHIEVE?

Pro:

- ✓ Emerging technologies enable new opportunities (e.g., plastic bottles as new input to 3D printers print that print new products)
- ✓ Humanity is aware of the circular economy and the problems of the “state-of-the-art” economy (we are talking about)
- ✓ Humanity can connect the entire world

Contra:

- – Redistribution of financial value (Every part of the circular economy has the same value. Which rich nation wants to share its historical advantages?)
- – Strong connection of many systems around the world (some countries have difficulties connecting only government systems)
- – Availability all over the world to every required participant

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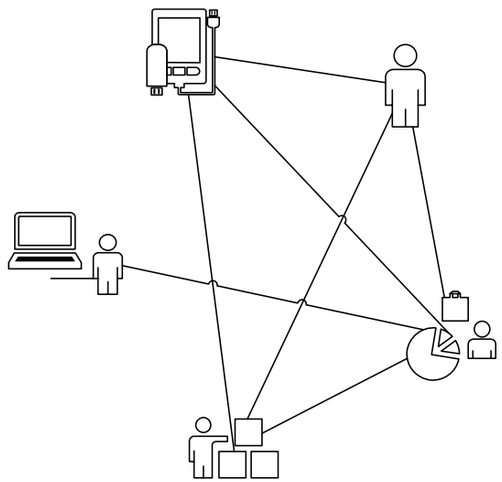

How can we easily and quickly connect many systems to achieve a larger goal?

- There are many approaches and research areas to connect people, computers, devices, machines, nature, etc. (i.e., **systems**)
  - HCI, robotics, sensors, microservices, IoT, Low Code, …

  ➔ it seems possible to connect systems to achieve a circular economy
- **BUT:**
  - In some disciplines, it is still difficult (speech/image recognition, robotics, …)
  - In most other disciplines (e.g., SOA, microservices), it is time consuming and causes a lot of overhead
- **GOAL**:
  - Reduce overhead through incremental standardization and generalization (if possible).

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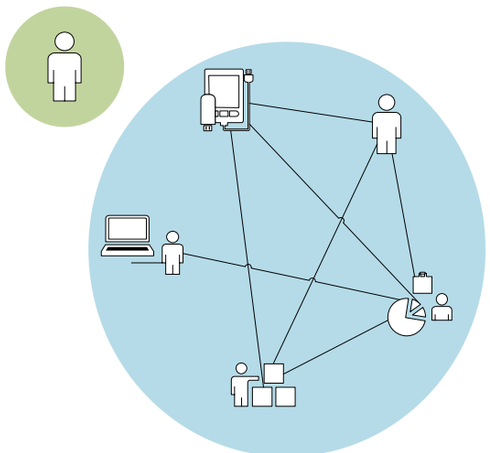

How can we build such circular economy systems so that anyone, anywhere in the world can participate?

- In a circular economy, most (or all?) should act with the rules of the economy in mind
- This means: everyone, everywhere in the world, should participate with the other systems of the economy

- This means: Social and global justice?

- There is a lot of research on inclusion; also for computer systems by including elderly, disabled people, children, etc. (HCI)

- **BUT**: It does not yet (unfortunately) seem possible to include everyone.

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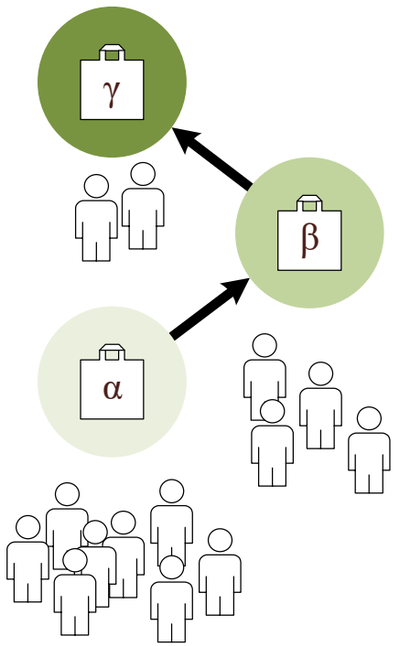

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How can we build new systems that allow creativity and productivity instead of pure content consumption like today?

- **Current**: (linear) economy focuses on consumption
- **Desired**: circular economy focuses on creation and creativity without trash
- There is research to enable, e.g., programming for kids and everyone (Scratch, MIT App Inventor, even Unity), or to be creative (apps on mobile devices for learning languages, musical instruments, etc.)
- **BUT:** If everything in the circular economy could lead to something new, existing techniques and methods are too slow to make these new things quickly available to everyone (without just consuming them)
- **Example:** Research!
  - Research is creative and everyone has access to it (for a fee)
  - BUT: It is not understandable to everyone, only to a small group; so this group has an advantage over the others

Photo: Anne Günther (University Jena)

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