Hoe digitale technologie gaat helpen om circulair beter te presteren.

Business Software Event – 31 mei 2022 – Arjen Wierikx

Disclaimer: research in progress

Agenda

- Waar staan u en ik?
- Wat is circulariteit
- Circulaire prestatie
- Digitale technologie en circulaire prestatie
- Het Physical Internet helpt

Short introduction Arjen Wierikx

Passion for logistics, allergy to waste

TU/e HU

TU Delft TNO BaaN mondeal: the orgware company HU SLIM CIRCULAIR

1985 1992 1995 2000 2020

- ❑Lecturer & coach
  - ❑Bachelor Logistics Management
  - ❑Master data driven business
- ❑PhD Student TU/e & HU
- ❑Researcher Process Innovation & Information Systems Research Group

In welke regio zit uw organisatie

Wat voor type bedrijf vertegenwoordigt u?

Mentimeter

1

Maak industrie (GB)

2

Maak industrie (MKB)

0

Proces industrie

0

Industrie overig

0

Logistieke dienstverlening

11

Zakelijke dienstverlening

5

Overig

19

Wat is uw functie binnen het bedrijf?

Mentimeter

Directeur / eigenaar

MT-Lid / manager

teamleider

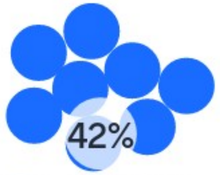
adviseur

0
ondersteunende dienst

anders

18

Hoe circulair is uw organisatie



Geen idee

0-10%

10-20%

20-30%

30-50%

>50%

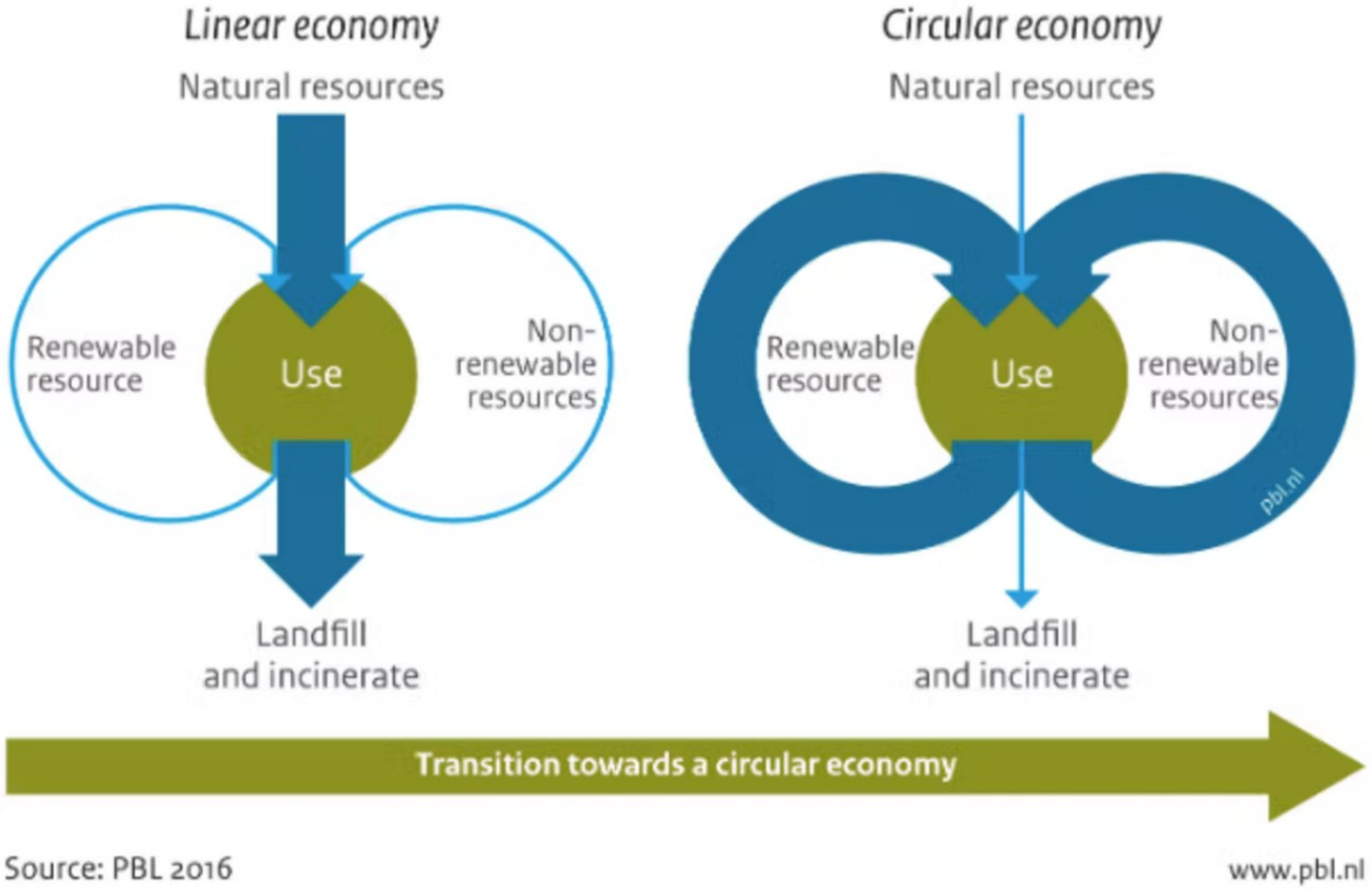
19

Waar staan we?

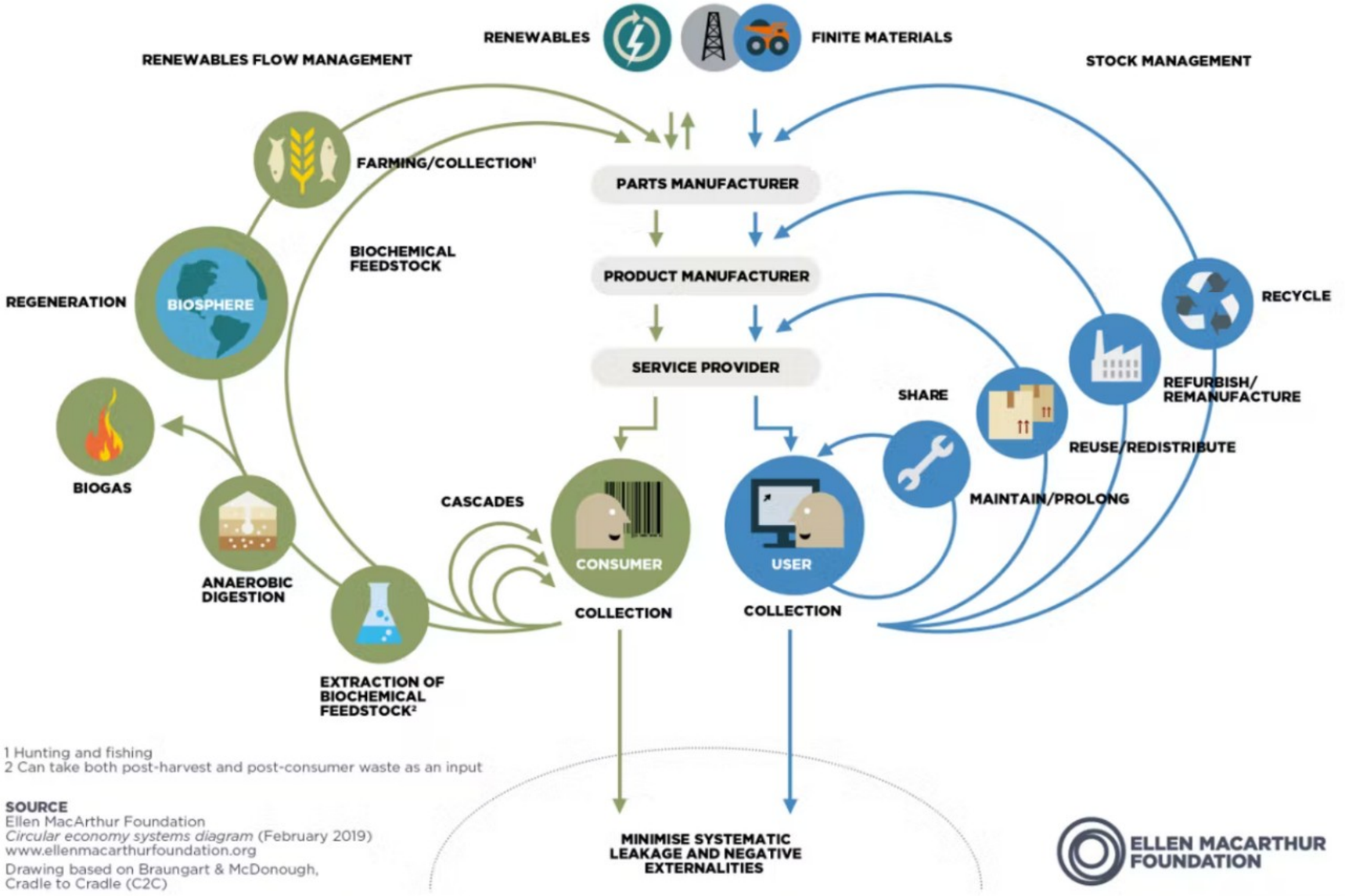
- Governments around the world announce the ambition to be 100% circular by 2050 (EC,2011);
- By 2020 the world was 8,6% circular (CGRi, 2020)
- In 2005 the world was 5% circular. An increase of 3,6% in 15 (!) years. (CGRi, 2020)
- If we do not change our behaviour, we will hardly reach 20% in 2050
- What is the point in time company X, Y, Z could say: “now I’m 100% circular”?

THE NETHERLANDS IS 24.5% CIRCULAR.

Major overhauls to the framework of the national economy - including jobs - will be necessary to achieve the government's ambitions of a fully circular economy by 2050.



Van Lineair naar circulair



1 Hunting and fishing
2 Can take both post-harvest and post-consumer waste as an input

SOURCE
Ellen MacArthur Foundation
Circular economy systems diagram (February 2019)
www.ellenmacarthurfoundation.org
Drawing based on Braungart & McDonough, Cradle to Cradle (C2C)

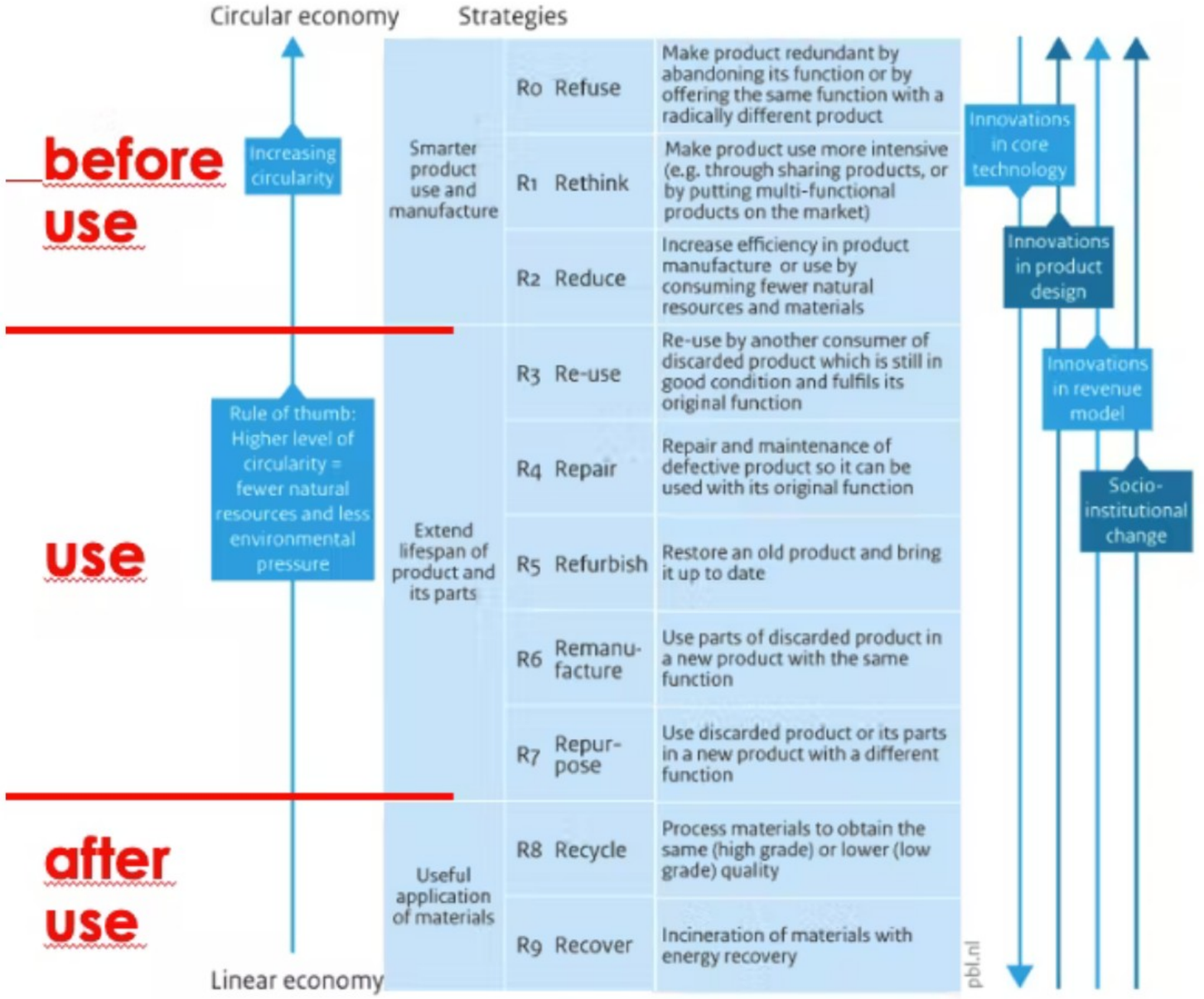
Wat is een circulaire economie?

114 definities (Kirchherr et al., 2017)

A circular economy is one that is restorative and regenerative by design and aims to keep products, components, and materials at their highest utility and value at all times, distinguishing between technical and biological cycles

– Ellen MacArthur Foundation (2013)

De R strategie



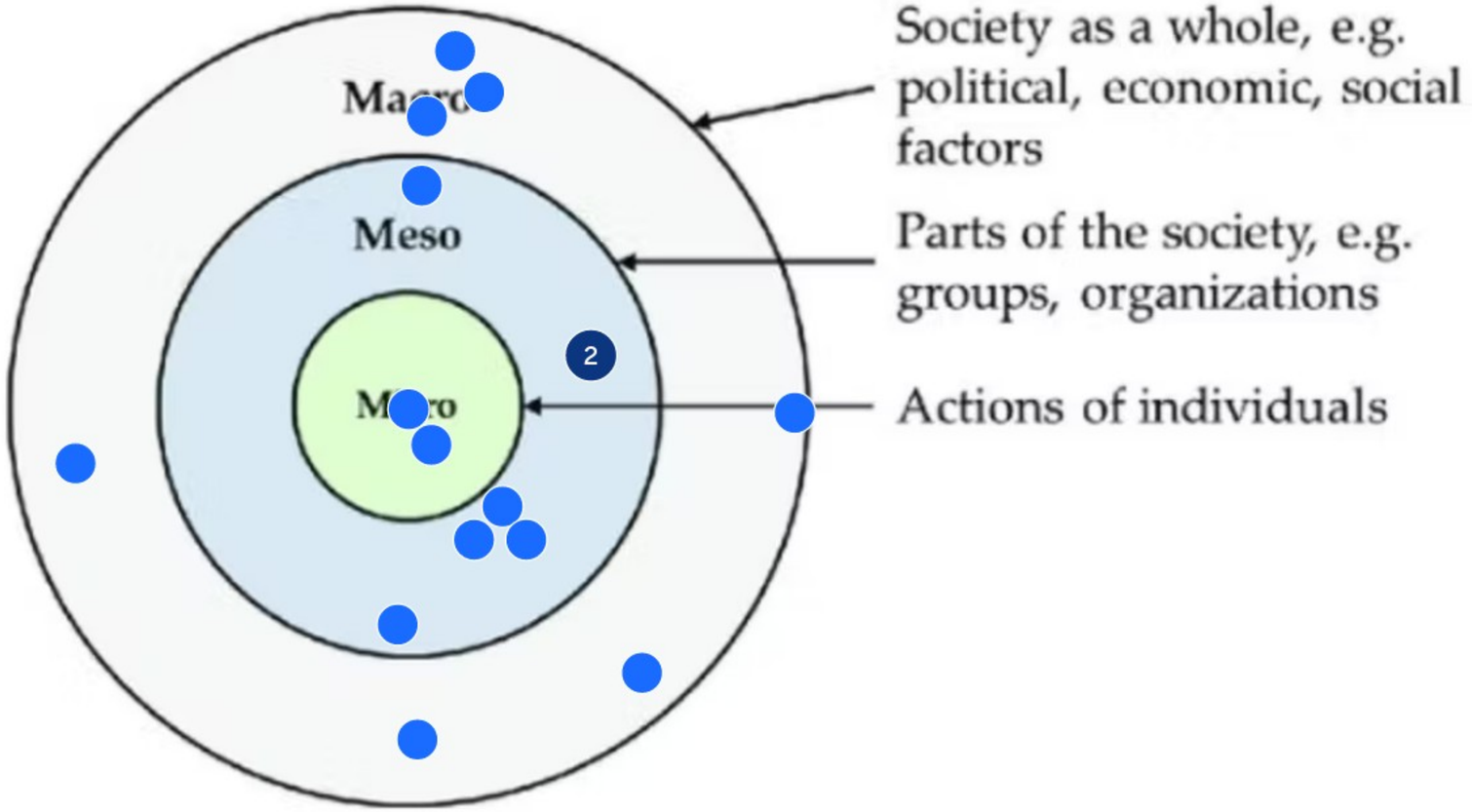
Wat kan ik met die circulaire economie?

Circular strategies within the production chain, in order of priority

Potting, J., et. al. (2017)

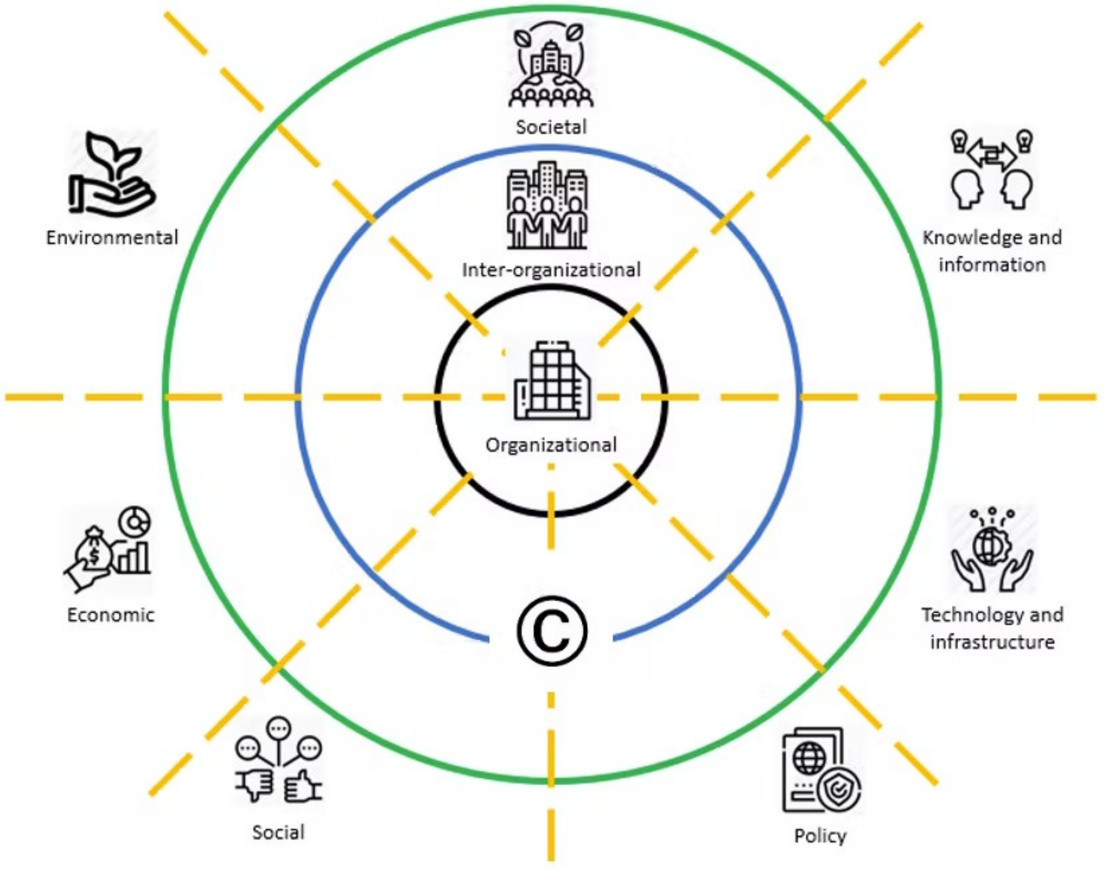
Naar welk denken gaat uw voorkeur uit?

Mentimeter



Macro, meso and micro level overview (Javaid, Javed & Kohda, 2019)

16



Six categories:

1. **Economic**

Drivers related to the market and financial

2. **Environmental**

Drivers related to the environment

3. **Knowledge & Information**

Drivers related to knowledge and information sharing

4. **Policy**

Drivers related to policy, guidelines and regulations

5. **Social**

Drivers related to motivation, awareness and pressure

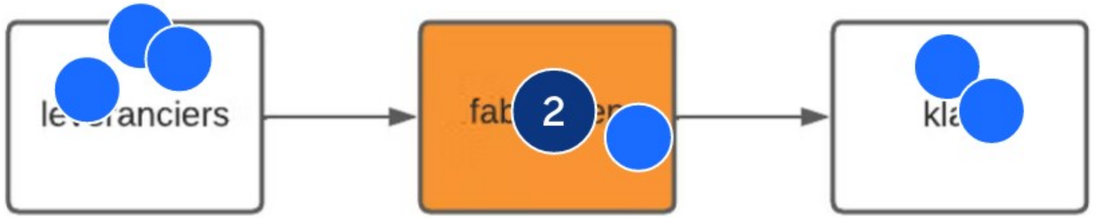
6. **Technology & Infrastructure**

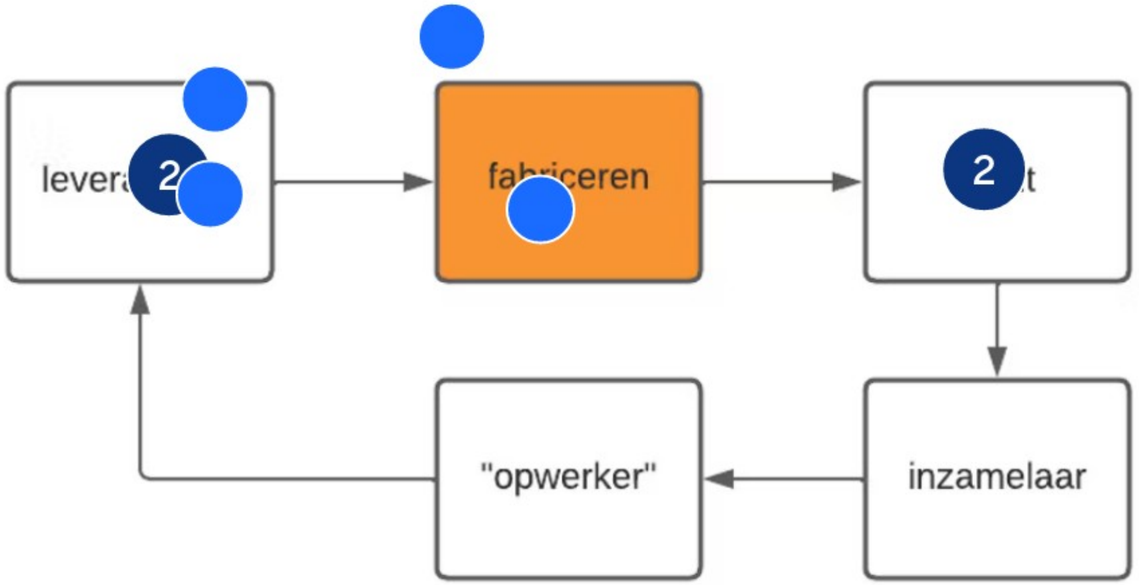
Drivers related to technologies and physical infrastructure

Circular Business Model Drivers - Pieroni et al., 2019

Waar zit u?

Mentimeter





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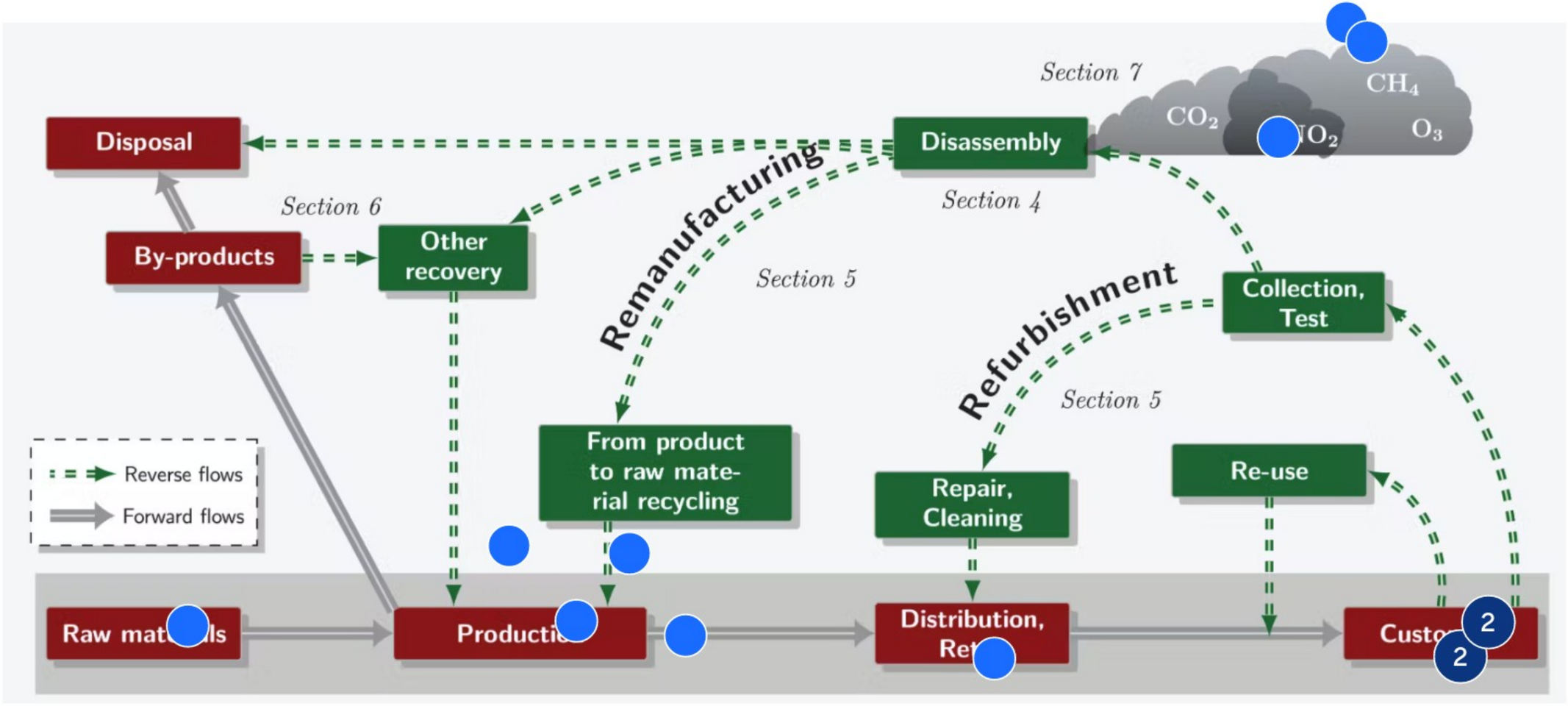
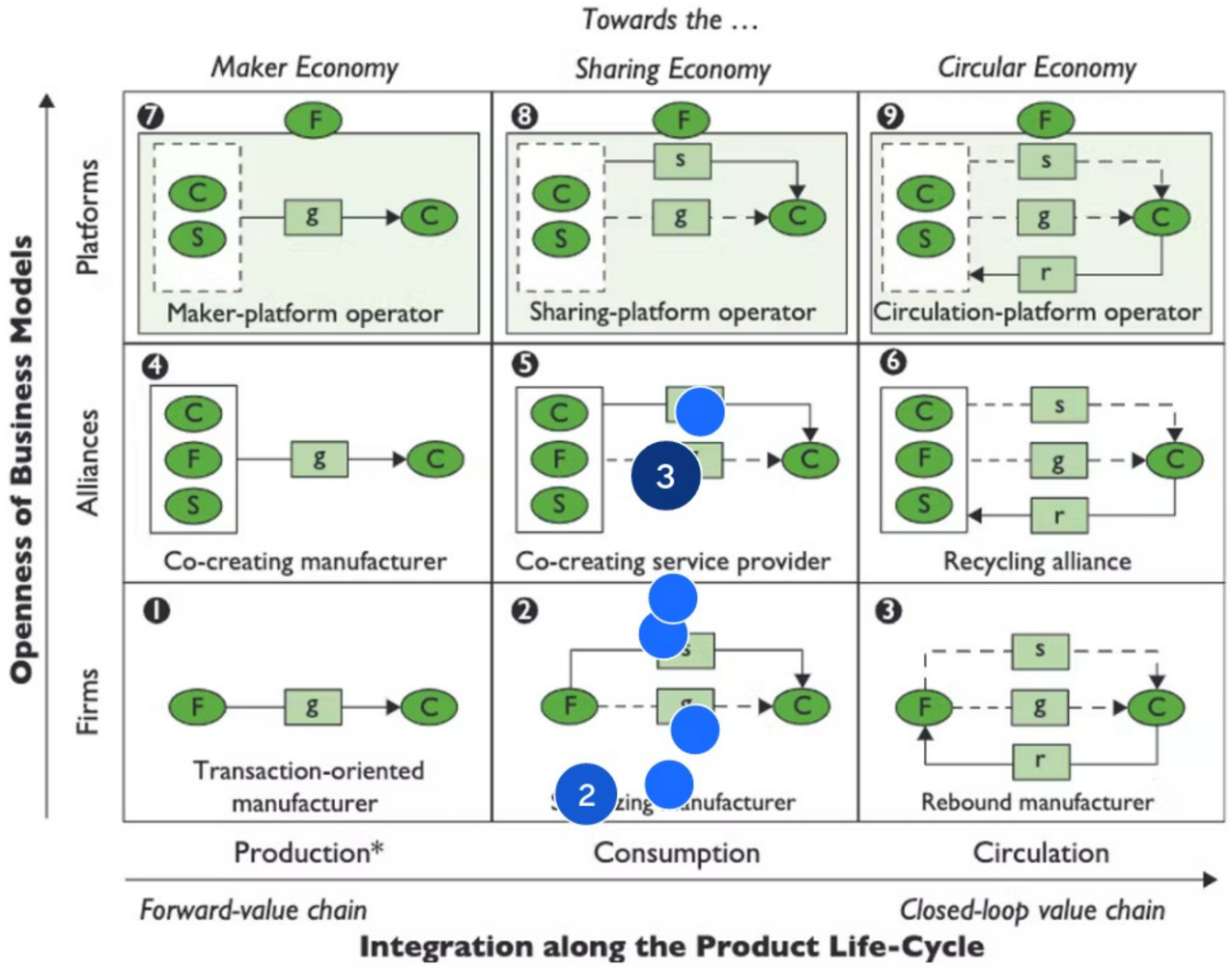
En waar bevindt uw onderneming zich hier? (Suzanne et al., 2020)

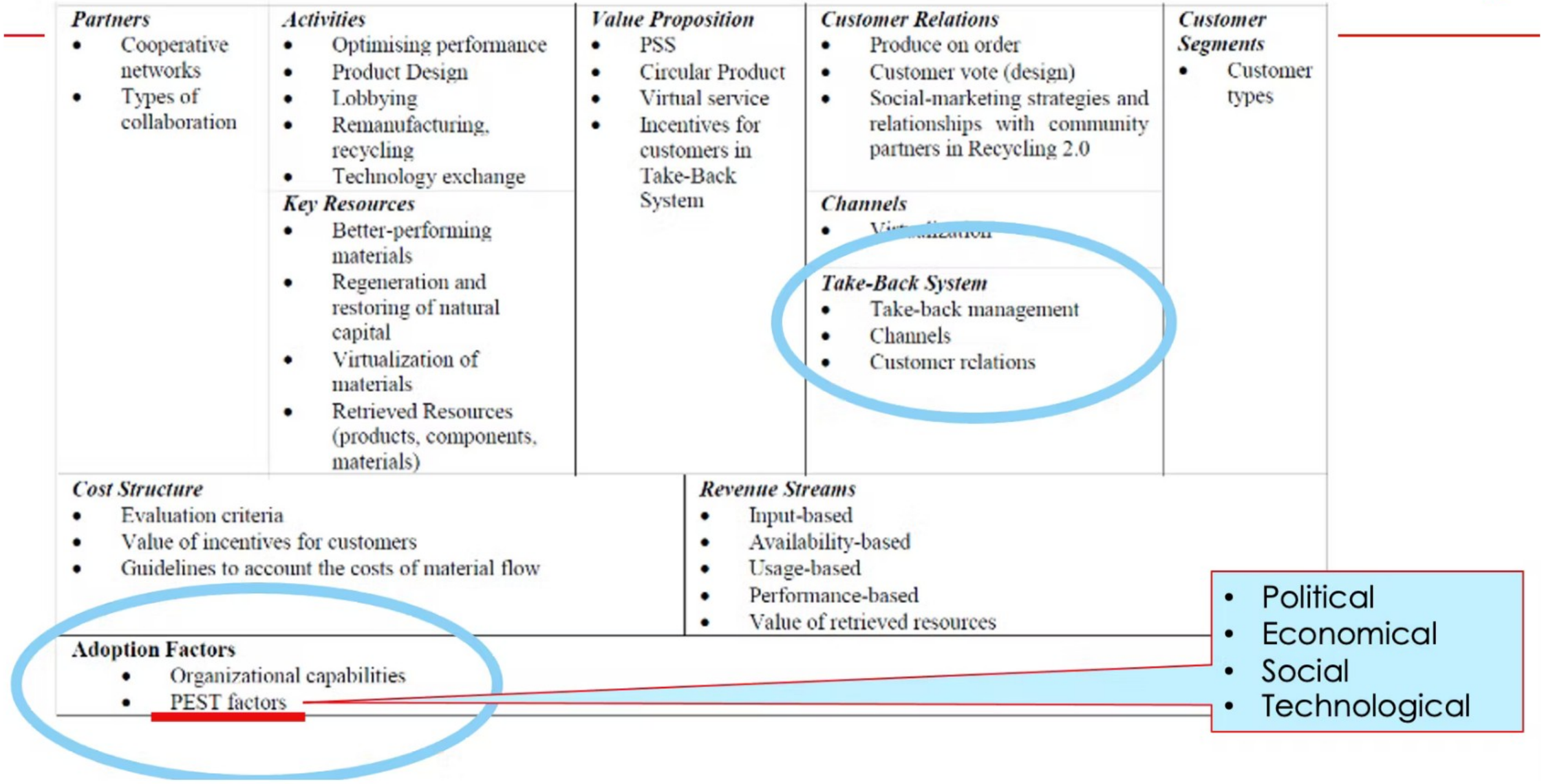


In welk vak zit uw onderneming nu?

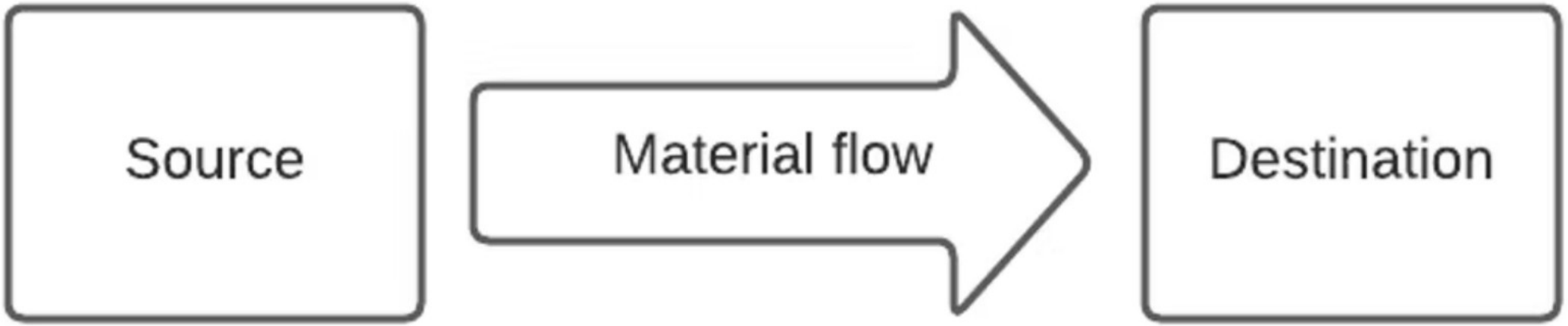


In een circulaire economie kun je bedrijven niet meer in isolement bekijken

Kortmann & Piller (2016)

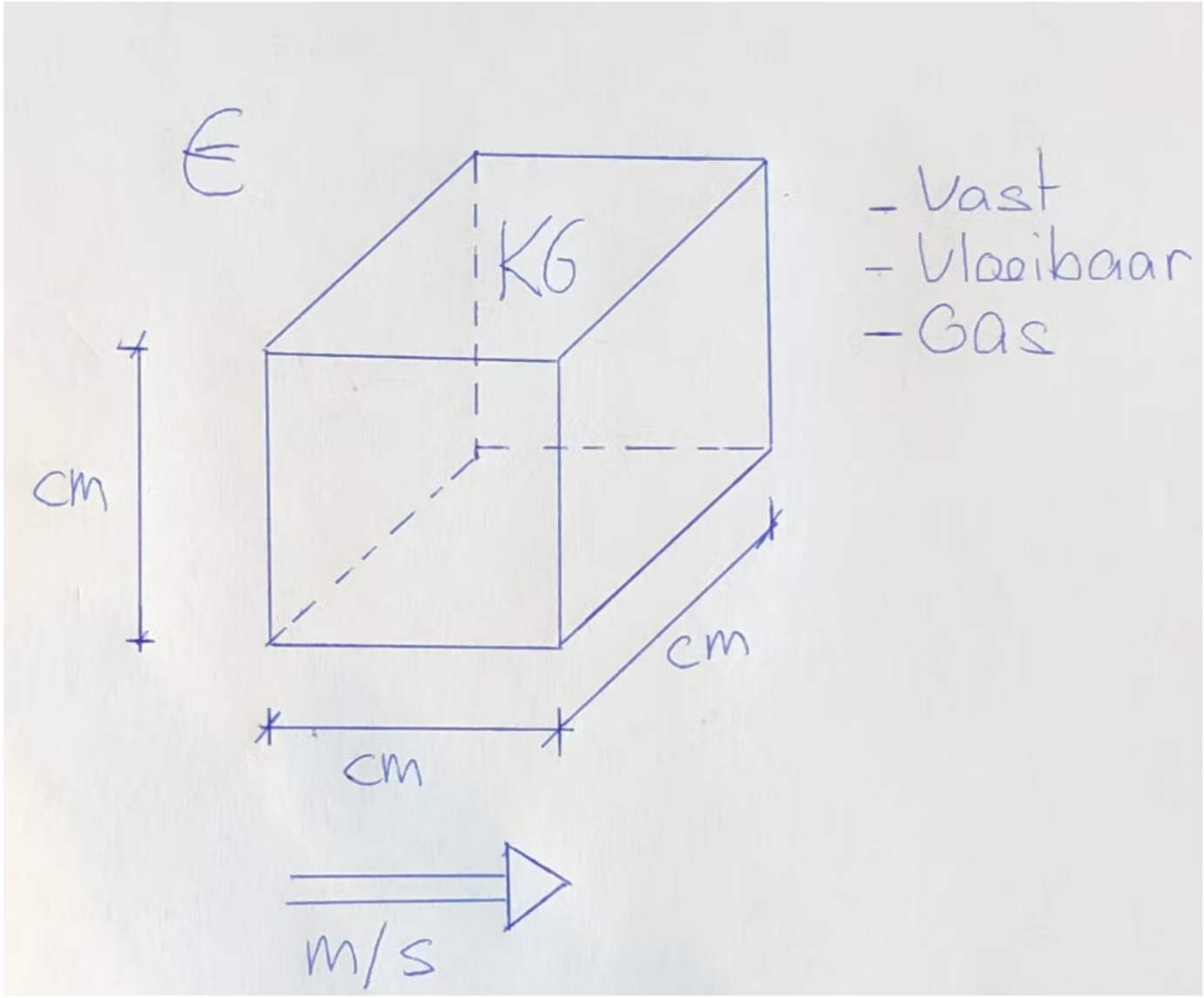


Circular Business Model Canvas (Lewandowski, 2015 / Osterwalder & Pigneur, 2010)



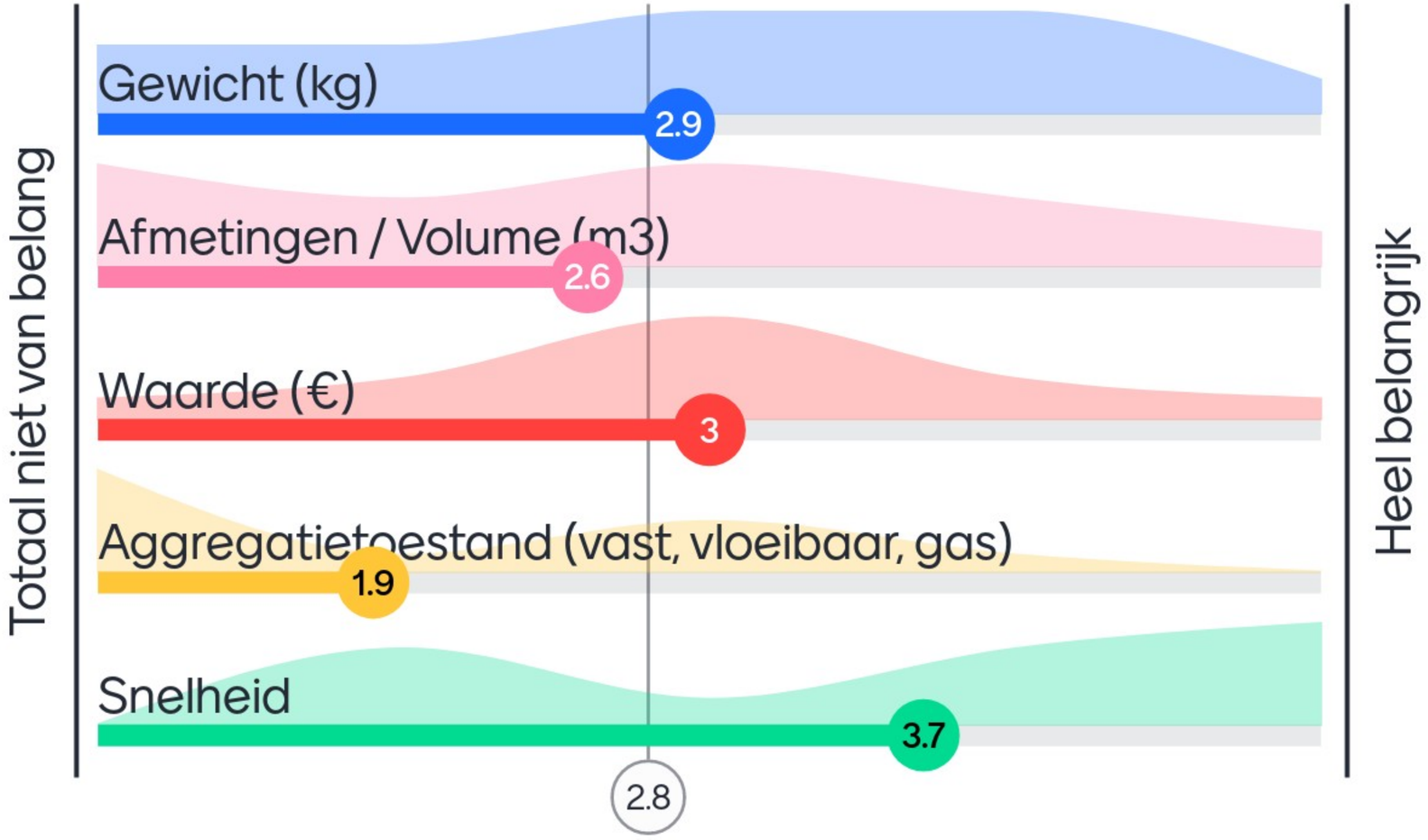
Materiaal stromen gaan van bron naar bestemming

Wat zijn EIGENSCHAPPEN van de MATERIAAL STROOM?

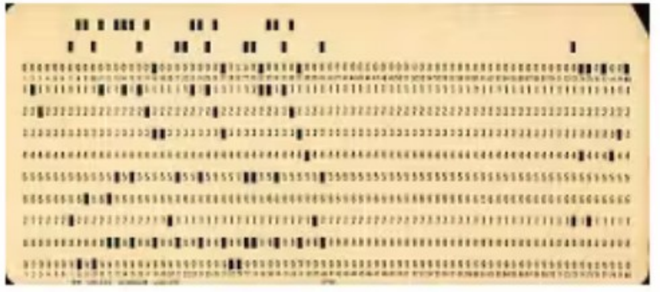


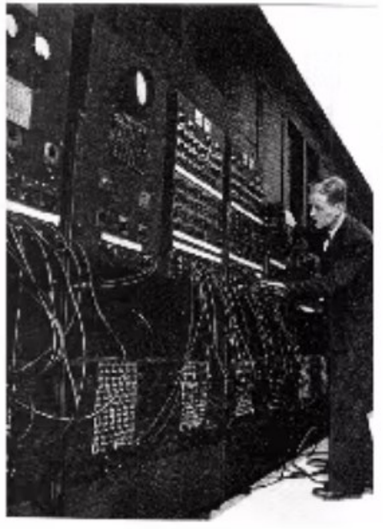
Eigenschappen van een materiaalstroom

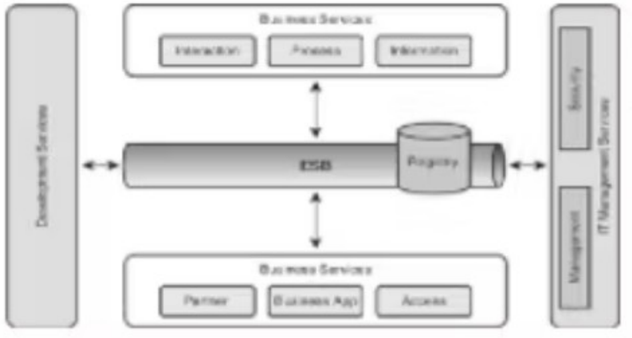
Welk belang kent u toe aan de eigenschap van de materiaalstroom (in relatie tot circulariteit)?



Material flows are triggered by information delivered through an information carrier







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Digital Technology is the application of a systematic technique, method, or approach, involving the recording or storing of data as a series of the numbers 1 and 0 in order to solve a problem

– The author

Lenzen van digitale technologie

- Ondersteunen van ***business functies*** (Belik et al., 2019)
- ***Historische*** lens (Visser & van Goor, 2019);
- Digitale technologie ***element*** lens (Nambisan, 2017);
- ***Front & Base*** technologie lens (Frank et al., 2019);
- ***Architectonische lagen*** lens (Pagoropoulos et al., 2017);
- ***Digitale functie*** lens (Liu et al., 2022).

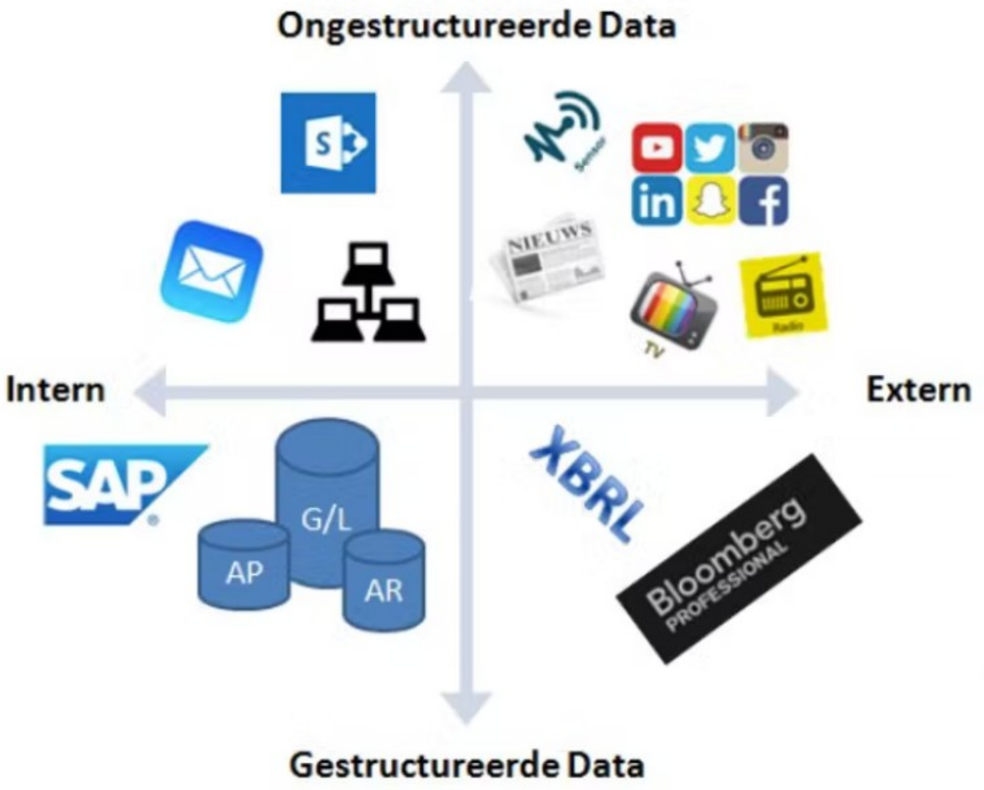
DATA

SORTED

ARRANGED

PRESENTED VISUALLY

EXPLAINED WITH A STORY



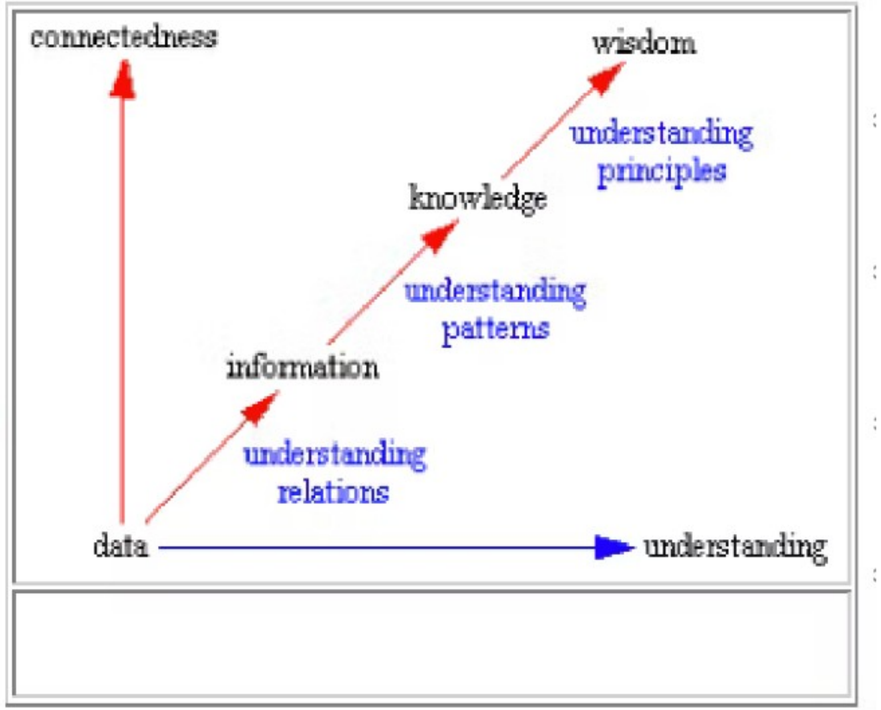
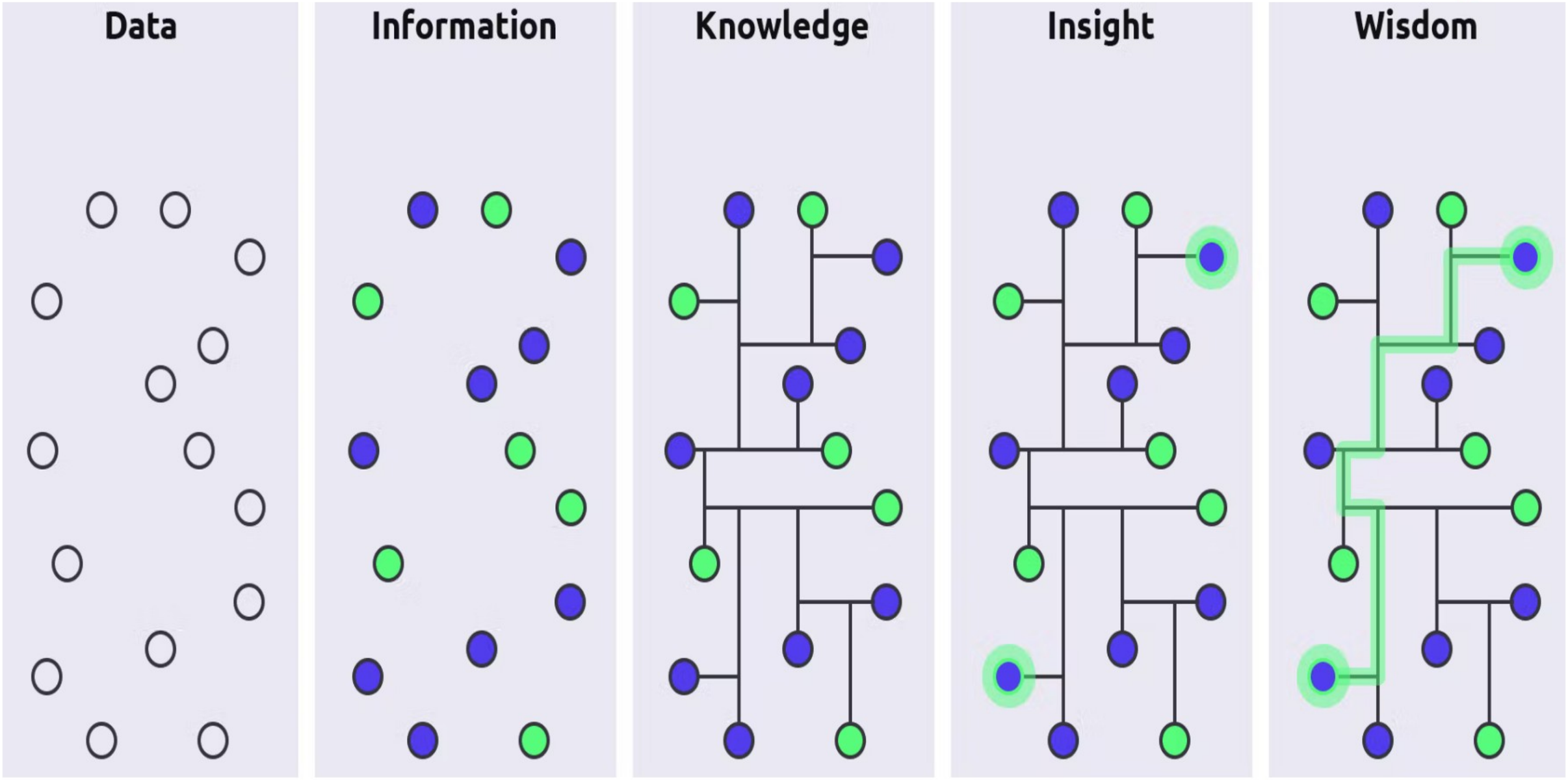


Figure 2. Transition through understanding

6

Informatie wordt afgeleid van data



In 2020, the world will produce 64 zettabytes of digital data (1021 (1 sextillon) bytes)

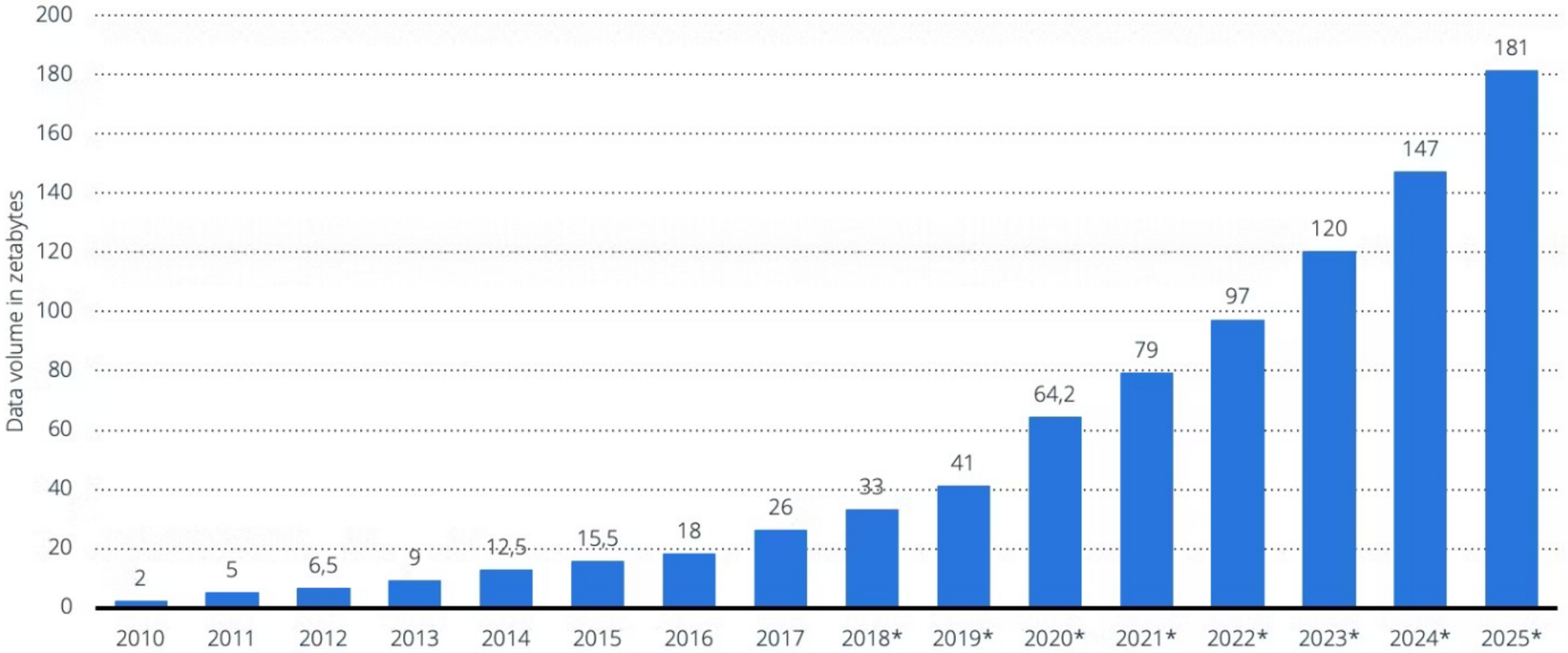
- B Byte
- KB Kilobyte
- MB Megabyte
- GB Gigabyte
- TB Terabyte
- PB Petabyte
- EB Exabyte
- ZB Zetabyte
- YB Yottabyte

- By 2025, 75 billion devices will be interconnected (Statista, 2016)
- 1.5 trillion photos are taken every day (van Beek, 2020)
- Only 1% of the data is used, 25%-37% is potentially valuable (van Beek, 2020)

Mentimeter

Volume of data/information created, captured, copied, and consumed worldwide from 2010 to 2025 (in zettabytes)

Amount of data created, consumed, and stored 2010-2025



Note(s): Worldwide; 2010 to 2020

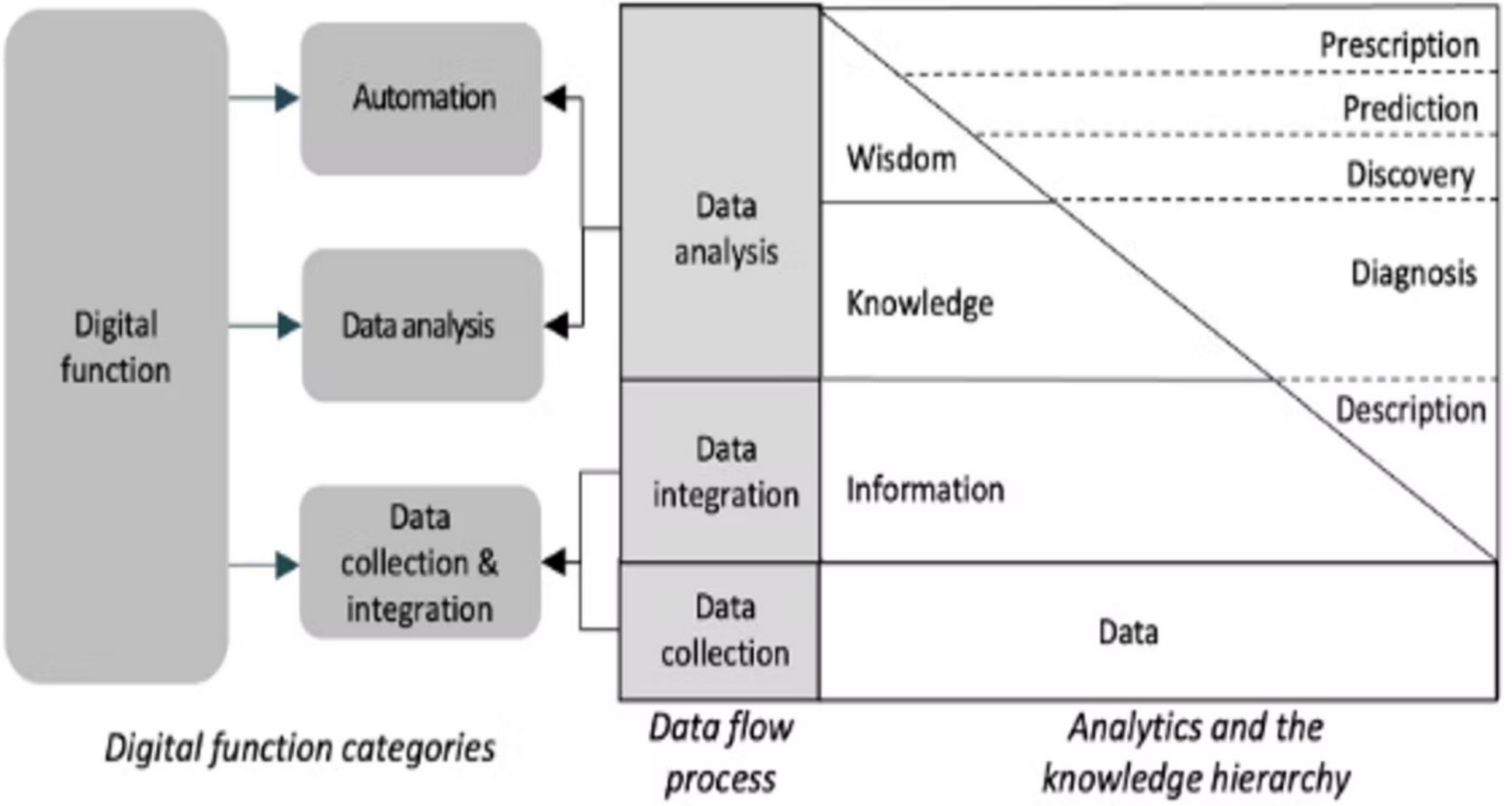
Further information regarding this statistic can be found on page 8.

Source(s): IDC; Seagate; Statista estimates; ID 871513

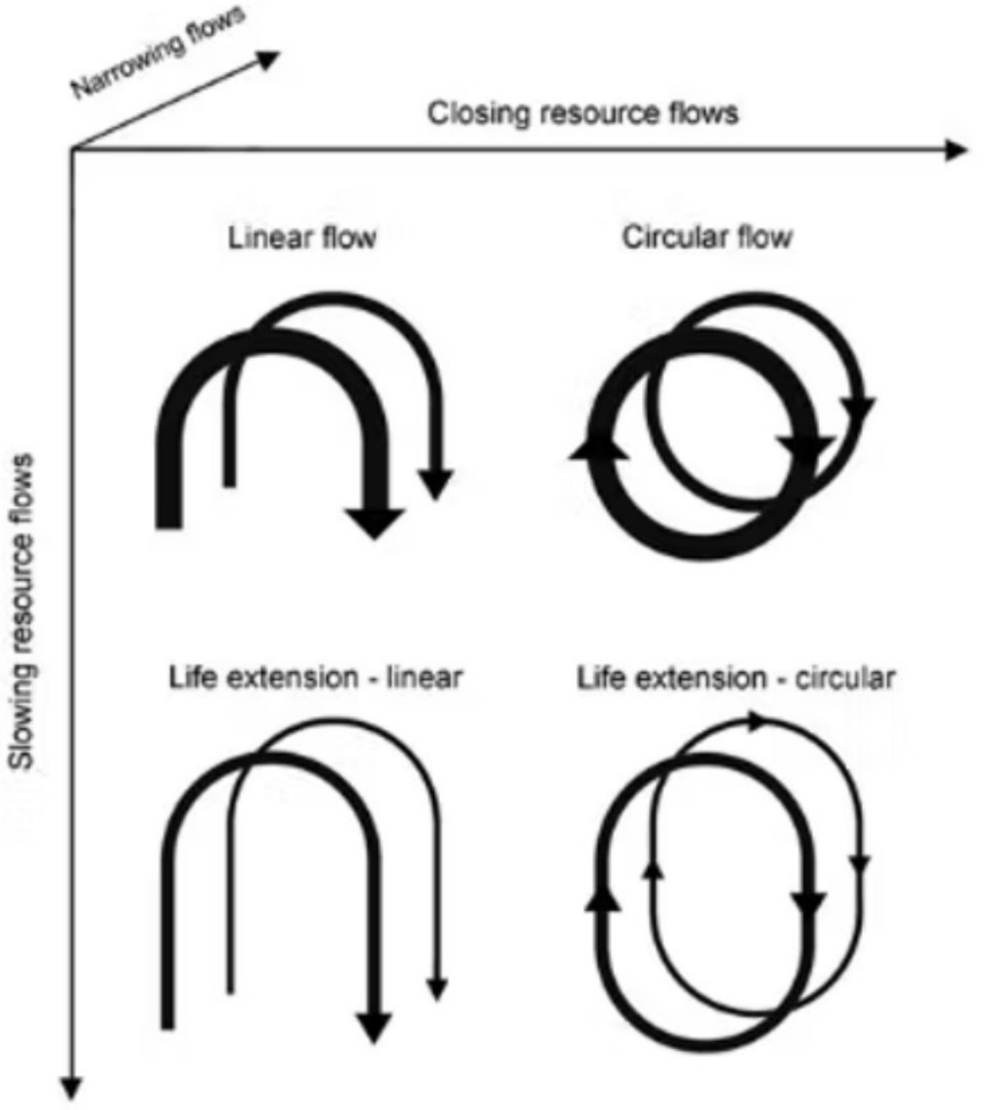
- Auto-plan
- Auto-control
- Sort and classify

- Optimize
- Innovate
- Forecast
- Connect
- Assess
- Detect
- Track & Trace
- Monitor

- Share
- Collect



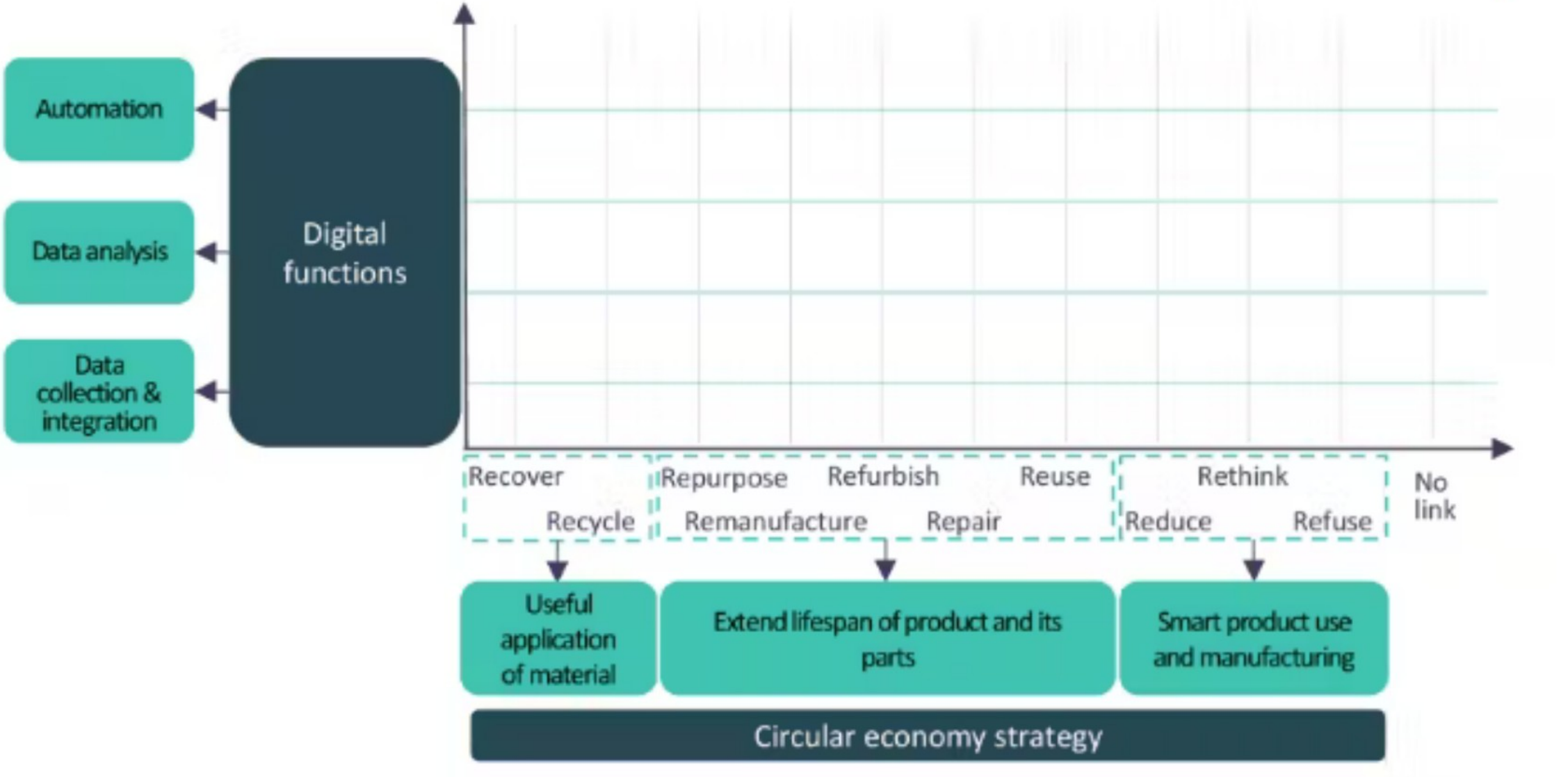
Digitale functie categorieën (Kristoffersen et. al. ,2020, Siow et al., 2018 en Liu et al., 2022)



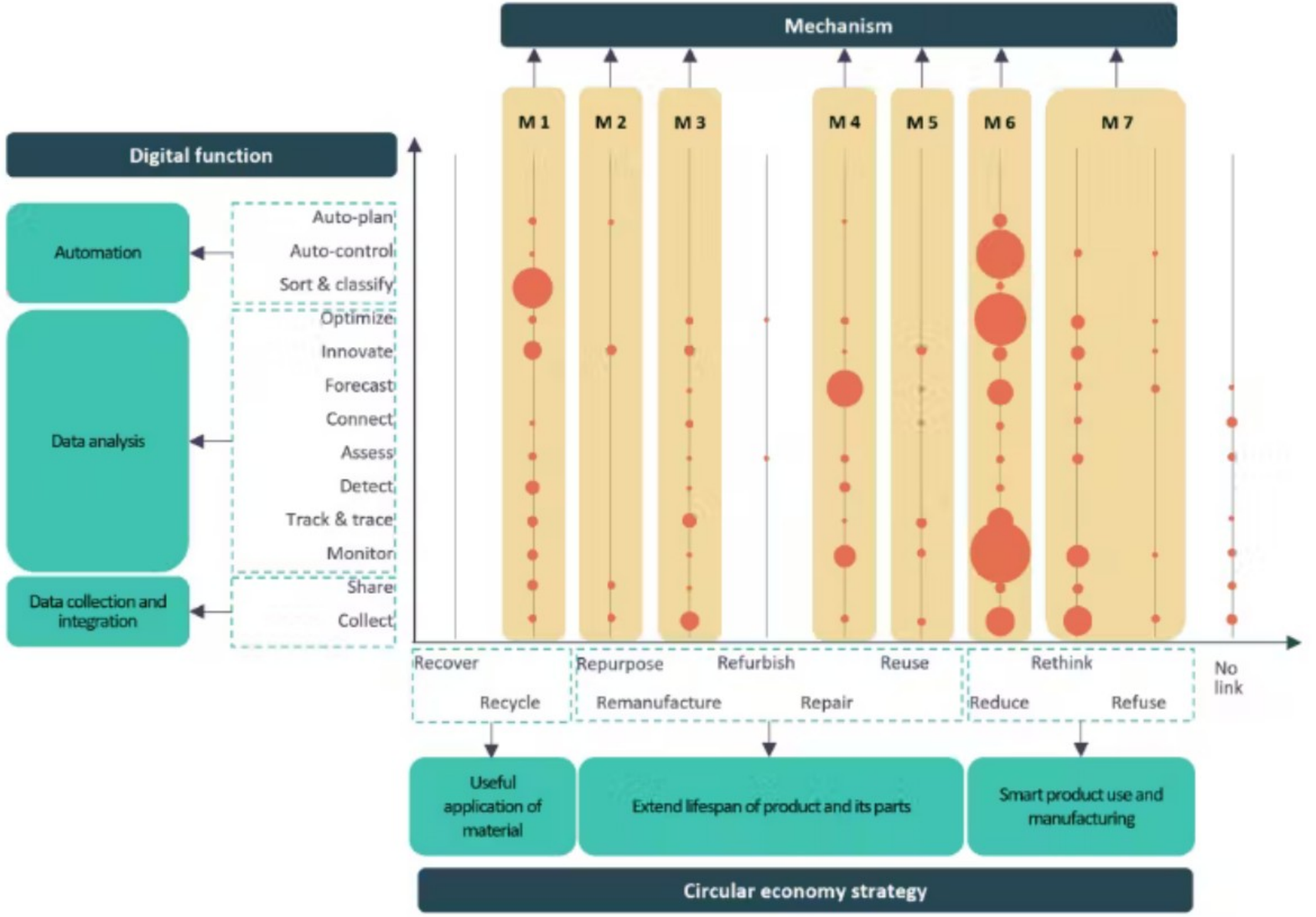
Circulariteit gaat over Materiaalstromen:

- Verkleinen
- Vertragen
- Sluiten

Bocken et al. (2016)



Mechanismen (Liu et al., 2022)



Mechanismen (Liu et al., 2022)

Table 3. Application of the framework to the seven contributions of the Sustainability special issue 'Circular Economy in the Digital Age'.

Article	Digital Technology	Lifecycle Phase	Circular Economy 4R Strategy	Circular Economy Practice	Sustainability Performance
Green Transition: The Frontier of the Digicircular Economy Evidenced from a Systematic Literature Review [66]	Internet of Things Big Data and Analytics (based on quantum computing)	Design Manufacturing Usage End of use	Reduce Recycling	Eco-design New business models based on servitization Value chain reconfiguration	Reduce the pace of emissions to a value lower than the rate at which natural systems can absorb them. Recycle resources at a pace higher than waste generation.
Digital Twins for the Circular Economy [67]	Digital Twins	Design Manufacturing Distribution Usage End of Use	Reuse Remanufacturing Recycling	Product design Servitized business models (sharing) Circular value chain coordination	Reduce the consumption of natural resources by optimizing product design based on digital twins. Reduce waste generation by increasing remanufacturing and recycling, thanks to improved decision-making enabled by digital twins. Economic benefits from the optimization of resources during the product life cycle.
Omni-Chanel Network Design towards Circular Economy under Inventory Share Policies [68]	Internet of Things	Distribution	Reduce	Value chain optimization	Savings in holding and transportation costs due to the optimization of inventory share policies. Reduce CO_2 over-production and transportation emissions due to the optimization of inventory share policies.
Circularity for Electric and Electronic Equipment (EEE), the Edge and Distributed Ledger (Edge and DL) Model [69]	Blockchain	Manufacturing Distribution End of use	Remanufacturing Recycling	Value chain	Reduce waste generation, especially for electrical and electronic equipment (WEEE).

Article	Digital Technology	Lifecycle Phase	Circular Economy 4R Strategy	Circular Economy Practice	Sustainability Performance
Circular Digital Built Environment: An Emerging Framework [70]	Internet of Things Big Data and Analytics 3D Printing Blockchain	Design Manufacturing (construction and assembly) Usage End of use	Reduce Reuse Recycling	Design for green buildings (long life, reversibility, improvements in efficiency) Circular value chain collaboration	Regenerate resources (using renewable resources). Narrow resource flows (resource efficiency). Slow resource loops (intensify usage and extend service life). Close the loop.
Using Internet of Things and Distributed Ledger Technology for Digital Circular Economy Enablement: The Case of Electronic Equipment [71]	Internet of Things Blockchain Big Data and Analytics	Distribution Usage End of use	Reduce Reuse Remanufacturing Recycling	Servitized business models Value chain management coordination	Prevent electronic waste generation. Prevent adverse environmental and human health effects due to inappropriate disposal and recycling of WEEE (e.g., related to the illegal exportation of e-waste to developing countries that use child labor and whose dismantling practices create hazardous pollution). Increase compliance with legislative requirements, such as the WEEE directive.
Industry 4.0 and Smart Data as Enablers of the Circular Economy in Manufacturing: Product Re-engineering with Circular Eco-design [72]	Internet of Things Big Data and Analytics	Design Manufacturing Distribution	Reduce	Eco-design	Reduce the environmental impact of the product (ceramic tiles), thanks to eco-design informed by the IoT and Big Data Analytics.

Bressanelli et al., 2022

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Alle beetjes helpen

- 90% van alle bedrijven zijn MKB bedrijven (Dey et al, 2022);
- MKB bedrijven veroorzaken 60-70% van de industriële vervuiling (Dey et al, 2022).
- Adoptie digitale technologie in MKB blijkt lastig (evofenedex)

Mentimeter

Dank voor uw aandacht en input

Arjen Wierikx
arjen.wierikx@hu.nl

HOGESCHOOL UTRECHT

HIER KOMT ALLES SAMEN

https://www.slimcirculair.info/