

# Looping on data

Best practices and barriers for sharing data  
in circular business models

- this report was produced by organisations of the Ellen MacArthur Foundation network

# Preface

The increase in data and use of digital solutions and technologies will play a fundamental role to get the wheels of the circular economy turning even faster.

Data on materials and products; where they come from, how they are designed, produced, and transported, and how they are used, reused and recycled, are invaluable for circular business innovation. And the widespread use of digital tools and technologies to connect devices and share data are vital for setting up circular business models and accelerate the circular transition.

The Danish Business Authority wants to provide companies with the best framework conditions to run a responsible business and support the establishment of a well-functioning market for green and circular solutions. The creation of trustworthy and transparent data infrastructures for sharing data and documentation of sustainability are essential in that regard.

The EU Commission's Green Deal and Circular Action Plan 2020 and legislative proposals such as the Fit for 55 package set the green and circular transition as a key priority for the EU. Included is a special focus on accelerating the transition by data sharing, digital tools and infrastructures such as digital product passports and common European data spaces.

The twin transition to a green and digital economy entails an opportunity for companies to exploit circular business models across value chains enabled by data sharing. Companies experience an increasing demand from business partners, public authorities, consumers, investors, audi-

tors etc. for data and documentation on the environmental and climate footprint as well as information on how products can benefit a circular economy. Sharing of data to promote circularity will increase transparency both upstream and downstream of product use and enhance the value creation and streamline company reporting processes.

This study examines data that are central to share across value chains to promote circular business models. It gives insights into which tools companies are using for data sharing, the barriers that need to be overcome, and examples of how using data to promote circularity can be supported by different initiatives and supporting digital infrastructures.

The study is based on desk research, company interviews and analysis by the Danish Business Authority with input from members of the Ellen MacArthur Foundation network.



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## Looping on data

- Best practice and barriers for sharing data in circular business models

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## About the Danish Business Authority

The Danish Business Authority makes it easier and more attractive to start and run a responsible business in Denmark - through effective regulation, strong digital solutions, access to business data, modern communication technologies, and international cooperation.

## About The Ellen MacArthur Foundation

The Ellen MacArthur Foundation was launched in 2010 with the aim of accelerating the transition to the circular economy. Since then, the charity has emerged as a global thought leader, putting the circular economy on the agenda of decision-makers around the world. The charity's work focuses on seven key areas: insight&analysis; business; institutions, governments&cities; systemic initiatives; circular design; learning; and communications. Further information: [www.ellenmacarthurfoundation.org](http://www.ellenmacarthurfoundation.org) | [@circulareconomy](https://twitter.com/circulareconomy)



# 1. Executive summary

When data are used and shared between actors across the value chain they have great potential to strengthen circular business innovation. This analysis conceptualizes data that are essential to share to promote circularity, explores barriers for doing so and gives insights into which tools companies are using for data sharing. Also, examples of sharing data for circularity can be supported by policy, supporting digital infrastructures and other initiatives.

Besides the innovation potential, data also provide qualified information for companies to document circularity to consumers, investors, other companies and authorities. Circularity and sustainability reporting can give companies a competitive advantage as larger companies and investors are increasingly demanding data and documentation.

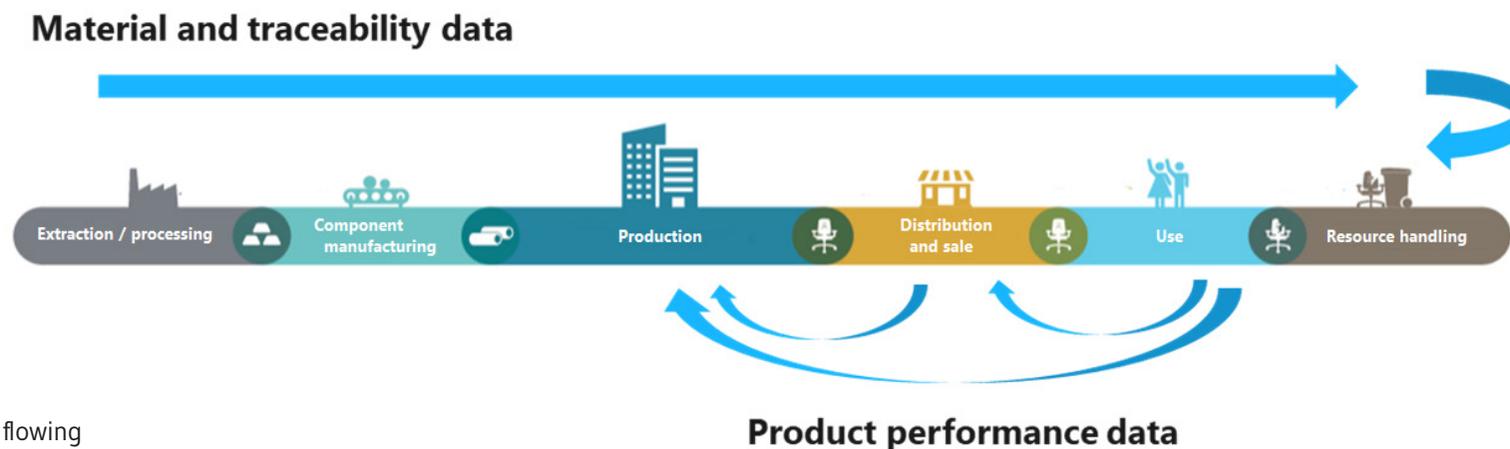
The study is based on desk research, company interviews and analysis initiated by the Danish Business Authority as a collaborative project with the Ellen MacArthur Foundation network.

## Data types

Two main data types underpins circular business models in different ways and in collaboration with suppliers and customers along the value chain. The two data types appearing from the interviews of this study are:

*Material and traceability data:* Information that travel down the value chain about product design, material content, -quality and -origin of products and packaging, life cycle assessment and environmental and climate impact are central to assess how and whether the products can for example be reused, repaired or remanufactured, or whether the materials of the products and packaging contain hazardous substances or can be recycled.

*Product performance data:* Information that travel up the value chain on the use and condition of the products can provide companies with information on how they can continuously maintain and improve the performance of the products.



**Figure 1:** Datatypes flowing in the circular value

## Barriers for data sharing

Although sharing of data has great circular business potential, it is not always easy to share these data from company to company, Thus, a lot of data is lost along the value chain - both downstream and upstream. This study identifies different barriers experienced by the companies as obstacles for collecting, using and sharing data internally and along the value chain to promote their circular business models.

Some of these barriers are:

- Lack of data-interoperability
- Lack of data standards
- Business sensitive data
- Lack of trust in the supply chain
- Lack of easy access to public data

## Digital tools for data sharing

To exploit the business potential in data-based circular business models, companies often use supportive digital tools to retain data along the value chain to collect, use, visualise and share the data. This study encompasses several case examples of state-of-the-art digital tools for data sharing provided by consultancies and other enabling companies. Such tools help alleviate some of the barriers for data sharing.

## Policy and initiatives

The study also identifies different public and public-private initiatives at a local, national and supranational level to promote circularity and a well-functioning market for circular solutions enabled by data sharing. It seems that there is an emerging market for data sharing solutions,

but also a need for the public sector to play an active role in accelerating the use of data to enable circular business models. For example, public authorities can:

- provide clear guidance for sharing of data and use of relevant tools
- develop common data formats and standards to increase data interoperability
- provide easy access to public data for business development
- request relevant data in public product procurement
- set requirements for reporting on sustainability
- develop open networks and digital infrastructures for data sharing

### Material and traceability data types

- Material content (bill of product)
- Material intersection points
- Origin of the materials
- Rate of recycled material in product and packaging
- Product design
- Resources used in the process

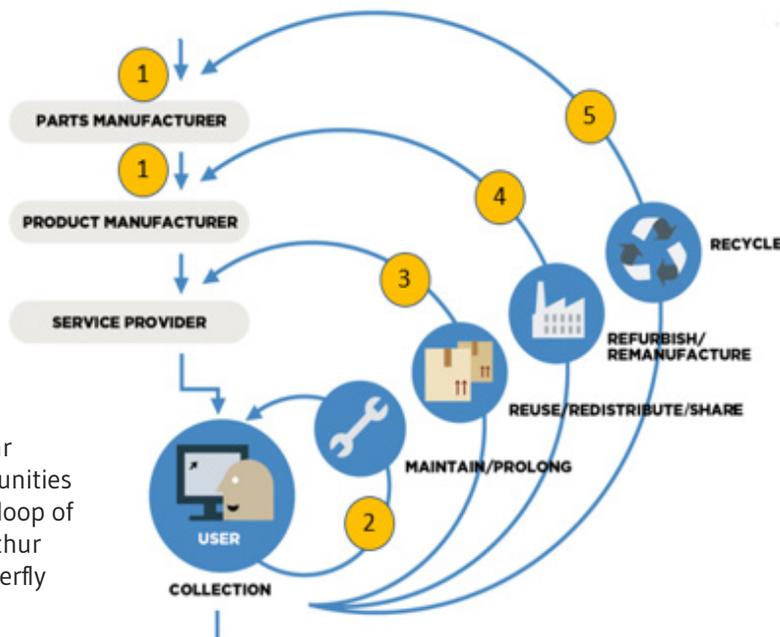
### Product performance data types

- Sales prices
- Take-back prices
- Rental frequency
- Consumer preferences
- Product usage (how often is the product used)
- Product damages

## 2. Why looping on data?

Data and digital technologies are increasingly recognized as a valuable tool for the global economy. More and more companies are adapting to the exponentially growing digital development. At the same time, many companies have realized the need to adopt circular business models, not only for the sake of the planet, but also to remain resilient in the face of increased resource scarcity.

Digitalisation provides opportunities for the transformation to a circular economy, as the use of data and digital tools and infrastructure can help to deliver on many of the circular economy principles. In the table below, we present examples of how data and digital technologies can support circular business principles. Also, digitalisation and use of data enables better consumer choices and product differentiation.



**Figure 2:** Circular business opportunities in the technical loop of the Ellen MacArthur Foundation butterfly diagram

Circular principles	Examples of data and digital technologies enabling circularity
1. Efficient material and resource use	Digital tools and use of data to align supply and demand to avoid waste, make use of surplus resources, less resource use.
2. Maintenance of products and prolonging of product life	Predictive maintenance based on real time data and use of sensors and Internet of Things. Data on product use and durability to improve future design.
3. Reuse, sharing and redistribution	Digital platforms facilitating sharing and reuse of products. Tracking of products along the value chain to improve redistribution.
4. Repair and remanufacturing	Monitoring use and performance of products and registration of product composition and material content to improve repair and remanufacturing. Access to repair.
5. Recycling	Digital tracking of materials in products along the value chain, data assessment of waste streams, intelligent waste collection and sorting.

# Company selection

In all, 14 companies were interviewed for the analysis performed during 2020/2021. All companies use data to support their circular business model. The companies divide into three different groups; Manufacturers, platform distributors and enablers.

- **Manufactures** are producing companies.
- **Platform distributors** are companies that distribute products and take care of sales, logistics, take-back, rental schemes etc. and companies that provide guidance in distribution.
- **Enablers** have developed a solution that help other companies or organisations to create transparency in their value chain or resource streams.

Other sectors, materials and data types exist and are out of scope for this analysis.

## Semi-structured interviews with focus on:

- **Company details:** How does the company focus on CE, for how long etc.
- **Use of data:** What types of data are they working with, who do they share it with, how it is collected, what are the barriers
- **Technology:** What technology enables their data collection etc.
- **Infrastructure and policy:** What are the barriers in policy, and what kind of infrastructure can enable data sharing.

## Manufacturers

- **Lexmark** (US) – Electronics
- **Schneider Electric** (FR) – Electronics
- **Michelin** (FR) – Tires, Logistics
- **Novo Nordisk** (DK) – Life science
- **Danone** (FR) – Food, Packaging

## Platform distributors

- **Lizee** (FR) – Fashion, sporting equipment
- **Continued Fashion** (DK) – Textile and fashion
- **Sellalong** (UK) – Textile, apparel and fashion
- **CHEP** (UK) – Logistics

## Enablers to create circular transparent value chains

- **Circular IQ** (NL)
- **Circularise** (NL)
- **Source Map** (UK)

### Waste streams

- **Topolytics** (UK)
- **Kabadiwalla Connect** (IND)

# Types of data

This study characterises the types of data that are used and shared in the value chain among the interviewed companies to underpin their circular business model. The aim is to get a better understanding of which data(sets) are valuable for circular business development, as well as to identify what types of barriers, actors and circular possibilities that are associated with different data types. Two central data types were identified to be highly valuable in the context of circular business models: *Material and traceability data* and *Product performance data*.

## Material and traceability data

This type of data relates to the content, production and origin of the product and which companies are involved in the supply chain. It includes detailed information about what materials are in the product and packaging (bill of product), where the different materials are combined in the value chain, the percentage of recycled content, and whether the product is built modularly, i.e. details on how the product is assembled and how it can be disassembled. Also, data on what materials and other resources that have been used in the manufacturing process are included in this category, e.g. water that has been used to manufacture jeans. Companies in the study working with such data are the manufacturers: Danone, Novo Nordisk, Lexmark and Schneider Electric, and the enablers: Circular IQ, Typolytics, Kabadiwalla Connect, Sourcemap and Circularise.

## Product performance data

This type of data carries information that indicates the performance of the product. Performance here encompasses both the market performance of the product and its durability. The former typically includes data on consumer behavior, e.g. what are customers willing to pay for the product, for how long will they typically rent the product, how often

is the product used. In addition, it contains information concerning the product's state, e.g. is it damaged, where are typical damages occurring on the product, what is the product's lifespan. The companies in the study working with such data are the manufacturers: Michelin, Schneider Electric and Lexmark and the enablers: Sellalong, Continued Fashion, Lizee and CHEP.

## Delimitation of data types

Other categories of data can support circularity, e.g. data on logistics used to optimize transportation, generic data on recyclability, climate impact etc. Thus, the types of data listed are not exhaustive.

### Material and traceability data types

- Material content (bill of product)
- Material intersection points
- Origin of the materials
- Rate of recycled material in the product and packaging
- Product design
- Resources used in the process

### Product performance data types

- Sales prices
- Take-back prices
- Rental frequency
- Consumer preferences
- Product usage (how often is the product used)
- Product damages

# Material and traceability data

Material and traceability data relates to the content and the production of the product and packaging, as well as the product's origin and which companies are involved in the supply chain.

## Manufacturers

From the perspective of the manufacturers of products, collecting data on the level of recyclability of a product and packaging supports a more sustainable and circular procurement strategy. In addition, collecting detailed data from suppliers on the material composition of the components, products and packaging and material characteristics supports improvements of the design of the product and packaging to promote recycling, refurbishment and repair.

As example, Circular IQ underpins such business opportunities by providing data on the best opportunities for improving circularity and eco impact on a product level.

## Users/consumers

From the consumer perspective better and more transparent data can support green consumer behavior. An increase in valid data sharing along the supply chain will enhance the transparency on the origin of materials and the environmental footprint of the product and packaging.

As example the company Schneider Electric (SE) collects to a great extent detailed data from their suppliers on material and traceability data and works with many of the same principles, as described on the product-manufacturer level. In addition, they make it possible for customers to see the 'green performance of a product' through their web-solution based on data collected from suppliers.



**Figure 3:** Material and traceability data flowing downstream

## Resource handling

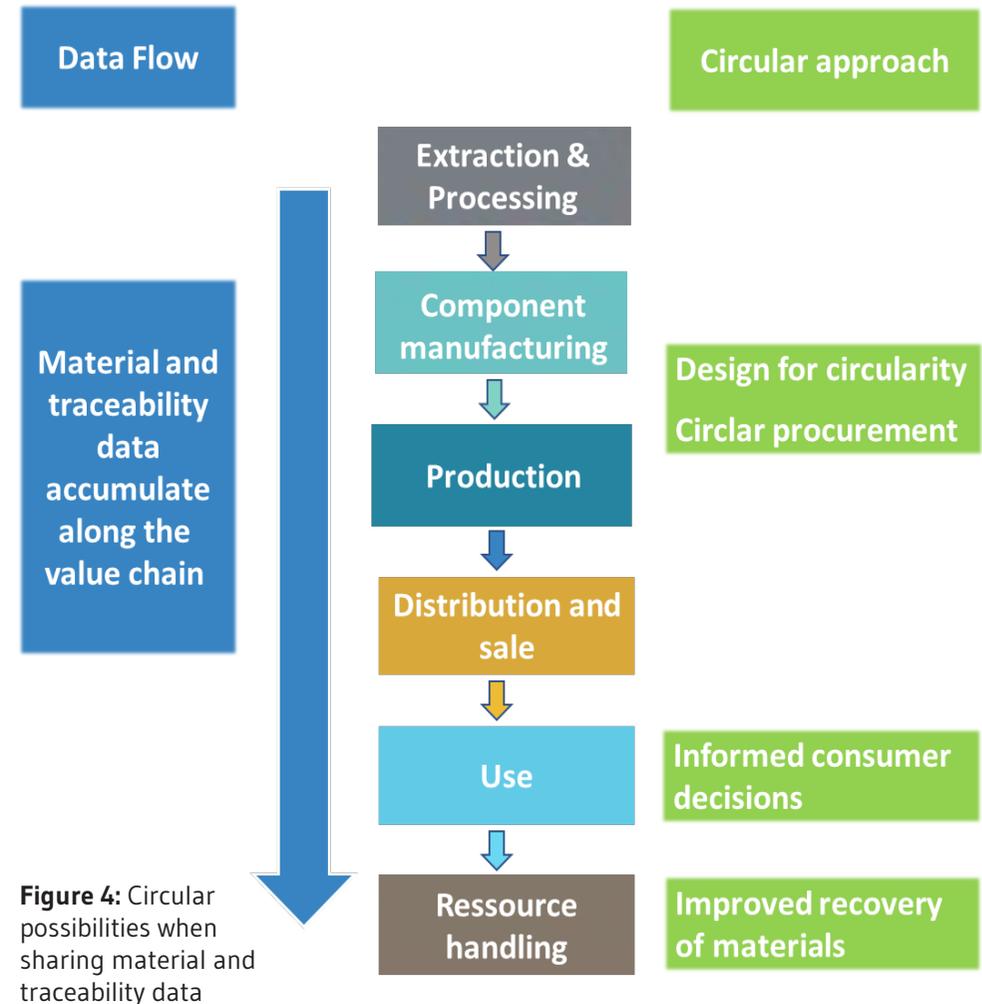
Detailed information concerning the composition of products and packaging, makes it easier to design for recycling. As example Lexmark have engaged in a cooperation with 16 stakeholders including recyclers, where they based on information concerning product composition etc. get feedback from recyclers on how they can improve the design of their products.

Sharing material and traceability data along the value chain have a great potential for promoting circularity for product manufacturers level as well as parts-manufacturers.

### Dataflow in figure 4

The middle of the figure indicates how materials/products/packaging travel along the linear value chain from mining of materials through manufacturing, distribution, consumption to resource handling.

Circular business opportunities arise in collecting, using and sharing material and traceability data along the value chain e.g. data that travels with the product and is generated from each stakeholder's contribution to the manufacturing and processing of the product.



# Barriers for sharing material and traceability data

The companies in the study using the circular opportunities in sharing material and traceability data are manufacturing companies such as Lexmark, Michelin, Schneider Electric, Novo Nordisk, Danone as well as 'enablers' such as Sourcemap, Circular IQ, and Circularise. The enablers help their clients facilitate circular transition and sustainability primarily on the production level. All companies were asked to elaborate on what barriers they had experienced in their work with data collection and CE.

From the interviews barriers such as the following were frequently emphasized:

- Lack of data-interoperability. Different formats and measures make it difficult to combine and systemise data. In other words, it is time demanding to collect, combine and use data from suppliers. There were also examples of this being a problem internally in large companies, where lack of data-interoperability between departments also is a problem.
- Lack of data/IT-skills at the suppliers.
- Lack of cooperation between IT and CE/CSR-departments
- Data on materials and traceability is perceived as sensitive to business which can create a hesitation to share data. To overcome this, trust and a good relationship with the suppliers is important. Also, timing appears to be an important factor, as the study indicates that the procurement process is a window-of-opportunity for companies to establish agreements on data-sharing with suppliers.
- Difficult to collect data from small suppliers, especially from outside the EU.

## Policy suggestions

- Improve sharing of external data from smaller suppliers that lack the necessary IT-skills and need insurance to share sensitive data.
- Improve internal data sharing between departments in big companies.
- Develop standards, open networks and digital infrastructure to improve interoperability in data sharing.

### Barriers for data sharing

- Lack of data interoperability
- Lack of data standards
- Low data skills among suppliers
- Lack of trust
- Sensitive business data
- Lack of data verification
- Resource demanding to collect data

### Policy suggestions

- Access to tools for sharing sensitive data
- Increase data competencies at supplier level
- Data standards and open digital infrastructures

# Product performance data

Product performance data relates to information that alone or combined with other information indicates the performance of the product.

## Users/consumers

Data at the distributor level enables the distributor to change from a selling model to a product-as-a-service model, which will increase the usage per product.

## Distributors

The distributor collects and analyses data on

1. For how much can they sell the products?
2. For how long will customers typically rent a given product?
3. How long does the product last?

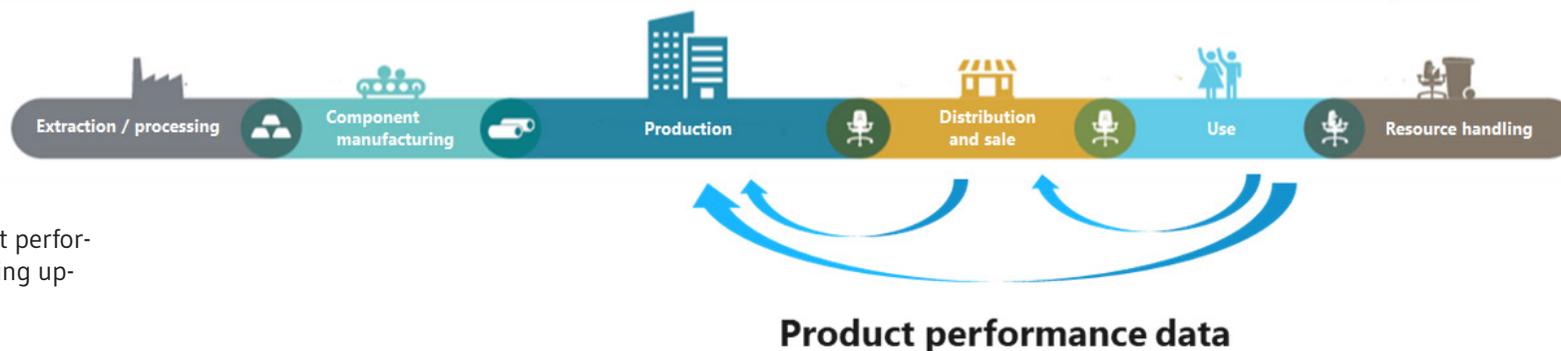
These kinds of data can be used for identifying the optimal price for rental-schemes or other take-back schemes, which enables them to change from a selling model to a 'Product-as-a-service-model'. Companies like Lizee, Continued Fashion, Sellalong and CHEP work with product performance data. They are distributors that work between the consumers and the product manufacturer.

## Platform distributors

Lizee and Continued Fashion use product performance data to help retailers in the fashion industry to change their business model from a selling model to a rental model, while Sellalong has implied a scheme to take back products from the consumer to give them a second life whenever the consumer wants to end their use of the product. Lizee and CHEP are also in charge of the logistical distribution and provide storage of products, from where products are collected, refurbished and redistributed.

## Manufacturers

When companies like Lizee, Continued Fashion and Sellalong establish a take-back scheme they register product damages from their use phase. These data are shared with the product manufacturers, as they give insights into how product design can be improved to enable reuse, (re-design) and longer product lifetime, which will lower the demands for producing new products as the usage per product is increased. Hence, besides providing circular solutions such as take back models it also enables the collection and sharing of data, which in turn enables circularity - it is a two-way street.



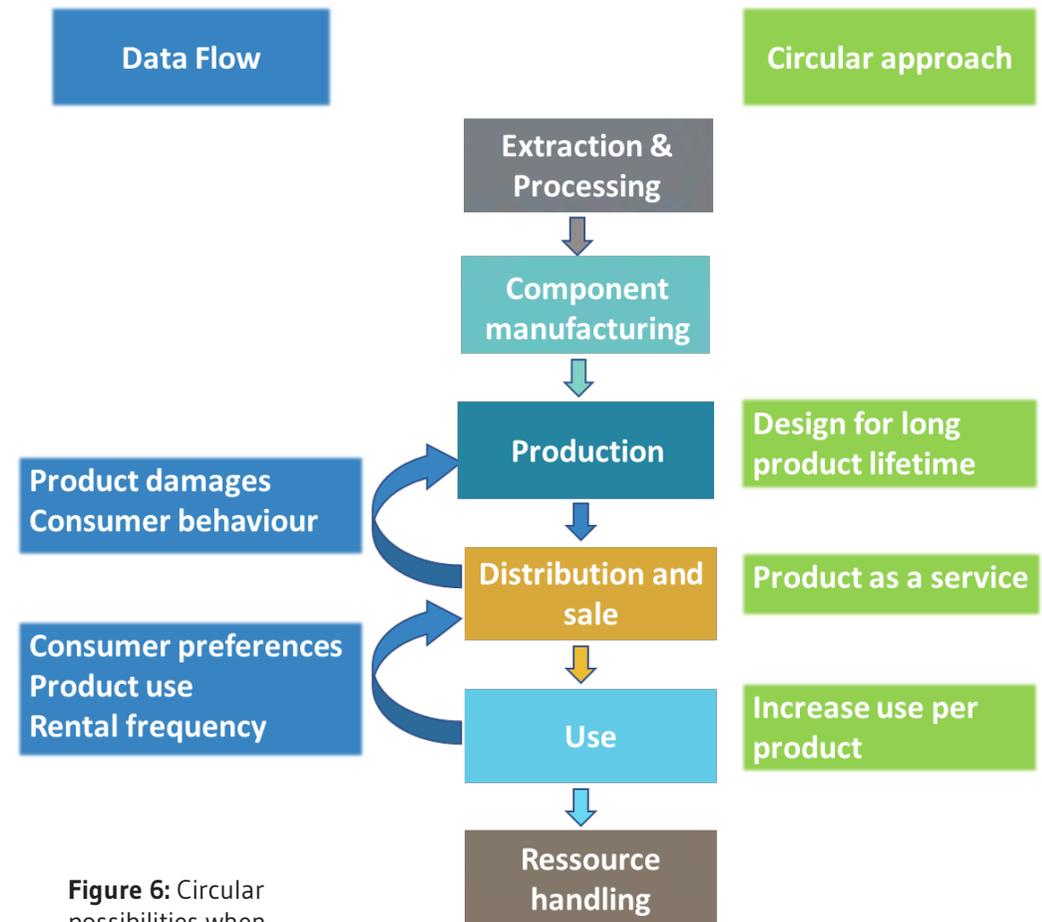
**Figure 5:** Product performance data flowing upstream

In addition, it is critical for making an exact assessment on wear and durability that each product can be uniquely identified from the point of sale to its return to the company. Both Lizee and Continued Fashion equip the products with an RFID tag, allowing them to follow the product and observe the damages over time. Sellalong register each customer with a unique tag, which serve as an anonymised customer identifier. Personal data is only exchanged at a later point in time, when the customer has decided to sell back the product.

Other ways of using product performance data such as reverse logistics and increased usage per product have been observed in the interviews. Compared to material and traceability data there is also a difference in how, and between who, the data are shared.

#### Data flow in figure 6

At the left side of the figure the dataflow between consumers and distributors contains data reflecting consumer behaviors, e.g. prices, product use, rental frequency (duration of a rental period) which indicate how the product performs on the market. The service provider (or distributor) collects these data from the user/consumer. Some service providers/distributors also register damages to the products when they are returned. These data are valuable and can be shared and sold to the retailer and the product manufacturer as they enable a variety of circular principles at different levels in the value chain.



**Figure 6:** Circular possibilities when sharing product performance data

# Barriers for sharing product performance data

The interviewed companies experienced barriers in different ways when working with product performance data. Several interviewees indicate an asymmetry between large and small companies engaging in cooperation on sharing data. The companies working with product performance data are both manufacturing companies such as Michelin, Lexmark and Schneider Electric and distributors that help product manufacturers to establish a product as a service model, these are often data-based technology innovators such as Continued Fashion, Lizee, CHEP and Sellalong.

In the interviews these distributor companies gave examples of barriers such as:

- Over-implementation of GDPR in companies they work with. There are examples of companies that experience demands from larger companies regarding GDPR compliance exceeding actual requirements.
- Difficulty in using standard contracts for data sharing. When engaging with larger companies at the production-level, the manufacturing companies often do not accept standard contracts. Instead, different amendments and changes are suggested each time, which makes it time consuming to engage in contracts. For a startup, this can be critical.
- Diversity in client companies' policy regarding cyber-security

## Asymmetry between large and small companies

It should be emphasised that the conclusions are based on a limited number of companies working with product performance data. However, the interviews indicate that there can be an asymmetry between large companies and small databased innovative companies, which seek to

bring circular economy solutions based on product performance data into the value chain. The asymmetry consists of small innovators not being able to match the resources put into varying contracts, technical security etc. by larger companies. Hence such asymmetry should be a point of attention for officials, in order to facilitate an innovation friendly environment.

## Policy suggestions

- Counter asymmetry between large and small companies by supporting SMEs in data sharing.
- Create judicial and technical frameworks for data sharing contracts between SMEs and manufacturers.
- Ensure legal clarity on ownership and rights for usage of product performance data

### Barriers for data sharing

- Sensitive business data
- Many amendments by larger clients to standard contracts for data sharing
- Wide dispersion in producers' cyber-security policies
- Over-implementation of GDPR

### Policy suggestions

- Better technical and legal framework for data sharing
- Data sharing standards and certifications

# Data sharing tools and technologies

Digital tools are necessary to share data among companies. The digital tools must rely on a good governance structure, reliable verification schemes and be able to provide the right incentives to share data across the supply chains with respect to possibly sensitive data. Below are described three different approaches and tools for data sharing to promote circularity.

## Data sharing tools

- **Software for customers to upload and share data, 3rd party audit and verification:** Circular IQ offers three different programs through its platform. 1) Circular procurement program to measure the circular performance of what you buy. 2) Product circularity improvement program providing in-depth and data-backed insights for the biggest circularity and eco impact improvements on a product-level. 3) CTI tool to measure circularity made for businesses and developed by over 25 global companies, supported by the WBCSD (World Business Council for Sustainable Development). Circular IQ has developed an audit protocol together with Lloyd's Register (LRQA) to make sure that the collected data for these programs are reliable. Through this protocol auditors can verify the extent to which data in the platform aligns with physical product characteristics and/or is substantiated by invoices and or other evidence.
- **Open-source blockchain platform allowing user to be anonymous, 3rd party audit and verification:** Circularise has developed a data sharing infrastructure for companies to show that their products are circular in a way that secures business sensitive data on material composition, processes and more by only register the signature of

data into an open blockchain. The signature is used to make statements on data without ever seeing the data. The signature is signed by the third-party auditor. The solution comes with smart questioning, where a company, investor or authority can ask about anything and another company can give any kind of answer.

- **Software to map the supply chain and enable traceable products:** Sourcemap has developed an online portal supplied with a cloud solution, where suppliers can create an account and upload spreadsheet data. They retrieve data to map the facility or location, their carbon footprint, transaction data and material origin. The data can be benchmarked and traced. Sourcemap helps brands and manufacturers to track their products to the material origin and assess their sustainability, compliance and risk in every step of the supply chain. They typically work with sectors with fast moving supply chains, like the food sector, apparel and pharmaceuticals. They work in many sectors and around the world, but primarily with manufacturers. The solution helps with procurement and selling a verified recycled material and circular product. The data is often sensitive and is only shared from suppliers to customer, not from supplier to supplier or between customers.

# Supporting policies and initiatives

Different initiatives have been taken at a national and supranational level to support the use of data to strengthen the circular transition. From a governmental level it is possible to develop a standard, a data sharing tool, or support a new market for data driven circular solutions through public procurement.

## **Nordic Smart Government**

- The Nordic Ministers of Business aims at making financial data sharing in near real time more effective via automation of administrative processes in the businesses, such as handling of invoices, bookkeeping, validation of accounting documents, reporting to authorities etc. Currently, focus is on financial information and transactions, but electronic business documents (electronic orders, invoices and receipts) could potentially also include non-financial data, e.g. data on climate footprint of products.

## **Denmark: A green digital standard and open network for data sharing**

- As envisioned by the Nordic Smart Government the Danish government aims to expand the existing digital Peppol-standards for electronic business documents, e.g. the e-catalogues and e-invoices, so they include green and circular product data, e.g. share of recycled material, certified sustainable packaging etc. Businesses would thereby be able to document and showcase the green and circular characteristics of their products and services in a digital and comparative form and help them share product data with relevant stakeholders, e.g. in public procurement, business partners, investors, etc. through an open network (eDelivery).

## **Luxembourg: Product Circularity Datasheet Standard**

- The Ministry of Economy in Luxembourg with consultancy +ImpaKT are piloting an industry standard for value chain data sharing on circularity of products among companies in the EU. Every company upstream in the value chain is filling out a questionnaire with non-sensitive information on product composition (materials and chemicals), design for better use, disassembly and reuse. Companies thereby document to what extent they work with circularity without revealing sensitive data.

## **H2020 project: C-Servees - CE in the Electrical and Electronic (E&E) sector**

- The initiative aims at boosting circular business models in the electrical and electronic sector by developing ICT-tools for secure information exchange through the value chain, with a special focus on washing machines, toner cartridges, telecom products and tv sets/displays. The initiative gathers relevant stakeholders within the sector including larger companies, SMEs, recyclers and research institutions.

## EU Green Deal and Circular Economy Action Plan

### Common European green data spaces

- Green data spaces can build on national initiatives to address sector-specific and green needs. To promote synergies between the data spaces a common framework architecture and cloud services will be established with a focus on data interoperability. An upcoming Data Space Support Center will have a coordinating role in setting up a common reference architecture, and the upcoming European Data Innovation Board will also focus on how to find the data spaces on common standards and interoperability enabling the private and public sector to share and use data within a secure and innovation-friendly environment.

### Digital product passports

- The initiative aims at gathering data on a product and its value chain to support sustainable production and enable the transition to a circular economy by providing new business opportunities and support consumers in making sustainable choices and to allow authorities to verify compliance with legal obligations. The objective is to prepare the ground for a gradual deployment of digital product passports for electronics, batteries and at least one ore sector (construction, textiles and plastics)

### Product Environmental Footprint (PEF) standard

- The intention is to create an EU standard for a simple, less time consuming and less costly life cycle analysis (LCA) aimed at products and used to calculate all environmental effects in a life cycle of a product, service or activity. With PEF implemented, the importance of companies knowing the material composition of their products will increase as will the demand for material and product data, also for documentation and comparisons between products with regard to sustainability.



# Results overview

## Valuable data types in the circular transition

This study sheds light on which types of data that need to be shared among companies to support the transition to circular business models, e.g.

- **Material and traceability data:** Information on product design, material content-, quality and origin, life cycle assessment and environmental and climate impact to inform on a product's suitability to be recirculated, e.g. reused, repaired or remanufactured.
- **Product performance data:** Information on the condition of the products can provide companies with information on how they can continuously maintain and improve the performance of the products, while data on how the product performs on the market can help businesses establish a leasing or buy-back model.

## Barriers

The study describes different barriers that companies experience as obstacles for collecting, using and sharing of data in their circular business models, e.g.

- Lack of data-interoperability
- Lack of data standards
- Low data skills among suppliers
- Lack of trust
- Data sensitivity
- Lack of verified data
- Data collection is resource demanding
- Extent of amendments to standard contracts for data sharing

- Wide dispersion in producers' cyber-security policies
- Over-implementation of GDPR

## Supporting policies and initiatives

A sustainable transformation enabled by data sharing and a well-functioning market for circular solutions are only at an early stage, and there is a role for policy and other initiatives to promote it further. The following examples have been identified:

- Data standards
- Data sharing standard for non-sensitive data
- Legal and technical frameworks
- ICT tools
- Digital product passports
- Open digital infrastructure for non-financial data
- Common EU green/circular data spaces
- Data sharing in public product procurement
- Reporting on sustainability

# Annex

Annex	Content
1.	Overview of selected literature
2.	Overview of data types for circularity
3.	Case studies

# Overview of selected literature



## Data to support circular business development (Technological Institute, 2019, in Danish) - a survey of 500 companies

- Access to external public and private data sources strengthens circular business development
- External data is applied to inform about the characteristics of products and manufacturing processes
- Challenging to get an overview of accessible data regarding e.g. applicability, quality, definitions and collection methods of the data



## Data sharing across the circular value chain (Metabolic, 2019, in Danish) – incl. a mockup tool for data sharing in the manufacturing industry

- Data sharing strengthens circular business development, creates new competition parameters and hinder green washing
- Business sensitive data is a barrier for data sharing
- Resource intensive for businesses to collect and integrate data



## Innovative business models within circular economy (Valuer, 2019) – a global scan

- Circular and data driven business models accounts for a substantial part of new circular business trends (13 out of af 30 cases in a global horizon scan of upcoming circular businesses in 2019)



## The circular economy: Going digital (EPC, 2020) – a European study

- Digitalisation can enable the transition to circular economy
- Data often does not follow materials and products throughout the value chain, which hinders circular business development
- Lack of data-interoperability is a challenge



## Artificial intelligence and circular economy (Google, EMF 2019) – exploring the link between artificial intelligence and the circular economy

- Use of data and AI underpin circular business models e.g. in relation to trial-and-error in design processes, and in relation to consumer behavior when price setting for instance reused or rental products

# Overview of the potential for circularity of different data(sets)

Circular principles	Recycling	Maintenance, repair, refurbishment and reuse	PaaS-models	Documentation regarding sustainability	Sustainable procurement
Material content- and quality (incl. dangerous substances in products and packaging)	●	●	●	●	●
Material origin/traceability				●	●
Product design (e.g. modular-based, seperability)	●	●	●	●	●
Condition on products		●	●	●	
Consumer behavior (preferences, rental frequences, prices, etc.)		●	●	●	
Logistic/transport/storage of materials and products			●	●	
Environmental and climate footprint from products and packaging				●	●

\*) the table is not an exhaustive list of how data can be used for circularity

# Case studies

The case studies are based on 45 to 60 minute interviews performed by the Danish Business Authority in 2020/2021. The case studies were confirmed after the interviews by the companies.

The case studies include information on:

- the circular business model of the company
- the type of data the company uses and shares
- the type of digital tools the company uses,
- the barriers that the company experiences
- the companies' considerations regarding policy and enablers

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# Case study – Lexmark

**About:** Lexmark is a large international company that produces printers and cartridges to businesses and offices all over the world. The company is based in USA and has approximately 8200 employees globally.

**Circular business models:** Lexmark has been working with the transition to a circular business model for several years with take-back models of cartridges in order to reuse, repair, remanufacture or recycle them. Lexmark provides a free pick-up service at their customers' location. Doing so, Lexmark collects more than half of their sold cartridges after use.

**Use of data:** Lexmark uses QR-codes to track the cartridges which gives them an opportunity to benchmark their efforts to improve reuse, remanufacturing and recycling, as the QR code contains customer ID and identify each specific product. In relation to data on materials and products, Lexmark is looking to expand and improve their circular business model by engaging with other companies through sharing data on materials and products. By sharing information with recyclers on material content and quality used in the products Lexmark can receive feedback on how to improve the design for remanufacturing purposes. To address the traditional barriers of information-sharing, Lexmark is engaged in the c-servees project (<https://c-serveesproject.eu>) and works with partners such as the Dutch company Circularise using blockchain solutions.

**Tools:** : A block chain solution makes it possible to share sensitive data by making it possible to share a signature of data instead of the actual data. The signature that is shared contains a statement about the product, which is verified through circularise's application.

**Barriers:** Traditional barriers such as the sensitive nature of data, lack of verification etc. are addressed by using the circularise solution. It is difficult to ask suppliers about data on the material content, especially if it is a small supplier located outside the EU.

**Policy considerations:** The growing trend among governments to require more transparency in the manufacturing of products is helpful. In France, the new circular economy bill (incl. a new reparability index) is an example of the additional expectations that will spread across Europe in the future. This will help push the agenda on product and material transparency and support the circular transition.



## Main focus

- Provider of toner cartridges and printers with take-back schemes for cartridges.
- 60 pct. of collected cartridges are remanufactured, the rest are recycled.

## Use of data

- Material content
- Material origin
- Products' usage-time

## Tools & technology

- QR-codes to track the cartridges
- Blockchain solution

## Barriers

- Collecting data from small suppliers, especially outside EU
- Data sharing on business sensitive information

## Company action

- Use of Blockchain solution to address barrier of sensitive data

## Circular focus

- Extending product life
- Take back
- Refurbishment
- Reuse
- Resell
- Recycling

# Case study – Schneider Electric

**About:** French producer of energy management, automation and software, 135.000+ employees globally, 12.000 service employees and engineers work with extending the life span of products with typical lifespan of 10-40/50 years. Long time experience in working with data communication and LCA to create transparency on material use and environmental impact.

**Circular business models:** An end-to-end circularity approach on all aspects of operations from suppliers to customers. Focus on resource efficiency across the value chain, and new circular business models like reuse, refurbishment, product as a service to extend lifespan of products after installation minimizing costs of customers. Close collaboration with stakeholders across the value chain to perform LCA. 80 % of their product turnover is covered by a Product Environmental Profile (PEP), which is a technical passport based on LCAs following the ISO 14025 and EN15804 standards to assess environmental footprint consistently including detailed information on circularity.

**Sharing of data:** A variety of data is collected and systemized to create traceability of products and materials and enable circularity. All new products are registered following PEP. LCAs are performed based on specific data (company or supplier-owned) combined with generic data e.g. data on use phases, performance, environmental impact, recyclability rate etc.

**Tools:** Business units (including R&D) are responsible for generating data and adding to repositories. All data going into PEP is internally verified before publication. Moreover, PEPs that are certified 'PEP ecoPassport' are verified by an externally accredited verifier.

**Barriers:** Difficult to collect detailed data across suppliers to do LCAs. Data interoperability is challenged by different formats and different use of standards among both suppliers and within the company making it resource intensive to do manual data operations. Suppliers lack data competencies which makes it difficult to communicate and receive the right data. Depending on sector, the progress and degree of advancement is variable.

**Policy considerations:** Common standards and formats would support interoperability. Access to open and free public data and harmonization of methods to assess circularity are needed (the same material should be considered the same way across industries). Make the most out of new technologies to improve data sharing and quality assurance. Both companies and service/data providers need to understand the digital and circular transformation.



## Main focus

- Enhance digitisation of product data and documentation
- Maintaining above 80% the PEP cover of product turnover
- Reinforce data collection from suppliers

## Use of data

- Material content
- Recyclability rate
- Product design
- Environmental footprint, LCA

## Tools & technology

- Internal and external data sharing platform (data verified by PEP)

## Barriers

- Lack of data-interoperability due to different formats/standards makes it tedious to combine data.
- Missing data/IT-skills across the value chain

## Circular focus

- Eco-design
- Refurbishment
- Reuse
- Extending product life
- Renting / Leasing
- Product as a service
- Recycling

# Case study – Michelin

**About:** French company and second largest tire manufacture in the world with an annual 24-billion-euro turnover and 127.000 employees.

**Circular business models:** Twenty years old PaaS-model to enable customers to extract higher value of their tires. Michelin do not sell the tires, but the use of tires, e.g. number of airplane landings/takeouts or number of kilometers in a car/truck. The tires are returned to Michelin after use and sold as second hand, repaired or recycled. Design promotes longer life span of the tires. Reused and recycled materials are used to produce recyclable tires.

**Use of data:** They use data on the performance of tires in their design phase to enhance the lifespan of the tires. They use data to follow the product life of the tire: mounting and demounting etc. They register performance data of tires, although manually and in close distance to the tires. Michelin is at an early stage at developing a sensor system for tires which provides live information on the condition of the tires to get all data about the performance and the identity of the tire.

**Tools:** They have registration tools to identify tires and eventually customers. They use embedded RFID chip in tires which must be in close distance from a reader to extract their unique tire identification and then from a cloud get the associated tire data. In their newly developed sensor system, the tires are connected to the internet where the performance of tires can be shown on dashboards.

**Barriers:** The main barrier is the ability to read the data from the tires which depends on use cases. Segregating tires is often a challenge due to reading distance and signal interactions with other parts.

The market for digitalization in tires is today limited. A larger deployment of RFID tags in tires as key to access to tire data would unlock many opportunities for various stakeholders (OEM, dealers, end of life actors etc.) to gain efficiency and optimize tire operations throughout tire life and ultimately improve consumer experience.

**Policy considerations:** Common standards to determine and document the environmental impact of their products. Country specific safety regulation is a barrier because the same used tires can be legal to reuse as tires in some countries and illegal in others. Some sort of cross-national security policies could ensure the safety of the users of the tires.



## Main focus

- Engaged in producing more durable and less resource demanding tires.
- Offer a PaaS-model related to kilometers driven.

## Use of data

- Material origin
- Product performance
- Product lifespan

## Tools & technology

- Registration tools to identify customers etc.
- ID-chip in tires.
- Dashboards

## Barriers

- Proximity is needed to read the information from ID-chip in the tires (within 20 cm).
- Country specific safety regulation

## Company action

- Developed a system with tire dealers regarding data sharing from RFID-chips

## Circular focus

- Extending product life
- Refurbishment
- Reuse
- Resell
- Product as a service
- Recycling

# Case study – Novo Nordisk

**About:** Novo Nordisk is a Danish pharmaceutical company with ca. 40.000 employees producing insulin and injection pens to customers globally. Their production of injection pens reaches 500 million each year.

**Circular business models:** To reduce the environmental impact of their production, Novo Nordisk has adopted a strategy called 'Circular for Zero' which seek to engage suppliers in reducing their climate impact and embed circular thinking by improving the design of their products to solve 'end-of-life challenges' of devices so materials can be recovered and recycled into new products. Around 90 per cent of Novo Nordisk's environmental footprint occurs in their supply chain. For that reason, it is important for Novo Nordisk to cooperate with their suppliers on how they can lower their footprint. Novo Nordisk is e.g. working to develop an extensive take-back program that collects used injection pens, in order to recycle the plastic from the pens into new products as e.g. chairs.

**Use of data:** Novo Nordisk works to collect data from their suppliers on how they produce their products - both their use of energy and materials; how much power they use, do they have the relevant energy related certificates, and are they located in an area where it is possible to use sustainable energy etc. Next step in Novo Nordisk's circular strategy is to collect more detailed data on the materials that goes into their products and how their suppliers design the products and components. These data are

particularly important, for knowing how to recycle their products.

**Tools:** Excel spreadsheets send via emails is currently used for sharing data with other companies. To enable more effective data sharing they are working on using a cloud-solution for uploading the data, which they want to make available for their suppliers.

**Barriers:** A variety of factors have an impact on the ability to collect data from suppliers. E.g. how digitized the company is and whether they possess the enquired data, how focused the suppliers are on sustainability and if they report on CDP (carbon disclosure project) etc. It is generally more difficult to collect business sensitive data and data from suppliers outside the EU. To address these barriers Novo Nordisk are looking into setting up contractual agreements on data sharing with their suppliers. It is their experience that the procurement process offers a window of opportunity to establish future data sharing. To address barriers related to business sensitive data, Novo Nordisk uses confidentiality contracts.

**Policy considerations:** Increased requirements on reporting from authorities, especially on materials and resources, have the potential of pushing the agenda of sharing data between businesses.



## Main focus

- Zero-emission plan for use of green energy and procurement and designing durable and recyclable products.
- Optimal material utilization and recycling of insulin pens.

## Use of data

- Material content
- Environmental footprint (energy use, emissions etc)

## Tools & technology

- Intentions of using a cloud-solution to share data with suppliers.

## Barriers

- Collecting data from countries with low trust
- Data sharing on business sensitive information

## Company action

- Intentions of setting up contractual agreements on data sharing with suppliers.
- Use of confidentiality contracts

## Circular focus

- Extending product life
- Recycling
- Waste reduction

# Case study – Danone

**About:** Danone is a large international French company with around 100.000 employees in 55 countries. Danone’s products can be categorized into three areas: water, dairy products and non-dairy products, and specialized nutrition.

**Circular business models:** Danone works towards enhancing circularity in different ways. In their water section they focus on use of plastic bottles and are looking into which methods their different business units are using in different countries to see if there are viable solutions that should be globalized. They are also looking into how their new manufacturing site can be more water effective and produce zero waste. Danone is also focused on the packaging, which they seek to design to be reusable, recyclable and compostable. Danone’s goal is for every piece of packaging – from bottle caps to yogurt caps – to be reusable, recyclable, or compostable in 2025. The Danone divisions work with circularity in different ways. To promote reuse, Danone is dependent on the local authorities in the different countries which makes their efforts very localized and separated.

**Use of data:** Danone is seeking to become more data driven and is in the process of creating a common foundation for data analytics across divisions in different sectors. Danone is in the process of creating an overview of the different decentralized approaches to work with data and circularity across divisions and countries. The aim is to make the platform and foundation of analytics and data clear

and accessible for internal stakeholders including creating a better overview of the external datasets that they are using. The data they work with is often sensitive to businesses, as it concerns sales and other competitive factors. They use this data on a global basis in the annual report to report on progress.

**Tools:** The sharing of data between internal divisions and stakeholders is often carried out through exchanging e-mails, Excel spreadsheets and local tooling. Danone now has a comprehensive data & analytics strategy including data storing in the cloud, implementing a global data quality framework and creating accessible data storage.

**Barriers:** The current practice of sharing data through e-mails and spreadsheets makes it challenging for Danone to extract all the value of the data asset Danone has. Danone also experiences traditional barriers such as lack of data culture, use of different data definitions and measurements, and the lack of data quality frameworks.

**Policy considerations:** Danone sees an important role for governments to promote recycling and effective waste management, not necessarily through regulation, but by having good systems in place. Also, governments have a role in educating consumers on what circular economy means.



## Main focus

- Reusable and recyclable plastic packaging
- Aims towards a zero-waste manufacturing site

## Use of data

- Material content
- Recyclability rates
- Operational data

## Tools & technology

- Cloud platform for data sharing with internal stakeholders

## Barriers

- Current practice of sharing data through e-mails and spreadsheets is resource intensive.
- Lack of data culture, interoperability and quality

## Company action

- Access to cloud-platform to store and share data internally

## Circular focus

- Recycling of plastic packaging
- Reuse of packaging
- Waste reduction

# Case study – Lizee

**About:** A French startup for brands and retailers, founded in 2019 having 12 employees. International clients, primarily in fashion and sporting goods industry.

**Circular business models:** Lizee helps retailers and brands in various sectors, like fashion and sporting goods, to kickstart their rental service. They help define the business plan and the handling of the front-end and back-end of the rental flow. The products can be stored in the warehouses accessible via Lizee's global network of connected partners to handle the picking, packing, shipping, returns and refurbishing of the rented products. With the rental model, brands keep the ownership of the products and increase their margins each time when a product is rented out, which encourage to create products that last longer. In addition, Lizee's solution produces data that gives brands the opportunity to get feedback on the product quality helping them to design more durable products and to reduce the need for producing new products.

**Use of data:** Lizee uses a variety of data, e.g. they register damages on returned products in the warehouse and create an overview on the products' lifetime after extensive use as well as weaknesses in the products. They share this data with their clients so they can improve the product design. It is the ambition also to use data on consumer behavior and product design to develop an algorithm that optimizes their clients' rental models and maximize the return on investment (ROI) for their products.

**Tools:** Lizee uses RFID-tags to register and identify each product and to follow the weaknesses of the products over time and evaluate the product design. Retail clients are provided with a dashboard, which visualizes KPI's such as suitability for rental, rental frequency, overall ROI, customer satisfaction and environmental impact of the service.

**Barriers:** Data on product performance and consumer behavior can be business sensitive for Lizee's clients which often have high criteria for data security, especially the large clients. As such, Lizee has invested in competencies for legal evaluation and data security checks, which is costly for a start-up. In addition, Lizee has experienced that entering data-sharing agreements with larger companies, requires a lot of resources, as only half of their clients end up accepting their standard data-sharing contract without making a lot of amendments to the contract.

**Policy considerations:** GDPR regulation can be complex for a young start-up and even more difficult to prove compliance to the strict requirements of larger companies. Lizee would find it helpful if authorities could assist small tech start-ups with guidance and access to legal consultancy on how to deal with GDPR regulation.



## Main focus

- Assisting retailers to set up renting schemes
- Provides reverse logistics services for storage where the products are rented, collected, refurbished and redistributed to consumers.

## Use of data

- Typical damages
- Product durability
- Consumer behaviour
- Data are shared with producers to improve design

## Tools & technology

- Product ID and tracking by RFID-tags
- Dashboard for clients

## Barriers

- Sensitive data on consumer behavior and design.
- High and many demands from large companies on data security.
- Ressource intensive to set up data sharing contracts.

## Company action

- Judicial counselling to establish data sharing contracts and data security checks

## Circular focus

- Reverse logistics
- Refurbishing
- Repair
- Product design
- Longer product life by renting
- Product-as-a-service

# Case study – Continued Fashion

**About:** Young Danish start-up company and platform provider for fashion industry, started in 2017. 4 employees and hiring external help for some tasks. They work with fashion brands (for example Ganni, Wood Wood), package distributors and washing services.

**Circular business models:** They have created a platform to help the fashion industry to rent out fashion clothing. Brands put their products on the platform for customers to rent, book and buy. All purchases made through the platform are registered, so that the consumer can choose to return or sell back the product to the brands.

**Use of data:** Their business model is collecting data about the performance of their products that is sold back to the brands using the platform to be used for improving the business model including designing more durable clothing.

**Tools:** Each piece of clothing has a small chip making it possible to keep track of every product, show who have rented/bought a product and for how long. Performance data are manually registered by the employees when products are returned. Items are priced based on simple qualitative assumptions about willingness to pay, use time etc., but they plan to develop a dynamic, automated price model based on several different factors and use of AI. Moreover, they are thinking about using “data crunching” on the platform to find patterns and connections to improve their business model.

Dashboards are used to show product popularity, lending periods, returning frequency, customer satisfaction and whether customers are spreading the word to others.

**Barriers:** More data are needed, but no other great barriers at this stage of development. GDPR is not an obstacle.

**Policy considerations:** Standards are useful, but many SMEs perceive them as expensive to follow and be officially certified to, although they are meeting the standard requirements. Policy, tools og screening criteria giving SMEs a ‘kind of guaranty’ towards bigger corporation are needed to make it easier for SMEs to comply to strict requirements, charters and standards of bigger companies. Access to external data (origin of products and materials, country specific energy mix) would be of great help. Also, it would be helpful with regulation, standards or guidelines for production of clothes to avoid textile blends and composite products that cannot be sorted for recycling.



## Main focus

- Offer a platform for fashion brands to establish a PaaS-model by renting, selling, buying back and reselling their products.

## Use of data

- Logistics (real time)
- Product condition
- Rent period
- Location
- Data are sold back to the brands

## Tools & technology

- ID-chips to track products
- Manual registration of product condition data
- Intentions to develop a dynamic price setting

## Barriers

- Access to external data is needed for business development
- Standards are perceived as expensive to comply to
- Easy and accessible tools are needed for SMEs to comply to bigger corporation demands
- Better guidance on use of materials in products to avoid material blends

## Circular focus

- Extending product life
- Rent/PaaS
- Buy back
- Repair
- Refurbishment
- Resell

# Case study – Sellalong

**About:** UK platform provider and social enterprise to facilitate sell-back of retailer products. International clients.

**Circular business models:** White label platform for retailers with instant sell-back of sold products for reuse. Customers log in to their retailer’s app or website and can review past 5 years purchases with an instant sell-back price on every item, regardless of condition. On demand, the item is picked up for free, and customers are paid by retailer vouchers. The item is resold or responsibly recycled. Sellalong considers using AI-algorithms to optimize the pricing based on secondary market expectations.

**Use of data:** Product data are used from the retailer’s product database (model, size, color, etc.) and from purchases (time and place of purchase, price etc.) to generate the sell-back prices. Due to GDPR, no personal information/data on customers are used, but each customer has unique tag kept anonymous until the customer decides to sell and wants the product to be picked up. Product data on material content is crucial for recycling or disposal. Data on products that have been sold back (use period, sale price, product condition, patterns of weakness) are sold to clients and manufactures. The data is sold back to clients and producers to improve products and to design rental or subscription schemes.

**Tools:** Interface on retailer’s app or website with customers’ personal account on their purchases offering instant sell-back. Focus on refining check-in

of items using AI and recognition tools and efficient assessment of product condition.

**Barriers:** Main barrier is merging and aligning data in different formats and stored in different databases (product data stored with buyers, marketing data stored with the marketing team and data on material content stored with manufacturers). Baseline product information (e.g. size, color, pictures etc.) is usually easy to collect through simple API’s. Transaction data (who bought what, when) and material content data are difficult to collect, align and share due their proprietary nature and being spread out. It takes resources to “clean” the data. Verification of data is difficult. Retail policies to delete data are sometimes a barrier.

**Policy considerations:** Data is key to circular business models for improving product performance, reuse and recycling. It should be standard practice for the industry’s supply chain to aggregate all material data of products (on products, materials, marketing etc.) supported by regulation and market. Standards are important, but retailer compliance is fluctuant making alignment and data aggregation difficult. More standardization, enforcement and incentives would be helpful. GDPR is not an issue as no revenue or business plan is connected to personal information. Reprocessing and chemical recycling in the textile industry needs more data on material mixes.

## Sellalong

### Main focus

- Sell-back used clothes for reuse.
- Use data to categorize clothes consistently and for price setting of buy and resell, forecast demand

### Use of data

- Material content
- Recyclability rate
- Transaction data
- Product condition
- The data are sold back to producers

### Tools & technology

- Digital platform/app
- AI and recognition tools

### Barriers

- Different formats and databases make it difficult to merge and align.
- Verification of data is difficult

### Company action

- Have developed unique anonymous codes/tags
- 3rd party data verification

### Circular focus

- Extending product life
- Refurbishment
- Reuse
- Sell Back
- Recycling

# Case study – CHEP

**About:** CHEP (UK) is part of the Australian owned Brambles-group. The company is a global provider of supply chain solutions focused on renting pallets and crates for delivery of goods in more than 60 countries with 12,500 employees.

**Circular business models:** During the past 70 years they have developed a 'pooling model', which uses and reuses secondary and tertiary packaging products (primarily pallets, crates, containers and kegs). The pooling model implies that companies lease/rent the necessary pallets etc. they need for delivery, instead of buying them. CHEP do not manufacture the products themselves but has certain technical and environmental criteria for the products. At the end of the supply chain, CHEP collects the pallets and crates and brings them to a service center (somewhere in the world, depending on demand) where they are fully inspected and repaired if needed, so they can be used again.

**Use of data:** A standard contracts is signed with each customer which obligates the customers to share data on the location of the products (pallets) being used. CHEP is very engaged in data use and data sharing as they receive a lot of operational data daily (from customers). Aside from data related specifically to their operations (e.g. destination, distance, quantity, truck capacity usage), CHEP also works with sustainability data (emissions, energy use etc.). To address the issue with lack of common standards for sustainability data, CHEP has bought a saas [software as a service] platform, which they

encourage their suppliers and other stakeholders to use when sharing data with CHEP.

**Tools:** Different data-standards and APIs are used to automatize the process of sharing data with their customers. Blockchain might also be used, but the investment is possibly too big compared to the turnover it would give

**Barriers:** Operational data can be sensitive for their customers, which hinders the sharing of data. A Blockchain solution might accommodate the sensitivity problem but it is too expensive relative to the economic gain it would give. Comprehensive cyber security protocols and a threat of violating GDPR regulation are also barriers for data sharing.

**Policy considerations:** The development of security standards or framework, and access to a neutral third party that could act as a broker and anonymize sensitive data could all help solve the barrier of sharing sensitive logistics data. Common standards and consensus to use the standards could enable the sharing of sustainable data.



A Brambles Company

## Main focus

- Rent out pallets and crates for delivery of primarily fast-moving consumer goods.
- Manage administrative procedure, retrieval and quality assurance of pallets in closed-loop system.

## Use of data

- Operational data (destination, distance, quantity, truck capacity usage etc.)
- Sustainability data (emissions, energy use etc.)

## Tools & technology

- Different data standards
- API

## Barriers

- Operational data can be sensitive for their clients
- Comprehensive cyber security protocols
- GDPR

## Company action

- Considers a Blockchain solution to accommodate sensitive data

## Circular focus

- Sharing
- Renting
- Reuse (pooling system)
- Repair

# Case study – Sourcemap

**About:** Software and service provider for companies to map their supply chain. They help brands and manufacturers track their products back to the material origin and assess suppliers' sustainability, compliance and risk every step in the supply chain. Sourcemap works primarily with manufacturers but works in many different sectors.

**Circular business models:** The supply chain mapping underpins circular business models in two ways. 1) they help companies assert and verify that the materials they are purchasing are actually recycled material. 2) they help companies prove to their customers, that they are actually selling them circular products.

**Use of data:** Materials in products are tracked back to their origin (the mining site) through the many tiers in the value chain. Sourcemap does not collect data on the material content, but are mapping the location of the facilities and sites as well as the qualitative attributes of those sites (e.g. whether they are certified, what are their carbon footprint etc.) They also collect transaction data, which helps them track and verify the origin of products/materials.

Due to data sensitivity a decentralized approach is applied, where data only can be shared between the supplier and the customer - not from supplier to supplier. As a result, Sourcemap can only reference data from one customer to another with the explicit permission of both parties.

**Tools:** To address possible lack of data competencies in the value chain, an online portal is used where suppliers can upload data in different formats e.g. in spreadsheets. The software is often made available to the suppliers by the manufacturer that Sourcemap works for. Data is shared using cloud-solutions.

**Barriers:** Tracing recycled material can be difficult because there is often not a database on where the raw material comes from. Moreover, many industries are still building the original data, meaning starting to collect and organizing structured data, and often they only do so, when they have a request from a customer.

**Policy considerations:** There is a big potential in public procurement, where government requires supply chain transparency which can be a big driver for circular economy and transparency. There is a great potential of government acting as a pre-competitive actor that maps and underpins optimization of supply chains. E.g. data on industrial byproducts can be mapped to identify and facilitate reuse and industrial symbiosis. Supply chain transparency should be mandatory, with disclosing material origin as a first step.



## Main focus

- To help clients across sectors with tracing materials back to the material origin and assess supplier's sustainability and risk.

## Use of data

- The location of supplier sites. Qualitative attributes (certificates) at supplier-sites. Transaction data

## Tools & technology

- Cloud-solutions
- Online portal for upload of data.

## Barriers

- In many industries data are not collected organized and structured.

## Company action

- The online portal makes it possible to upload data in different formats.

## Circular focus

- Verifying purchase of recycled material from client's suppliers
- Helping clients with documentation of circularity

# Case study – Circularise

**About:** The company started as a spin-off university project. They offer a data sharing platform with the opportunity to share information on products and materials without sharing sensitive data by keeping business-critical information decentralized and ensure trust and reliability of information shared. In the beginning the focus was on electronics but they have mostly worked with plastics industry, including a major collaboration with Domo and Covestro. Since 2018, Circularise has had a steady growth, today nine employees and will be hiring three more. Clients come from all over the world, but mostly Europe.

**Circular business models:** Assisting companies to share information without sharing sensitive data on products along the value chain to promote reuse, remanufacturing and recycling.

**Use of data:** Circularise mostly works with data around the material, the process and how the product is manufactured. Data can be added in two ways. 1) data accessible for certain parties, 2) data that are sensible where only a signature of the data is shared and verified by a third-party auditor. Circularise works with list of questions and answers. A company can ask about anything and another company can give any kind of answer. Anyone can come up with relevant questions and the use can then accept these questions, e.g. recycling companies ask questions about material composition, while fashion brands ask questions about the process like use of child labor.

**Tools:** Using an open blockchain technology (Ethereum), QR code scanning and smart questioning to ensure that critical information is not shared but at the same time containing enough information to answer a number of selected questions and details. In addition, the blockchain contains information on who can ask which questions, as well as who can answer them.

**Barriers:** GDPR can be a barrier for using blockchain.

**Policy considerations:** Mandatory reporting will help more companies to share data. Governments can play a big role in defining the minimum level of transparency or the minimum level of data that companies need to share. Guidance on auditors and schemes and how to use them are needed, e.g. in the plastic industry there are at least 3 or 4 large schemes. More certifications are needed.



## Main focus

- Offer a blockchain solution with smart questioning technics to enable reliable data sharing along the value chain
- Mostly working with the plastic industry

## Use of data

- Material and product data
- Signature data

## Tools & technology

- Blockchain
- Smart questioning technic
- QR codes

## Barriers

- GDPR
- Sensitivity of data

## Company action

- Smart questioning technics to enable sharing of information without sharing sensitive data

## Circular focus

- Transparent value chains
- Reuse
- Remanufacturing
- Recycling

# Case study – Circular IQ

**About:** Circular IQ is a Dutch software company with 9 employees. They generate dashboards and reports that fuel conversations and support decision-making. Circular IQ's software platform is used by both private and public organizations in over 75 countries.

**Circular business models:** Circular IQ offers three different programs through its platform. 1) Circular procurement program - a program to measure the circular performance of what you buy. 2) Product circularity improvement program - Provides in-depth and data-backed insights for the biggest circularity and eco impact improvements on a product-level. 3) CTI tool to measure circularity made for businesses and developed by over 25 global companies, supported by the WBCSD (World Business Council for Sustainable Development). The software is used to measure and improve circular performance in line with the CTI Framework.

**Use of data:** All three programs are aimed to help business and governments' collect material and product-information, make the data more reliable, better available, comparable and complete to enable decision making and reporting on circular performance and impact. Where no specific data is available Circular IQ uses reference data. To make sure that the collected data is reliable, Circular IQ has developed an audit protocol together with Lloyd's Register (LRQA). Through this protocol auditors can verify the extent to which data in the platform aligns with physical product characteristics

and/or is substantiated by invoices and or other evidence. Suppliers also sign Supplier Declarations of Conformity.

**Tools:** Circular IQ's platform helps collect, process and visualize data to improve decision making, prioritizing improvement efforts and (progress) reporting. They present the results in dashboards and product passports, working with multiple standards e.g. CTI.

**Barriers:** There are two important factors when collecting relevant data from suppliers – timing and relationship. When a company or an organization asks their suppliers to share data, it is much easier if they ask during a procurement process. Otherwise, the suppliers' incentive to share and/or collect data from sub-suppliers are low. The relationship with the suppliers is important, because data concerning products and materials can often be perceived as sensitive.

**Policy considerations:** Specific data on product unit level is ideal, but generic data on categories of materials/products are also important to overcome the current challenge of exchanging data on an individual product level. Databases can be a good start and create awareness on the importance of what type of information is needed and help businesses become accustomed to using data.



## Main focus

- Materials accounting and reporting software for the circular economy, assessment of supply chain and environmental footprint

## Use of data

- Material content
- Product composition data (e.g. connections)
- Bill of materials data
- Energy & Carbon

## Tools & technology

- Indicators
- Analytical software
- Dashboard
- Product passport

## Barriers

- Supplier incentive to share data
- Availability of data

## Company action

- Use of external generic data on performance and impact of different materials and products

## Circular focus

- Measure and improve circular performance
- Assessment of supply chain
- Quantifying environmental impact
- Report impact

# Case study – Topolytics

**About:** Topolytics is a Scottish data and analytics business in the industrial- and commercial waste sector.

**Circular business models:** Topolytics helps industrial companies to digitally track and monitor solid waste and effluent or air emissions from industrial and commercial activity to underpin recycling. They help the companies make use of waste stream data and identify areas of improvement, e.g. possibilities of waste reduction, recycling or remanufacturing of the materials. Moreover, they help waste managers get an overview of waste streams through a digital live map which provides information on where the waste is generated and where it is sent to disposal, recycling or reprocessing.

**Use of data:** Many different data are used depending on what is available, e.g. from bin-sensor and satellite data and what they receive from their clients, e.g. an industrial company or a recycling company. They connect the data with public databases and work a lot with qualifying, normalizing, cleaning and understanding the quality of the available data.

**Tools:** Data are used and combined across many different data formats collected from Excels spreadsheets, bin-sensors, satellites, or other sophisticated software etc. They verify data using many different sources, machine learning and data science to measure the waste streams. The estimate has a certain statistical uncertainty, but Topolytics seeks

to be transparent towards their clients on their data collection and calculations. The data are visualized on digital maps. They use data sharing agreements if their clients find it necessary.

**Barriers:** Digital registration of waste is mandatory in UK, but the quality of public available data (for instance how often the data is updated) and the data formats varies a lot, which can make it difficult to make precise estimates of the waste streams.

**Policy considerations:** The Extended producer responsibility (EPR) schemes from EU is putting more focus on waste streams and recycling and recycling, but the EPR is applied in different ways in different jurisdictions. Plastic has for instance received a lot of focus opposite to other types of materials. The EPR should be applied on all types of materials.



## Main focus

- Consulting on waste management helping to reduce waste, recycling, remanufacturing, identify efficiencies, enhance reporting etc.

## Use of data

- All sorts of data depending on what they receive from clients and what is publicly available

## Tools & technology

- Machine learning and data science.
- Digital live maps.
- Data sharing agreements

## Barriers

- Lack of quality in publicly available data like low frequency in updating data and variable data formats

## Company action

- They use data science to verify and merge data from many different sources that has varying quality.

## Circular focus

- Extending product life
- Reuse
- Recycling

# Case study – Kabadiwalla Connect

**About:** The company has existed for 5 years and have now 9 employees. It is a for-profit social enterprise based in Chennai, India with main focus on engaging with the existing infrastructure of the informal sector of cities in India and Indonesia to promote an effective collection of solid municipal waste, mostly within plastics, for recycling using digital tools for data collection, analysis and visualisation.

**Circular business models:** Offering assessments and visualisation of city waste stream in flow maps as baseline to underpin a more effective collection of waste for recycling by engaging with the informal sector in India and Indonesia.

**Use of data:** Data is collected to map the supply chain of waste streams and visualize a traceable waste collection in the city incl. identifying how waste is collected street by street by small waste pickers, the location of small and large scrap shops and how they operate, which types of materials they collect etc. and how it is sold to the waste processors. Flow maps like Sankey diagrams are used to create a baseline for the implementation of an effective and traceable waste collection scheme. Data is their business model and not shared with others.

**Tools:** They use ID cards to validate the waste pickers, point of sale devices and blue tooth scales in the scrap shops and to a certain extent also IoT sensors in waste bins to collect data on the different

materials in the waste stream. The data is made accessible through an app, where materials and their origin can be tracked for every neighborhood in the city.

**Barriers:** The greatest challenge is to understand how to engage with the informal sector the best way, by understanding its social capacity, the infrastructure and the important social role it plays in the municipality.

**Policy considerations:** Standards are important but also needs to be reviewed and re-designed to better suit their purpose. Certification of waste processors and traceability of waste materials are also important.



## Main focus

- Promotes an effective collection of solid municipal waste, mostly within plastics, for recycling by using digital tools for data collection, analysis and visualisation.

## Use of data

- Waste streams in cities at all levels; street, small and large scrap shops and waste processors.

## Tools & technology

- Personal ID cards
- Point of sale devices
- Blue tooth scales
- IoT sensors in waste bins
- App

## Barriers

- Understanding the informal sector incl. its social capacity, the infrastructure and social role.

## Company action

- Engaging with the informal sector through different pilots and competence building projects

## Circular focus

- Collection of city waste
- Recycling of waste

