Enhancing WEEE management using the Digital Circular Thread

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The problem

- On average, most of the EU member states achieved a 45 % collection rate[1], which however is far from the target for collection rate set by the 2019 WEEE directive.

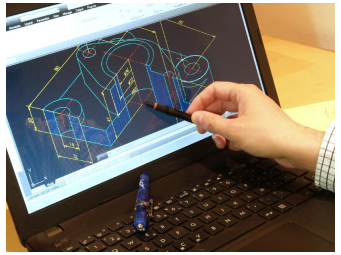
- Where WEEE is properly collected and enters recycling streams, a significant part of easily separated metals such as gold and copper are recovered via recycling, yet many others have very low rates of recycling, especially critical raw materials.

- In this context, the transition from linear consumption models to a Circular Economy with closed material loops and minimum resource use seems to be of especial relevance.

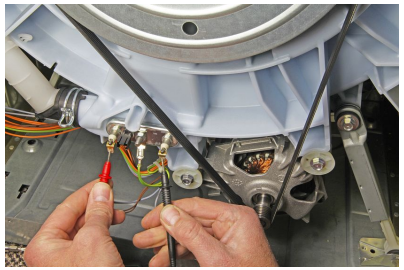
- In particular for the WEEE management value chain, the enhancement of CE strategies such as reuse, repair and recycling can greatly extend the lifespan of products and utilisation of materials, closing materials loops thus reducing waste generation.

[1] European Commission. Eurostat Database, Waste data. https://ec.europa.eu/eurostat/web/waste/data/database

The challenge: enable the Digital Circular Economy






Make information exchanges possible for decision support:

- From design to manufacturing
- From transit/retail to OEM
- From OEM to retailers
- From OEM to users
- From OEM to users/repair
- From users/repair to OEM
- From repair to users
- From users to collectors
- From OEM to collectors / recyclers
- From collectors to recyclers

The challenge: enable the Digital Circular Economy

To **link useful product information across its lifecycle**: from the supply chain, OEM, to retail, to re-use, repair, disassembly, recycling and secondary raw material inputs back into the supply chain – **to form a Circular Digital Thread for individual products.**

What is needed?

- A physical-digital tracing log to the product (QR-codes ideally laser embedded + digital ID).
- A product log that is maintained with key info at each product life cycle stage.
- A way to identify, standardise and exchange product/component and use information.
- A product meta-data catalogue that shows what information is available (and who has it).
- A permissions approach for exchanges with trusted information users (data contracts).

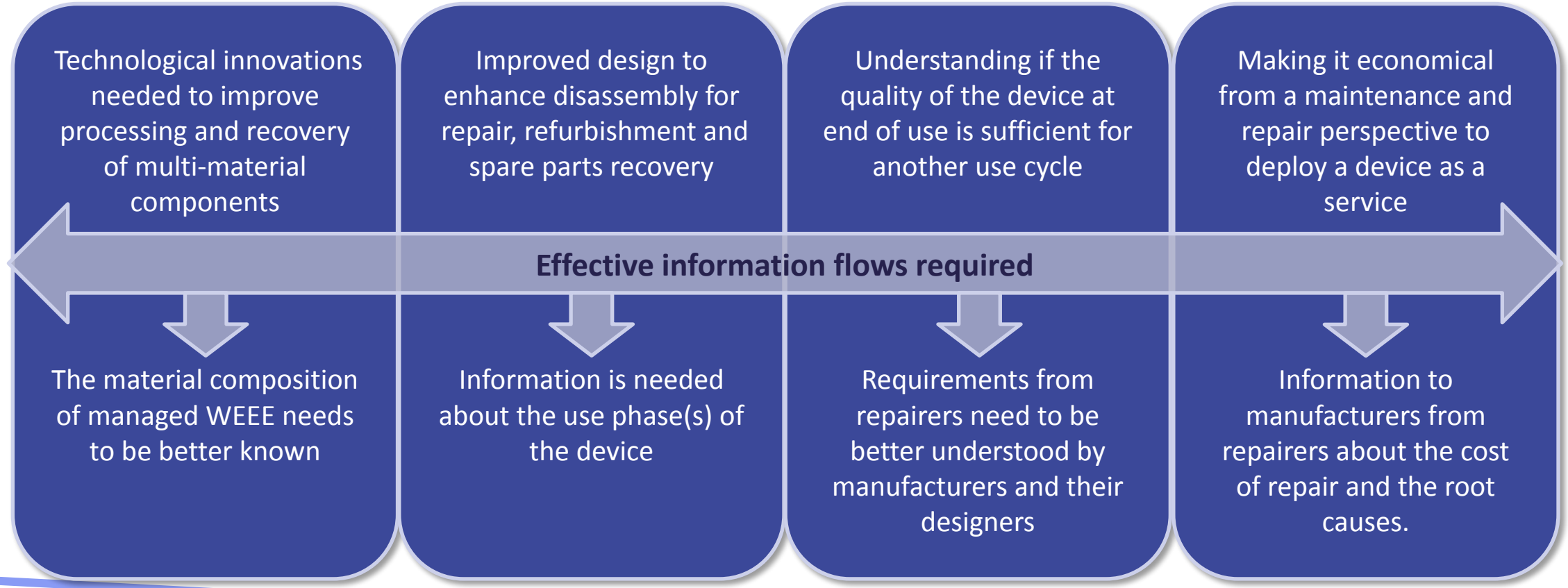
The Circular Digital Thread

Key mechanisms are needed for this to be achieved:

- Sufficient benefits from circular Economy decision services to make the efforts worthwhile for a company to deploy a local the platform.
- For the data owner/provider(s) (such as a manufacturer) to have full control on its data.
- For the platform to become a broker, not a 'hoarder' of data (no data lakes).
- For the data owner/provider(s) to be able to decide who they do and do not share their data with.

The specific need for a Circular Digital Thread for EEE and WEEE management

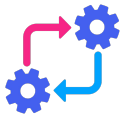
- Why a Circular Digital Thread for EEE and WEEE management?



The specific need for a Circular Digital Thread for EEE and WEEE management

Creating a digital identity of the product and linking all parties across the life cycle

Making it possible to link information from the manufacturer to the ‘Product Digital Identity’



Enabling repair companies to recover as many parts as possible from used appliances

Empowering collectors to decide what is best for used appliances: reuse, remanufacturing or recycling loops

Making a continuous improvement planning process for product lifespan extension

Making it easier to know what chemicals and critical raw materials are in products for recycling purposes

Empowering citizens to make better purchasing and use decisions for repair and lifespan

7 uses cases under study

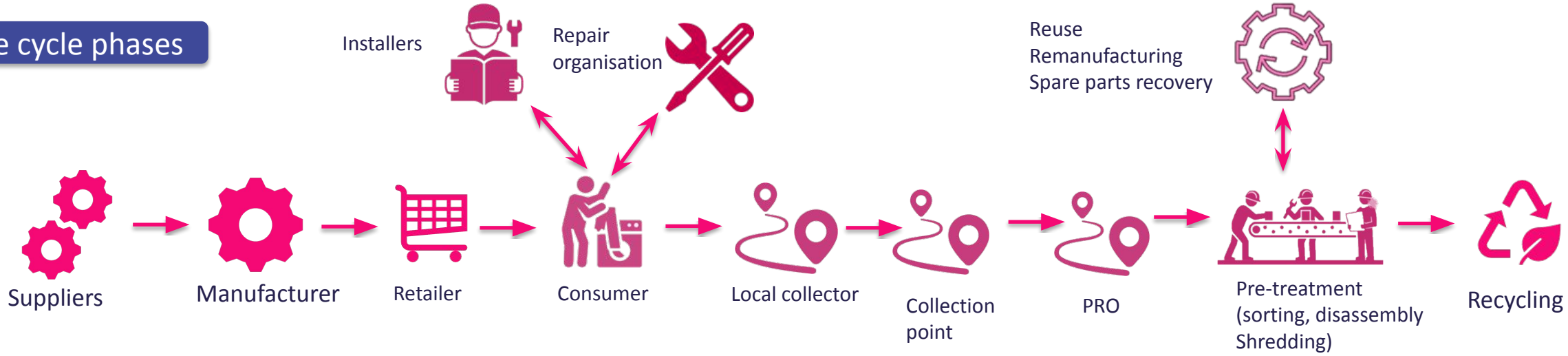
Use case 3: In-transit and after-market spare parts recovery

Concept

- The capture of information about the quality of products that are either damaged in-transit or during use and collected, to assess their potential for spare parts recovery for purposes of repair, refurbishment or remanufacturing.
- Many products at end of use or end of life contain components that are re-usable. The need for recovery of these parts for repair has grown substantially with the introduction of right to repair legislation creating a baseline economic driver.
- This will reduce the number of discarded parts that end-up as WEEE, while at the same time optimizing the collection/recovery process and allowing for new business models.

Use case 3: In-transit and after-market spare parts recovery

Life cycle phases



Linked technical information

DPP - product series linked info
- Material composition extract
- Priority parts for recovery
- Disassembly manual
- Disassembly effort
- Components with special depollution needs

Product value estimations (internal)
- Spare parts recovery value
- Reuse value
- Recycling value

Product disassembly log
Disassembly effort log
Spare parts identifier

PRO benefits

Identification of products at end of use **that contain X number of** spare parts desired by manufacturer

Identification of residual value of product by PRO after collection based on efforts vs price for spare parts, reuse, recycling, using materials/components/ disassembly information

Enhanced value for manufacturers (spare parts recovery), for pre-treatment operators (reduced efforts)

Use case 3: In-transit and after-market spare parts recovery

Information flow

- First, understanding the initial need for components in a used device, secondly, understanding how to retrieve the components in a disassembly process, and thirdly, the quality of the component(s) for re-use.
- Once this information is generated and linked to a product information record, it can be linked to the individual product using a product tag such as a QR code for on-the spot checks to sort products with and without components in demand for recovery.
- The collector can then advance sorting. In the next stage the recovery operator, can benefit from exchanging information on the disassembly steps to recover the components.
- Finally, the component, once recovered, will need to be assessed on its quality for re-use. To this end an examination and/or testing procedure needs to be put in place prior to shipping the component.

Use case 3: In-transit and after-market spare parts recovery

Benefits and potential applications

- In this context, enabling an effective flow of information across the actors involved the end-of-use optimize the recovery of useful components to be used as spare parts will have a positive impact from the perspective of circularity.
- Improved traceability will increase the knowledge about incoming materials and components resulting in a better decision-making process along the value chain. As a result, circular strategies could be implemented from the design stage for new products and as part of the optimization of the use of secondary components and raw materials,
- This flow of information has the potential to unlock new collaborative business models. Additionally, enhanced access to lower cost, higher quality spare parts will make it easier for the appliances to stay longer in use, extending their useful life and reducing the demand for new appliances.

Use case 4: Product end-of-use recommendations

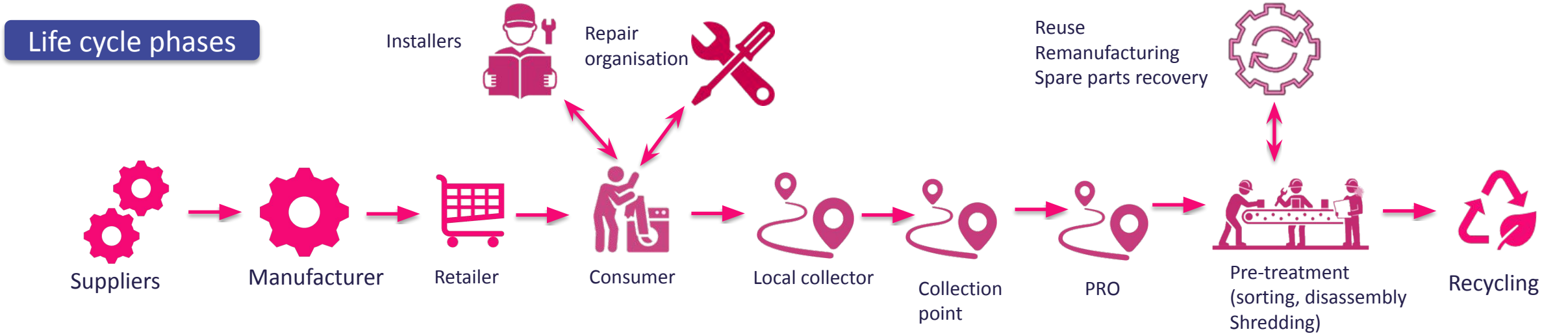
Concept

- The aim of the use case is to unlock different circularity routes at a product level (incl. re-use, remanufacturing and recycling) from a reverse logistics perspective, based on end of use circularity recommendations when a device is no longer wanted by a consumer and put out for collection or donated.

- The enhancement information for collectors and Producer Responsibility Organisations (PRO's) to enable a quick-scan of a device upon collection or processing, to understand the potentials for recycling, re-use or repair, so as to improve decision making.

- At present the routes for collected WEEE are primarily to collect and direct to the most economic recycling facilities, with differentiation resulting from the cost of processing and the technical process capabilities. To improve the possibilities for re-use, recycling and component recovery, take-back collectors and waste-management companies require improved product and component information.

Use case 4: Product end-of-use recommendations



Information exchanges for End of use decisions

- Production year
- Product lifespan
- Product disassemblability
- Product repairability
- Product durability
- Product recyclability

- Product usage
- Maintenance log
- Repair log

- Product end-of-use decision log
- (prepare for reuse, recycling, spare parts recovery, remanufacturing)

- Product disassembly log
- Disassembly effort log

- Materials batch recycling performance log

- Product to materials batch with sales ID.
- Materials batch composition/grading log

PRO benefits

- **Ability to check the age of the product at collection vs minimum lifespan information & durability indicators**
- **Ability to check the ease of repair, recycling, remanufacturing, spare parts recovery**
- **Ability to reduce the costs of extended producer responsibility**

Use case 4: Product end-of-use recommendations

Information flow

- Collection companies and producer responsibility organisations will need information about individually collected devices, both on-the-spot and as part of the reverse logistics process.
- Examples include age, usage cycle and product status information from the user of the device, and product level information to signal if there are desired spare parts in the product from the manufacturer and/or repair company. Also, information on material composition from manufacturers and enhanced safety information.
- Information from the consumer/user of the appliance during use and at the end of its useful life, and how best to manage this information also from a privacy perspective, to enhance end of use recommendations.
- The information will be paired with economic, environmental and logistic evaluations, per product, so as to ensure the approach also works from both business and environmental perspectives.

Use case 4: Product end-of-use recommendations

Benefits and potential applications

- The potential circular economy benefits can be split into the impacts of traceability on the increase of WEEE entering recycling chains, the possibilities to recycling more WEEE that enters these processes, the impacts of component recovery on life-span extension through repair and refurbishment, as well as the possibilities for remanufacturing and therefore replacement of virgin components.

- The potentials are influenced by:
  - How traceability combined with digital product passports enhances WEEE entering well managed collection routes;
  - How enhanced product information increases the economics thereby improving the value added both by recovering more from WEEE and by improving the purity of sold secondary raw materials;
  - The degree to which repair and remanufacturing becomes standardised.

Conclusion

- The study and delivery of tools for achieving a circular economy has focused on a wide range of areas including: circular business models, engineering and design principles, performance measurement indicators, standards for enhanced WEEE management such as prepare for reuse.

- The deployment of is largely hindered by the absence of information needed for decision making to unlock and enhance all circular economy strategies. Significant digital development efforts are critical in the next phase to achieve a circular economy

- Two specific use cases were outlined for spare parts recovery and end of use circular economy recommendations, and how they enhance the current situation including describing what circular economy benefits they can provide for.

- Recommendations for further work include examinations of what specific product information is needed, how it fits within the operational process of organisations and how the digital systems need to be orchestrated and who needs to be involved.

Thank you for your attention

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