# CIRCULAR DESIGN FORUM

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# Repair
# Knowledge stream

Session report out. June 27th 2023

**Hosted by** Accenture, Microsoft, Logitech, Philips

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# The Team

Sustainable
Design Engineering
consultant

Francesco De Fazio

Accenture Industry X
Industrial Design

Director of NPI
Design for Repair

Jason Brown

Microsoft
Devices

Sr. Sustainability
Engineering Scientist

Yi-Hsieh Wang

Logitech
CP&G

Sustainability Engineering
Program Manager

Kevin Sheridan

Logitech
CP&G

Circular Product Design
consultant

Sharina Ligtelijn

Philips
Engineering Solutions

Sustainability Engineer

Lotte Fonteijne

Philips
Grooming & Beauty

# Goals of this session

## The goal

In this Knowledge session we tackled and discussed in detail different aspect of repair: repair scoring system, Business and consumer incentives, design approaches and traceability.

The goal was to bring together a diverse group of organizations, to share different point of views and way of working to tackle the similar challenges and opportunities. Based on the discussions that took place during the session, we believe that this goal was achieve. The key learnings have been synthetized in this report.

## The impact

Repair is a complex, but essential strategy to enable a circular economy and a more sustainable consumption. Repair does not only contribute to product's longevity, hence determining a positive impact on the environment. It can also promote fairer and future proof economy and society. Learning how others are addressing the same challenges in a different way can spark innovation and collaboration. Hopefully, the insights shared and captured in this report can help to expand people knowledge on the topic and speed up a systemic transition towards more sustainable solutions.

# Session setup

In this first sharing session, we addressed four key topics related to repair.

Four expert organizations from the academic, manufacturing and scale up fields, shared their key learnings. Each presentation was followed up by a plenary discussion, where the entire audience was involved.


### Repair scoring systems

TU Delft compared different scoring systems and identify the most relevant parameters to properly describe ease of repair.

### Design approaches

Different approaches to design repairable product, from a Nokia mid price range smartphone to high end Bang & Olufsen audio system

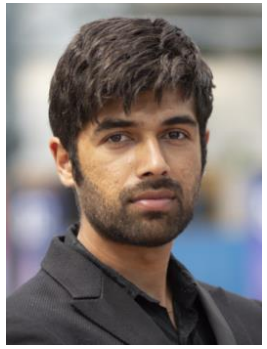
### Incentives around product longevity

The incentives that are driving Framework circular business model and system, based on modularity.

### Traceability and its relevance for repair

What is the digital product passport and how it can help to successfully implement and track ‘Reduce, Reuse, and Recycle’ strategies with industry examples from Circularise.

# Repair scoring systems



Sagar Dangal
PhD researcher, TU Delft

There are more and more scoring and labelling systems coming up at EU level and worldwide. Although this is a great sign that regulatory organizations are starting to take the topic of repair seriously, having different assessment systems can create confusion.

Sagar presented the key insights learnt during his latest research work, where he and his team applied different scoring systems to the same type of products and compared similarities and differences in results, and identified which parameters describe repair in the most reliable way.

# Repair scoring systems

Repair scoring systems are important to increase consumer awareness, introduce new regulations and bring more transparency to consumers. Of course, scoring systems alone are not sufficient to push consumers to repair their products.

As part of the EU funded PROMPT program, Sagar evaluated different repair scoring systems which have been introduced in Europe in the past few years. This was done by asking to different testing bodies to assess the same product using:

- French Repair Index (FRI)
- Joint research center (JRC) scoring system for smartphones and tables (now implemented in the Ecodesign directive)
- iFixit scoring system

While all scoring systems tackle ease of disassembly and spare parts availability, sparts availability parts is only considered by FRI. On the other hand, only JRC consider software related aspects.

Different scoring systems assessed

| Critera | FRI | | | | | JRC | | | | | Ifixit | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sub criteria | Smartphone | | Vaccum cleaner | | Sub criteria | Smartphone | | Vaccum cleaner | | Sub criteria | Smartphones | | |
| | | weight | total criteria weight | Weight | total criteria weight | | weight | total criteria weight | Weight | total criteria weight | | Weight | total criteria weight |
| **Ease of Disassembly** | Disassembly step | 10% | | 10% | | Disassembly step | 25% | | 18% | | Disassembly time | 21% | |
| | tools required | 5% | **20%** | 5% | **20%** | tools required | 15% | **55%** | 18% | **55%** | Path of entry | 21% | **55%** |
| | Fastners type | 5% | | 5% | | Fastners type | 15% | | 18% | | Tools required | 13% | |
| **Informaiton availability** | Type of information (REP, CON) | 20% | | 20% | | Type and cost of information (PRO, CON) | 15% | | 18% | | Availability of repair information | 13% | |
| | Information on update type | 10% | **35%** | - | **40%** | - | - | **15%** | - | **18%** | Visual cues | 4% | **17%** |
| | Remote assistance availability (REP, CON) | 5% | | 20% | | - | - | | - | | - | - | |
| **Spare part availability** | availability over time (PRO, RET, REP, CON) | 15% | | 15% | | availability over time | - | | 9% | | Availabiltiy over time | 5% | |
| | Delivery time (PRO, RET, REP, CON) | 5% | **20%** | 5% | **20%** | who is spare part available to | 15% | **15%** | 9% | **18%** | Who is spare part available to | 17% | **21%** |
| **Spare part price** | Ratio between part and product price | 20% | **20%** | 20% | **20%** | - | - | | - | | - | - | - |
| **Software aspects** | Software reset (PRO,REP, CON) | 5% | | - | - | availability over time | 15% | | 4.5% | | - | - | - |
| | - | - | **5%** | - | - | Free avaiablity of update | - | **15%** | 4.5% | **9%** | | | |
| **Health and saftey** | - | - | | - | | - | - | - | - | - | Tools risk | 2% | |
| | | | | | | | - | - | | - | Puncture risk | 2% | **4%** |
| **Repair endorsement** | - | - | | - | | - | - | - | - | - | Repair allowed by | 4% | **4%** |

# Repair scoring systems

Sagar's team assessed these scoring systems based on

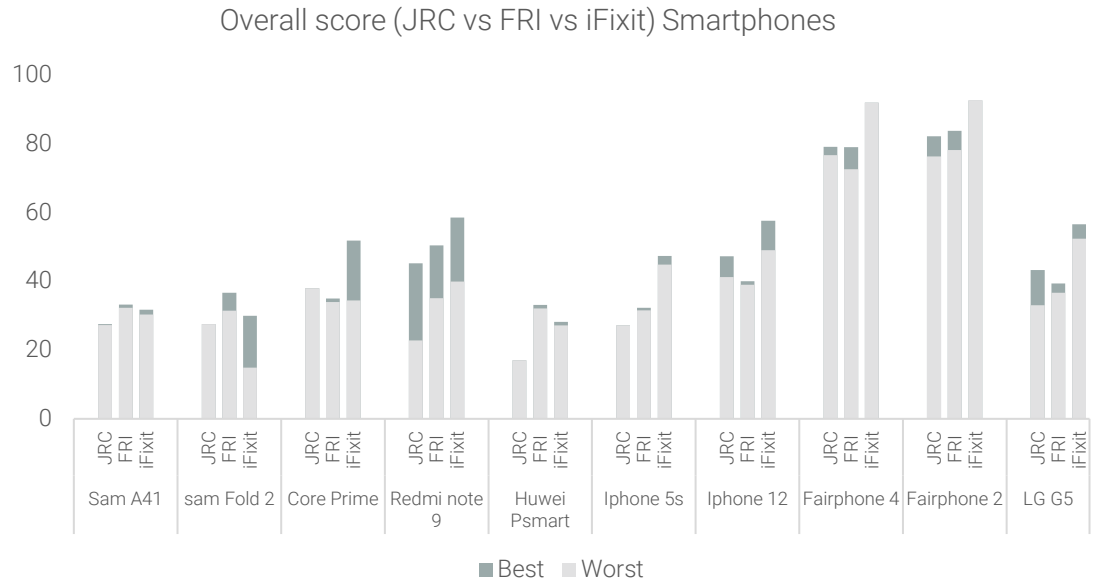
- **Reliability**: is the scoring system objective and are results from different testing bodies comparable?
- **Viability**: does the score reflect the actual ease of repair?

## Reliability

All assessment system showed a big level on uncertainties (important variations in the score calculated by different bodies for the same product). The key reasons identified are:

- Level of bundling: different manufactures bundle parts in different ways. While in some products single parts can be independently disassembled, in others they might be bundled in one single replaceable unit
- Breakable connectors: while some connectors might not break if unfastened very carefully, this might not always describe a real scenario, where improper force might be applied
- Spare parts availability and price: parts availability and cost vary from region to region and over time.

Uncertainties in assessing the same product




Example of bundling: both PCB and motor are electronics parts. But in this case, they are glued together.

# Repair scoring systems

## Viability

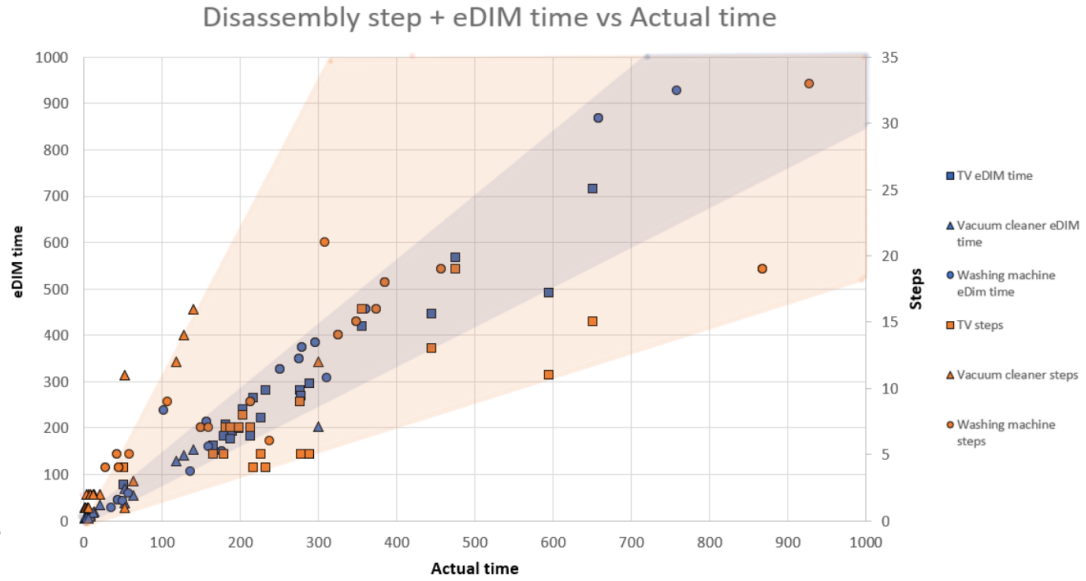
Sagar's team used actual disassembly time, measured using a stopwatch, as a parameter to check the viability of measuring ease of disassembly using number of steps, which is the main parameter used by most scoring systems. His research shows that disassembly steps don't reliably reflect the actual time, hence effort, required to repair a product, and that other tools, like the eDiM, created by the JRC, are more reliable ways of measuring ease of disassembly.

Additionally, Sagar also pointed out that there are two parameters that should be a minimum requirement: spare parts availability and disassembly of priority parts. However, in all scoring systems, it is possible to achieve above 8/10 if everything is perfect, but there are no spare parts. Of course, this does not make sense, since without spare parts, repair cannot happen.

## Proposed solution: Prompt scoring system

PROMPT proposed a new scoring system where they propose parameters that if are scored under a certain level, they would heavily impact the final score, independently by how much the other parameters are scored.

Discrepancy between disassembly steps and actual disassembly time




Prompt scoring system

| Criteria | Weight (WM) | Weight (VC) | Weight (TV) | Weight (SP) | Sub criteria | Weight (WM) | Weight (VC) | Weight (TV) | Weight (SP) |
|---|---|---|---|---|---|---|---|---|---|
| Repair information | 10% | 10% | 10% | 10% | Step by step repair guide (including disassembly) (Manual or Video) | 80% | 80% | 80% | 80% |
| | | | | | Presence of part code | 20% | 20% | 20% | 20% |
| Diagnosis | 10% | 10% | 10% | 10% | Error message indication | 64% | 64% | 64% | 64% |
| | | | | | Diagnosis troubleshooting manual | 18% | 18% | 18% | 18% |
| | | | | | Additional diagnosis tools/software | 18% | 18% | 18% | 18% |
| Disassembly Assessment | 65% | 65% | 65% | 65% | Disassembly time | 85% | 85% | 85% | 85% |
| | | | | | Safety Risk | 5% | 5% | 5% | 5% |
| | | | | | Tool Required | 5% | 5% | 5% | 5% |
| | | | | | Fastener type | 5% | 5% | 5% | 5% |
| Spare part and repair cost (LF) | 15% | 15% | 15% | 15% | Spare parts costs | 50% | 50% | 50% | 50% |
| | | | | | OEM repair cost | 20% | 20% | 20% | 20% |
| | | | | | Period of availability | 30% | 30% | 30% | 30% |

| Criteria | Weight (WM) | Weight (VC) | Weight (TV) | Weight (SP) | Sub criteria | Weight (WM) | Weight (VC) | Weight (TV) | Weight (SP) |
|---|---|---|---|---|---|---|---|---|---|
| Software aspects | Reliability 3% | Reliability 0% | Reliability 14% | Reliability 7% | Security and Functionality updates | 100% | 0% | 100% | 65% |
| | | | | | Software-based prevention of repair | 0% | 0% | 0% | 25% |
| | | | | | Reset to factory settings | 0% | 0% | 0% | 10% |
| Maintenance | Reliability (27%) | Reliability (20%) | Reliability 6% | Reliability 3% | Maintenance Indication | 20% | 20% | 5% | 60% |
| | | | | | Maintenance instructions | 60% | 60% | 5% | 20% |
| | | | | | Ease of maintenance | 20% | 20% | 15% | 20% |

# Repair scoring systems

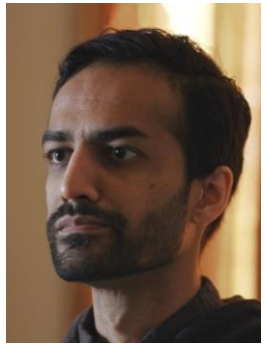
**Insights from the plenary discussion**

Consumers are more inclined to repair their products if the total cost of repair is below 30% of the cost of a new product.

The use of a diagnostic tree can aid in analyzing and identifying issues during the repair process.

Tools like Error Mode Indication and Failure Diagnostics Information Manual can be utilized to support the diagnostic and troubleshooting efforts.

# Aligning incentives around product longevity



Nirav Patel
Founder and CEO, Framework

framework

Designing a product for repair is often not the main challenge; the key challenges is aligning consumer and business incentives, by creating a repairable product and a successful business model.

Nirav presented about how Framework managed to make product modularity, repair and longevity an appealing proposition for consumers and a successful business proposition for their company.

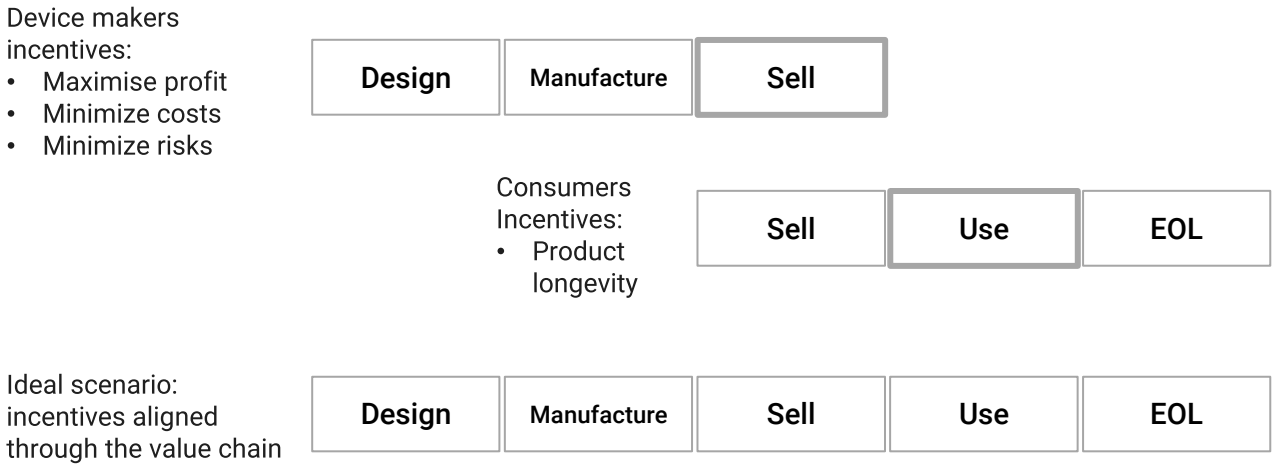
# Aligning incentives around product longevity

Nirav explained that often times, the real challenge of repair is not design or technology, but aligning incentives for user and business. It is often difficult for businesses to feel confident that having repairable and long-lasting products can be a successful business proposition.

The key reason why incentives are often misaligned is that the key incentives for a business are more upstream focused (design, manufacture, sell), while users and environment incentives are more downstream related (sell, use and EoL). The key for success is to find a way to align business and user incentives. Framework decided to focus on longevity (use phase) to make this happen.

Key factors that Framework leveraged to align incentives around longevity are:

- Regulation: making your proposition ready for future regulation
- Demand: growing consumers and company interest in longer lasting product (because of sustainability and investment)
- Competition: creating a new proposition, different from incumbents




Use

**Framework strategy**
Focus on longetivy and find ways to align incestives

This requires:
- Designing products to be easy to repair, upgrade, and customize.
- Making sure parts, tools, and documentation to enable that is easily accessible.
- Making sure you're building a business that actually works with that!

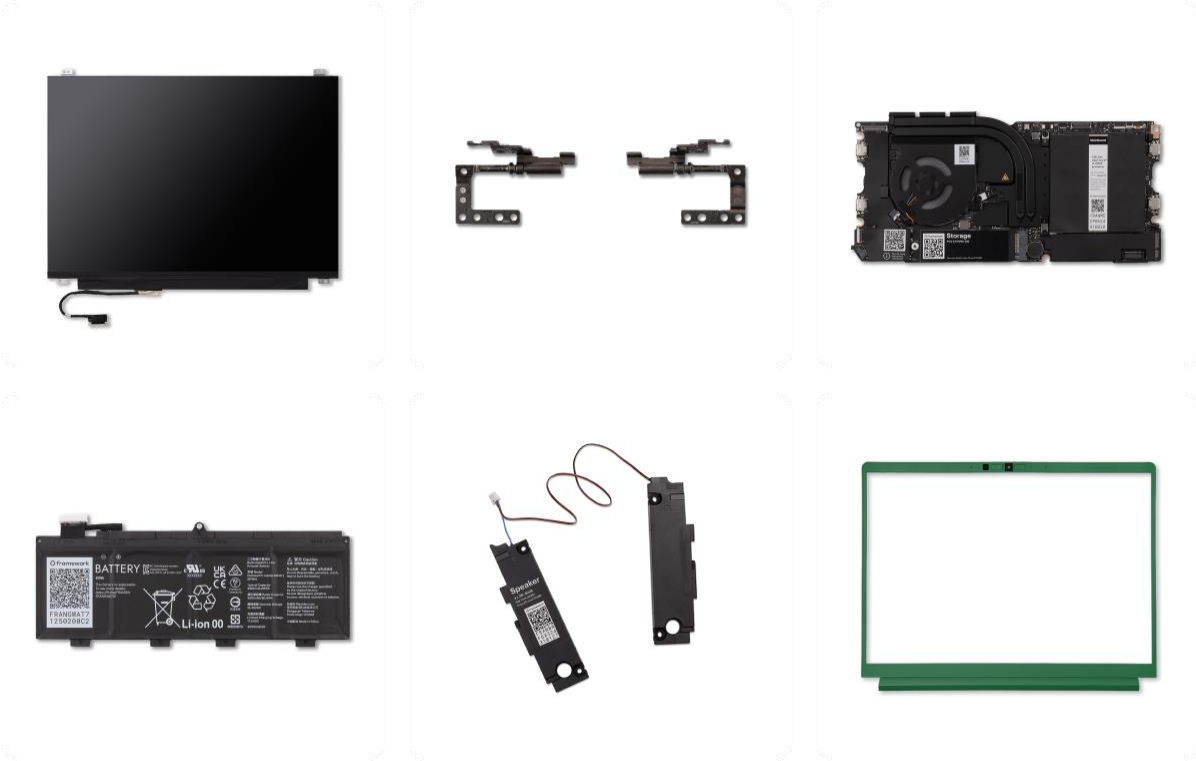
# Aligning incentives around product longevity

There are three main ways Framework is using to align incentives around “use”:

**Counter-positioning**: building a business model that incumbents (big, established competitors) can’t adopt in the short term. In their case, this is a product lasting longer than the average competitor and offer post sale services. Framework is already considering that the notebook industry market size will shrink, but they are confident that their counter-positioning will allow them to capture market share

**Re-engagement**: Capturing additional sales after the first purchase, thanks to post sale services, like spare parts and upgrade options. These sales have often higher margins.

**Network effects**: Fostering economic activity as the install base grows. Examples are resale markets, marketplaces where third-party businesses can also participate, software and services for longevity




Main parts that Framework is currently supplying for post sale engagement

# Aligning incentives around product longevity

## Insights from the plenary discussion

- Framework has repair service centres, but 95% of repairs involve sending parts to users for DIY repairs, which is also more cost effective for the company.
- Designing products for repairability can address safety concerns and minimize damage during repairs, while also lowering the psychological barrier for users to attempt repairs themselves.
- Maintaining the same design architecture and tooling when expanding product portfolios makes it easier to ensure spare part availability.
- In the case of notebooks managing upgrades and spare parts has been successful, with upgrade versions of critical parts developed. The main reason is that the laptop markets has reach a saturation point at the level of innovation (much more stable and less fast changing compared to smartphones and other products)

# Bang&Olufsen design approach to enable repair

Jakob Bergstrøm Graabæk
Sr. Specialist Mechanical Engineering

Kresten Krab-Bjerre
Creative Director

Mads Kogsgaard Hansen
Head of Product Circularity

BANG & OLUFSEN

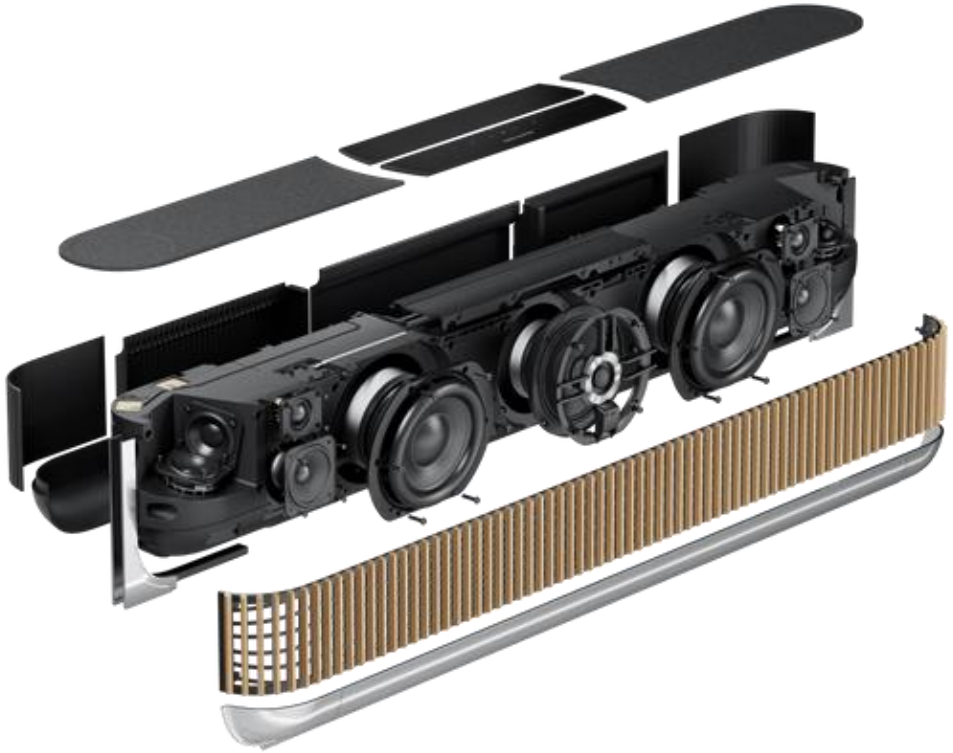
Bang & Olufsen presented how their design process works and how they address longevity, serviceability, repairability and upgradeability. This by show casing the design process applied to Bang & Olufsen's soundbar, Beosound Theatre and how design for repair impacted the design and engineering decisions taken during the product development process. Finally, the presentation provided an outlook to how Bang & Olufsen's sees design for repair playing a key role for the future strategic direction of the company.

# Bang&Olufsen design approach to enable repair

Maximizing product value is an important element of the B&O brand identity, and longevity and repair are an important part of that. B&O does not look at repair in isolation, but it is tackled next to other design strategies like upgradability and emotional durability. Their goal is to have a fully cradle to cradle certified product lineup.

Key success factors that B&O shared are:

- Creating cross competence teams, all working in the same open space, which helps to avoid physical and mental barriers
- A design brief sustainable from the start. In the case of Beosound Theatre, key project goals were:
    - **Longevity**: outlast any screen on the market
    - **Adaptable**: adaptable to different TV sizes, different stands and brackets, stand alone or integrated TV solution
    - **Personalization**: vast collection of aesthetic personalization options,
    - **Upgradable**: upgradable with other B&O speakers to become a surround system



# Bang&Olufsen design approach to enable repair

The key design features that made this possible are:

**Standardized, simple interfaces**. For instance, the same exact interface is used to attach the different stands variation

**Designing around parts keener to obsolescence**. A special mounting interface of the soundbar to the screen was designed to be standardized and decoupled from the attachment mechanism of the screen itself, since the soundbar is expected to outlast the screen. This allows to replace screen while maintaining the soundbar.

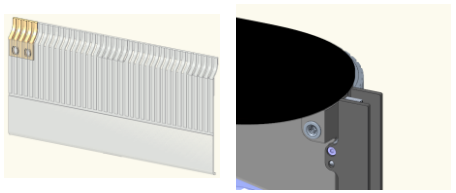
**Reversible joints**. Plastic joints, subject to breakage, are minimized. Screws, rubber grommets and snap hooks are prioritized.

**Ability to upgrade, both at physical and software level**. The soundbar horizontal size can be extended by using exchangeable elements, which allow to make it as big as the screen used.

**Service ready**. All the modules are accessible in a simple way. Most of the electronics is centralized, all easily accessible from the back of the product. B&O developed their own internal serviceability service score, which they use to ensure all their NPI's are service proof.

Adaptable design, as sound bar and as stand.

Standard screen interface



Reversible joints

Upgradable horizontal size and aesthetics

# Bang&Olufsen design approach to enable repair

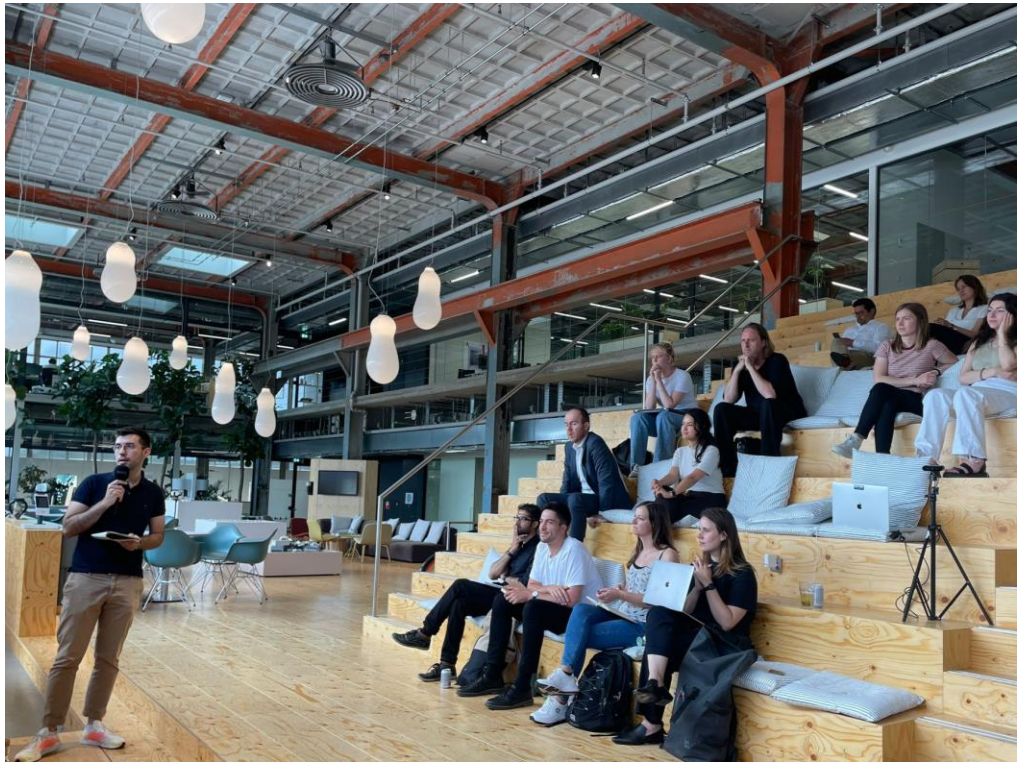
## Insights from the plenary discussion

Bang & Olufsen is planning to roll out this design approach to their entire product line, making it the first cradle to cradle certified.

Bang & Olufsen's strategy for ensuring 10 years of spare parts availability varies based on product categories, maturity, and user expectations.

Strategies include building up inventory to support spare parts for a decade or implementing a trade-in program to salvage parts for supply.

There is a big concern about the potential use of inferior or non-genuine parts in products. To mitigate this concern, Bang & Olufsen promotes the use of service centres and authorized professional installers.



# Road to Repair: Nokia G22

Adam Ferguson
Global Head of Insight and Product Marketing,
HMD Global

hmd.
The Home of Nokia Phones

Longevity and repair have been key focuses for HMD, the home of Nokia phones, in recent years and Adam is lucky enough to have been involved in driving both agendas, being able to tell the story of devices like the G22 from both a design standpoint, but also covering why certain aspects of the design have been put front and centre. During this presentation, Adam told us about the ongoing challenges in developing repairable smartphones in the sub €200 segment.

# Road to Repair: Nokia G22

When designing the Nokia G22, HMD set an ambitious objective and project brief for themselves:

- Create a under 200 dollars smartphone with longevity and repair at its heart
- Design it in such a way that repair becomes desirable for users

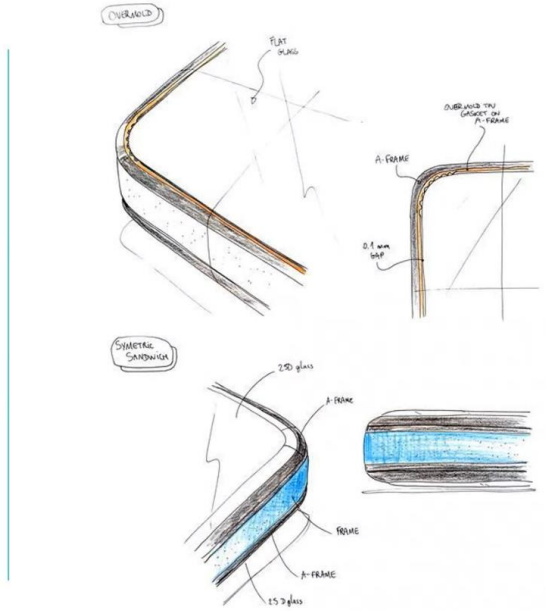
Key considerations/challenges were:

- There was no real starting point (the range had to be completely redesigned)
- Impact on desirable features, like device thickness, had to be minimized
- BOM costs constraints to stay under 200 dollars target
- Maintaining a desirable user experience and purchase drivers

hmd.

**OBJECTIVE:**

**CREATE A PHONE WITH REPAIRABILITY AND LONGEVITY AT IT'S HEART, THAT USERS ACTIVELY WANT TO KEEP FOR LONGER.**



# Road to Repair: Nokia G22

The key design approaches used have been:

- Using a “sandwich unibody” architecture to reduce number of disassembly steps by 50%. Components, like the PCB, are screwed to an internal frame. The back cover and the front display act as closures on the two sides of the device.
- Focusing on tackling the most repaired parts: battery, screen, charging ports, rear case
- To provide an extra layer of security, the main opening of the back housing was hidden in the SIM tray slot. This to avoid that people, other than the owner, can easily understand how to open the phone
- A snap fit frame solutions is used for the back cover and screws and glue is used to fasten the battery. Although, not ideal, these choices were made to respect requirements at the form factor level and to allocate a 5050 mAh battery. These were two important consumer desirable features which could not be compromised. Additionally, recycled material is used for the back cover, requiring extra thickness and strengthening structure.

# Road to Repair: Nokia G22

Some challenges could not be addressed in this model; however, HMD is determined to tackle them in generations to come:

- **Behavior change and desirability.** Behavior change plays an important role to enable consumer repair; from their studies HMD found out that, when it comes to smartphone, having a repairable design does not mean users will repair it. Desirability of carrying out a repair in some cases is still low.
- **Post repair IP rating**
- **Pop on and off covers**, with water-based paint for improved recyclability
- **Improved screen repairability**. In the current model, the front screen is still a bit challenging to replace, although possible

# Road to Repair: Nokia G22

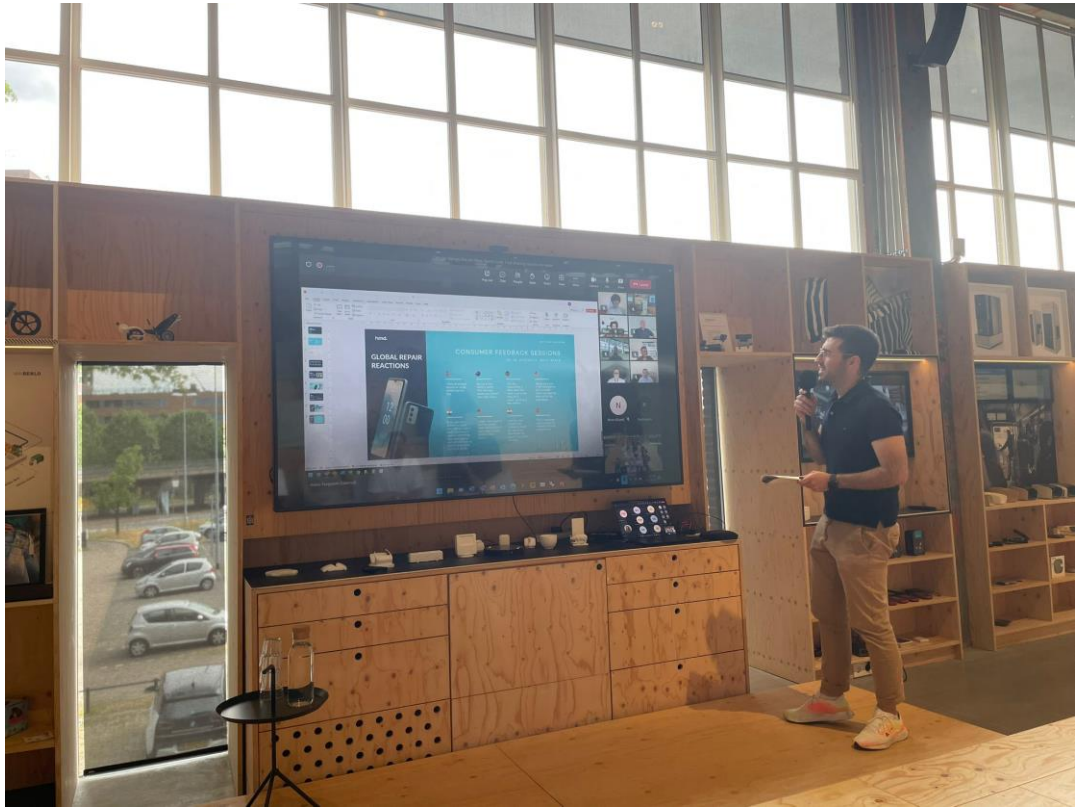
HMD collected positive reactions from user studies carried out in many different geographies. This shows that, although it might be not highly desirable, consumers in general strongly resonate with the topic.

# Road to Repair: Nokia G22

## Insights from the plenary discussion

All manufactures agreed that there is a certain level of concern related to the use of non-original spare parts when a product is fully optimized for repair. However, different companies are using different approaches to tackle it:

- Making sure genuine spare parts are readily available and affordable
- Team up with third parties that can support in providing genuine parts, such as iFixit and others
- Create “approved” suppliers programs and marks on parts
- Working with authorities to identify the sources of these inferior parts and implementing measures to counteract their use is also undertaken
- Make only some parts replaceable by consumer, while keep those that heavily impact performance to professional repairers



# Traceability and its relevance for repair

Thomas Nuyts
Head of Sales, Circularise

Digital Product Passports (DPPs) can enable efficient and transparent tracking of product lifecycles, encouraging repair, extending product lifespan, and promoting circularity.

By capturing and sharing essential product information, such as repair history, component details, and material composition, DPPs empower stakeholders to make informed decisions regarding repairability, incentivize reuse, and optimize recycling processes.

Thomas from Circularise presented about the transformative potential of DPPs in driving sustainable practices, fostering collaboration, and realizing the vision of a circular economy within these industries.

# Traceability and its relevance for repair

## What a DPP is

Digital product passports are a means to gather data on a product and its value chain, so that it's journey can be documented and traced, and information can be shared with different value chain stakeholders.

Circularise is a scale up that helps retrieving data and creating Digital Product Passports for companies. Retrieving data from different value chain stakeholders is essential to determine where value can be best retained in products and where it is currently still destroyed.

DPP's can be embedded in different forms: from simple QR codes to RFiD tags and more advanced technologies. By scanning/ reading the digital identifier, different stakeholders can access a database containing the product passport. Depending on who they are, they will be able to read and even add information.

DPP's are meant to reflect the life of a product, and to be constantly updated by the different stakeholders to document the product journey. For instance, if a product gets repaired by a professional organization, they will update the DPP of the product describing the type of repair. DPP's are already part of EU's ESPR and are active regulation for the battery industry. They are expected to come to electronics soon.

# Traceability and its relevance for repair

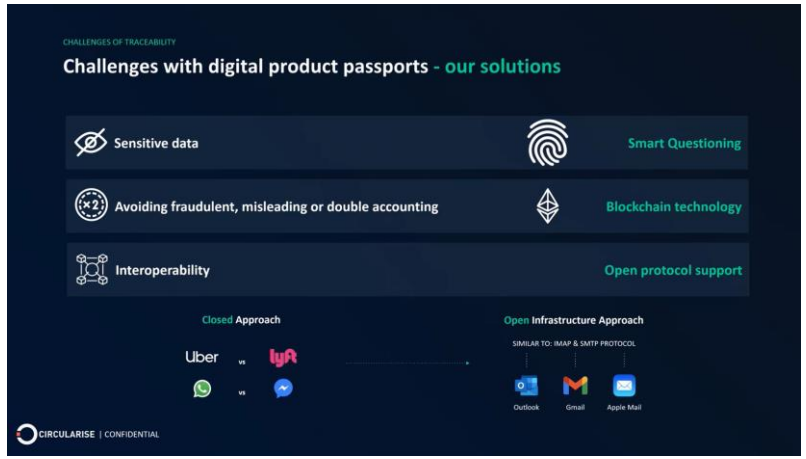
The key challenges of creating and maintaining DPP's are:

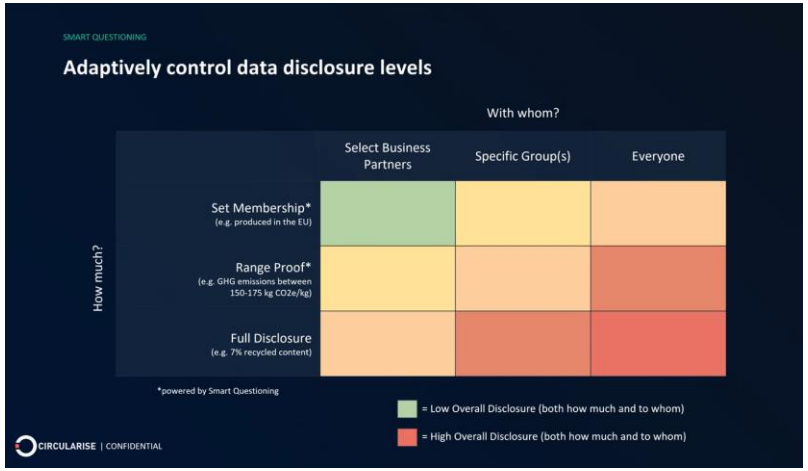
- Handling sensitive data
- Blocking fraudulent activities
- Ensuring interoperability

Primary data, often confidential, is needed to make credible claims and monitor accountability, but it can't be made available to all stakeholders. DPP's use different accessibility level, to ensure only the right stakeholders can access certain type of information. This selective information availability is the core of DPP's.

Circularise uses blockchain technology to avoid fraudulent, misleading or double accounting. Future development emphasises interoperability and open protocols.

Currently there is no single standard that defines how a DPP should be built. However, companies like Circularise, strongly believe in interoperability as the only way to make DPP's work. A coming EU standard will help in standardizing DPP's.



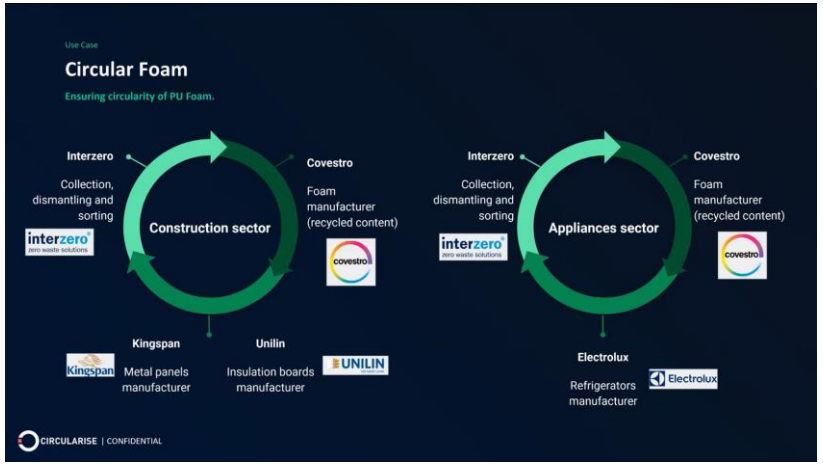



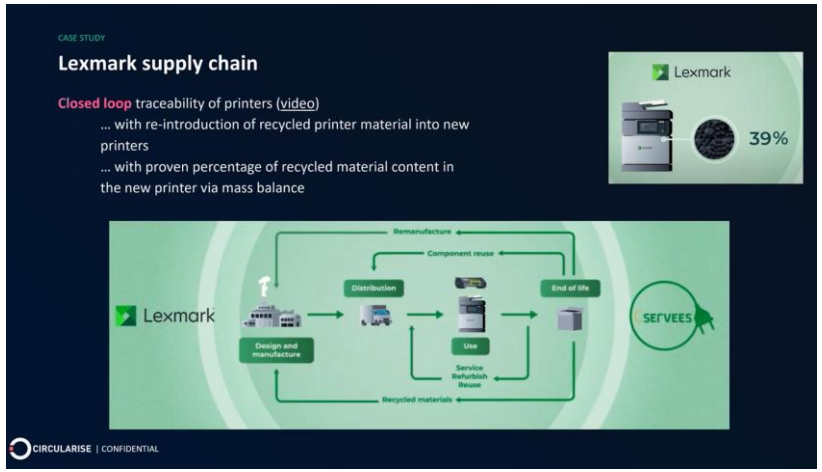
# Traceability and its relevance for repair

DPP's present a clear opportunity to facilitate and promote repair:

- Repair information can be easily made available to users or repair centres
- They can be used to keep track of what repair operations took place on a specific product, tracking which parts have been replaced and when
- They can be used to track post sale service and engagement, which can be used to improve product reliability and service quality

Circularise presented multiple case studies, where DPP's was used to track materials information to facilitate end of life recycling, but also to monitor the quantity of recycled content in new products.



# Traceability and its relevance for repair

## Insights from the plenary discussion

Circularise sees the DPP as a possible simplification tool for all existing and upcoming traceability legislation (GS1,  European EUIPO observatory, green claims and more..)

Europe is a frontrunner in defining the granularity of DPP's; if an individual product will get a DPP or if a batch or product type gets a passport.

DPP's should take into account professional and consumer repair in order not to block this. If DPP's are implemented on an individual product level it could show the replacement of components. If consumers can not adapt a DPP but would replace a component this would lead to a gap in a DPP or incorrect data.

# What's next?

This first session of the KS Repair managed to cover multiple aspect of repair, and at a good level of depth. It was great to hear about different perspectives and way of working to tackle similar challenges.

A key takeaway of the session is that different solutions are necessary for different products, markets, price ranges and companies' type (size, ambitions and resources). It is a complex topic, which not only presents challenges at the design and technology level, but also at business model, behavior change and value chain level.

Despite this, one conclusion is clear: repair is essential to promote a circular economy and a more sustainable consumption, making it something worth fighting for!

Based on this first session we defined two next steps:

- We are organizing a monthly informal online call to exchange insights among different experts working on this specific topic. This allows to meet more often, but without any strong commitment/preparation
- We will definitely organize a second session next year, to tackle other topics connected to repair.
- One topic in particular, behavior change, was mentioned multiple times. However, it was not address in detail. We will connect with the KS Behavior Change to explore how this overlap could be address in their session.

Circular,
**together!**