

## SPECIFIC SORTING PROCESS FOR INNOVATIVE SEPARATION – THE CASE OF SMARTPHONE RECYCLING

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### Background and Aim

Modern **electronic devices** contain a large variety of **different materials**. Some of these are of high **market value** or can be considered as **critical** from an ecological, economic and social point of view, making their recovery particularly important.

The increase in **complexity** and the continuing **miniaturisation** of components present new challenges for recycling.

Today, valuable materials have to be extracted with **manual labour**, which can be **hazardous** due to Li-ion batteries, or will be lost in **unspecific recycling processes**.

The presented development of a recycling process has two main objectives: First, it wants to create a **safer process** compared to the manual processing of smartphones right now. A further objective is to generate an **economic benefit**. This is achieved by substituting manual labour with an **automated processing** and through **higher recovery rates**.

### Module-Based Sorting Plant

#### Separation

- Electro Hydraulic Fragmentation

- Impact Crusher

#### Classification

- Air Classifier

- Flip-Flow Screens

#### Physical Sorting

- Magnetic Separator

- Eddy Current Separator

#### Sensor-Based Sorting

- Colour Cameras

- NIR-Spectroscopy

- Metal Detection

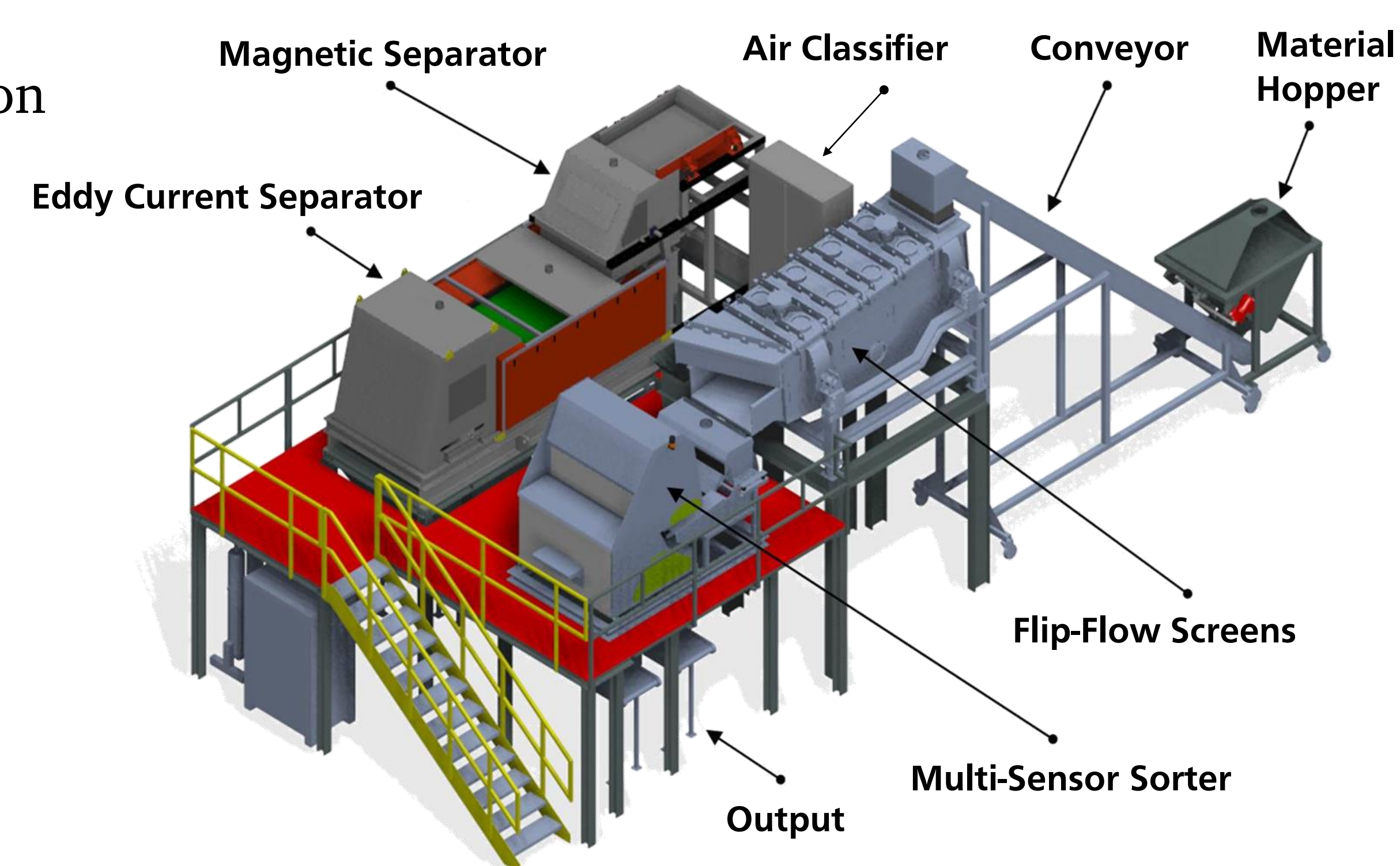


Fig. 1: Module-Based Sorting Plant ©Fraunhofer IWKS

### Creating an Individual Sorting Process for Specific EoL Products

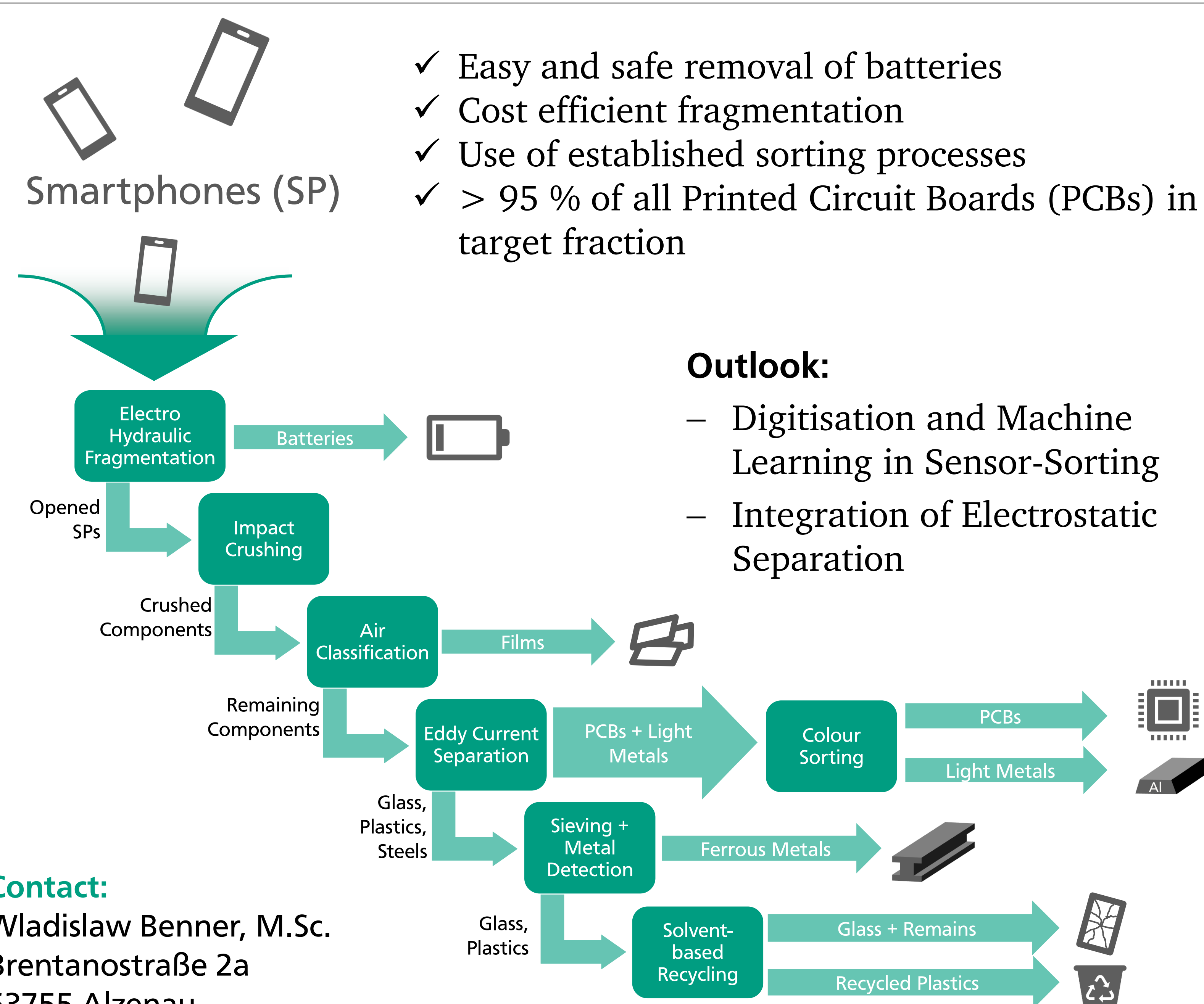
- Analysis of valuable material content in smartphones
- Definition of sorting goals
- Evaluation of module yields
- Combination of modular process steps
- Optimisation of connected process steps

### Results

Fig. 2: Yield of different modules for large, manually presorted fractions (>50 mm); mean value of tested phone brands, excluding *apple*; rounded to integers

| Sorter                 | Fraction               | Eject | Reject | M%  |
|------------------------|------------------------|-------|--------|-----|
| Eddy Current Separator | Printed Circuit Boards | X     |        | 97  |
|                        | Light Metals           | X     |        | 99  |
|                        | Non-Magnetic Steels    |       | X      | 89  |
|                        | Plastic Covers         |       | X      | 95  |
|                        | Display Glass          |       | X      | 98  |
| Metal Detector         | Printed Circuit Boards | X     |        | 93  |
|                        | Metal Parts            | X     |        | 92  |
|                        | Plastic Covers         |       | X      | 86  |
|                        | Display Glass          |       | X      | 100 |
| Colour Camera          | Printed Circuit Boards | X     |        | 95  |
|                        | Metal Parts            | X     |        | 57  |
|                        | Plastic Covers         |       | X      | 65  |
|                        | Display Glass          | X     |        | 89  |

Challenges: Black Plastics, Reflections, Plastic-Metal-Compounds



#### Outlook:

- Digitisation and Machine Learning in Sensor-Sorting
- Integration of Electrostatic Separation



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Fig. 3: Final process sequence for the recovery of largest valuable material share from smartphones