Investigations of sustainability and reusability improvements of high-valued electronic printed circuit boards (PCB)

Master's thesis in collaboration with ZF

Background of the thesis

Large amounts of electronic components are used e.g., in the automotive industry with the increased usage of electro-mobility, the computer industry, the communication industry, and for several other appliances with high value components. Within these examples, there is a widespread space of printed circuit boards with differences in value chains, quality of the components involved and with very different cost distributions. Today, in many cases proper recycling is economically not viable, which leads to a downcycling of the materials and components at the end of their use cycle. Independent from this fact, the overall recycling quota of PCB is very low, i.e., not higher than 30 %.

A proper circularity engineering, however, does require a systematic in-depth analysis, classification of different cases, and proper measures for ex-ante design, engineering, ex-ante preparation of the recycling process, and consideration of the recycling process on a "value-retention" level.

Thus, the main objective of this thesis is to investigate possibilities of improved circularity strategies and technologies for a given example of a typical high-valued PCB.

Intended tasks

Understand the present techniques of material usage in PCB creation available for a given relevant example.

- Understand and quantification of the recycling quota presently done for all involved materials and components with special emphasis on the electronic components.
- Establish several sets of key sustainability indicators for the present circularity approach
- In a Pareto analysis establish the 5 key components for potential value-retention processes.
- First without consideration for the design: Propose changes to the existing design which would improve the recycling process based on the KPIs.
- In a second step: try to estimate the impact of the design changes on the parameters: cost, qualification status, and performance.
- Design and simulate/estimate three scenarios using a design environment to get a qualitative estimate.
- Optional: Detailed performance/cost/qualification comparison of the proposed measures with their impact.
- Writing the Master thesis and preparation of a talk for defending the findings and conclusions

The examples of the PCBs needed for the design are available at the start of the thesis.

Contact and supervision

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Duration

According to exam regulations, (6 months)

Application documents

Please send your relevant application documents in a PDF-file (cover letter, resume and transcript of records (Bachelor grades) in an e-mail to Ms. Christine Höher efm@inatech.uni-freiburg.de .