

英文題目 : Product Evaluation toward Upgradable design: Integrated Viewpoint of Repairability and Failure Risk

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英文要旨 :

The transition to the circular economy necessitates extending product lifespans to minimize resource consumption. While upgrade design is a valid approach, it faces implementation challenges. Consequently, this study focuses on "repairability," the factor of upgradability that gaining attention as a design requirement for extending product lifetimes. However, a critical design trade-off exists: features that enhance reliability often obstruct repairability. If this trade-off is ignored, designers may only improve the repairability of low-risk components, limiting practical longevity. Therefore, this study aims to develop a design evaluation method that integrates both repairability and reliability for a target product to improve. The proposed method combines the Repairability Scoring System (RSS) with Failure Mode and Effects Analysis (FMEA). The method utilizes the Risk Priority Number (RPN)-derived from failure frequency, severity, and detection difficulty-to determine the weighting of priority parts. This ensures that components with higher failure risks contribute more significantly to the overall repairability score. A case study applying this framework to smartphones demonstrated that the integrated approach successfully identified critical parts in need of improvement, supporting both enhanced repairability and improved reliability. Furthermore, the study critically examined the validity of existing repairability metrics through applying them to the smartphone. The analysis revealed that current standards predominantly focus on "disassembly" and "repair support" but overlook critical practical factors. Specifically, the study identified "ease of reassembly", "failure risk during repair process" and "post-repair quality verification" as missing dimensions.