HSLU Hochschule Luzern

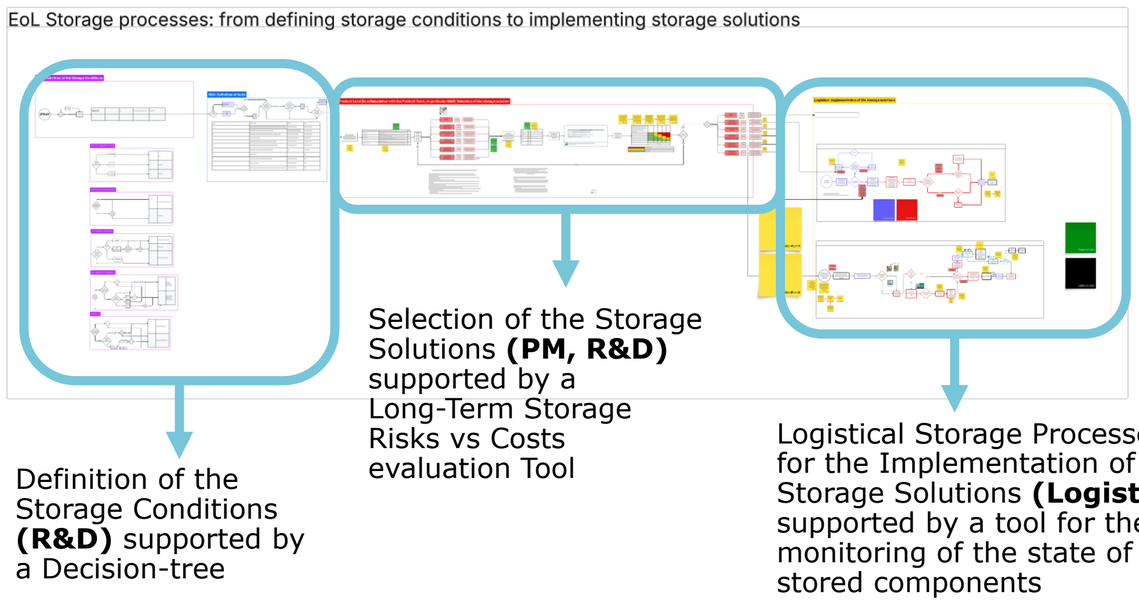
Technik & Architektur

Master of Science in Engineering
Business Engineering

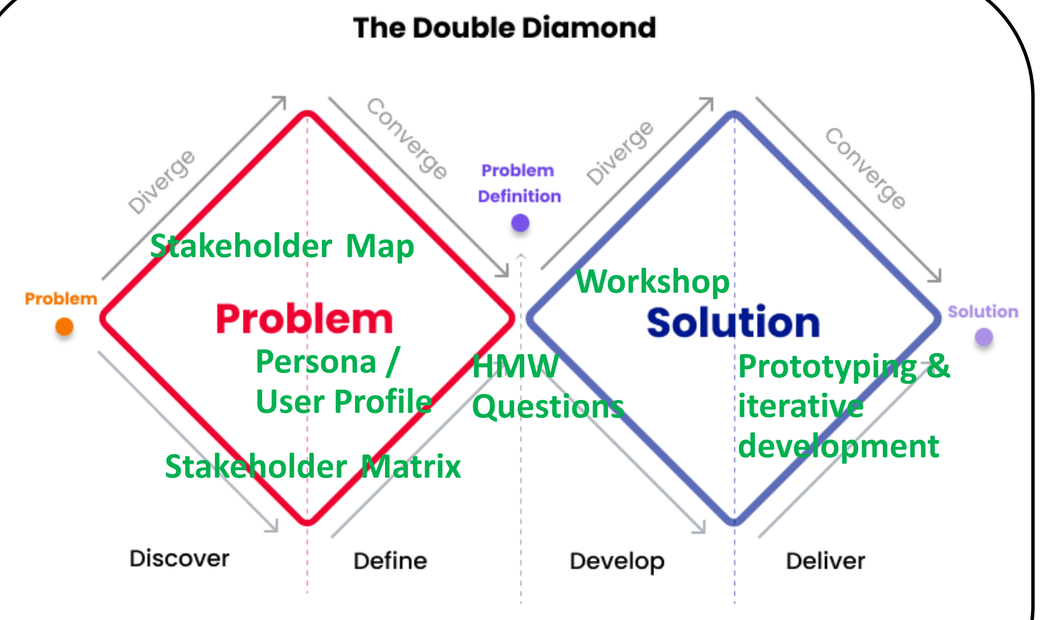
Double Degree Master'sThesis –Hochschule Luzern (HSLU) and University of Florence (UNIFI)

Designing a process for long-term storage of electronic components:

insights from a case study with Roche Diagnostics International

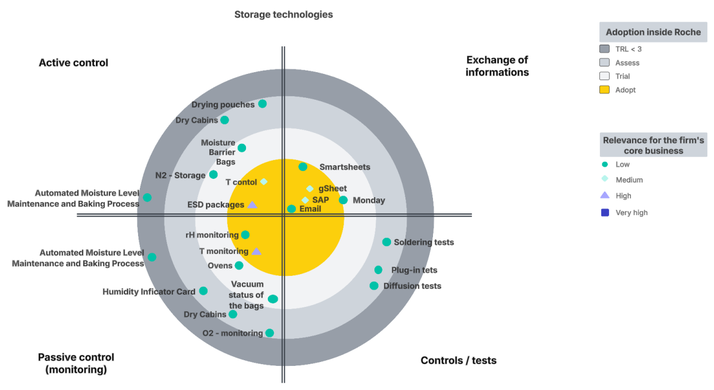


Representation of the LTS process for EoL electronic components, with the sub-processes assigned to the three departments.

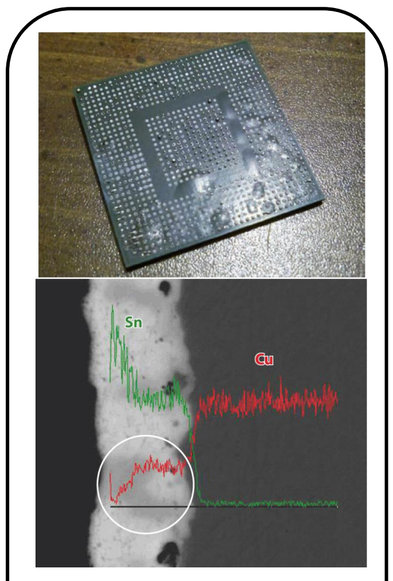


Tools belonging to the DTA used inside the work, and their position on the Double Diamond.

Persona / User Profile of a Product Manager, resulting from the AI-supported analysis of the transcripts of the interviews.



Technology Radar for RDI of the storage technologies identified during the analysis.



Example of popcorn effect (top) and diffusion (bottom) on electronic components after LTS.

ID	Failure Mode	Mechanism	Influencing Factors / Causes	Func	Sold	S	O	D	RPN	Measures	New S	New O	New D	New RPN
1	Change in solderability, formation of intermetallic phases (e.g., Cu–Sn) with higher melting points	Diffusion	T	☐	☒	5	3	3	**45**	Vacuuming in nitrogen-filled Moisture Barrier Bags	5	2	2	**20**
2	Cracks in housing, delamination at substrate interfaces, bubbles	Popcorn Effect	RH	☐	☒	5	3	3	**45**	Vacuuming in nitrogen-filled Moisture Barrier Bags	5	2	3	**30**
3	Loss of shielding, reduced conductivity of contacts, leaks, interruptions, short circuits, dendrites, discolorations, reduced solderability	Corrosion/ Oxidation	RH, T, oxygen, chlorine gas (Cl_2), nitrogen oxides (NO_x), sulfur compounds, outgassing from plastics	☐	☒	5	3	3	**45**	Vacuuming in nitrogen-filled Moisture Barrier Bags	5	2	2	**20**

The three most relevant failure modes and mechanisms, and the reduction of their Risk Priority Number after the implementation of the corrective measures suggested by the LTS process.

Problem Statement

The rapid pace of technological innovation in the electronics industry has led to significantly shorter production lifecycles for electronic components compared to the long service lives required for medical devices, such as those manufactured by Roche Diagnostics International (RDI). When the production of a critical electronic component is discontinued from the supplier and no immediate replacement is available, companies must often perform a Last Time Buy purchase and necessitate storing sensitive components for long periods of time. Currently, RDI lacks a standardized process for LTS, facing risks of material degradation (e.g., oxidation, diffusion, or "popcorn effect"), leading to potential production stoppages, high scrap costs, and defects in products.

This work has the goal of showing how an implementation-ready LTS process for an OEM can be designed such that it is tailored on the necessities of the users of the most involved departments, using the situation at RDI as case-study.

Methodology

The study makes use of the human-centered Design Thinking Approach (DTA) structured around the Double Diamond model, combining qualitative data from semi-structured interviews, analyzed using Generative AI, with analytical tools such as the FMECA and a Technology Radar. The LTS process was refined through iterative prototyping and validated with the most important stakeholders.

Results

This work shows how the most relevant departments for a LTS process at RDI are R&D, Logistics, and Product Management.

The standardized LTS process created during the work at the company sees all of them as owners of different sub-processes and provides them with specific tools for defining the storage conditions, selecting the most appropriate storage solutions, and monitoring the stored components during storage. Risk and economical analysis show how such a process can effectively mitigate storage risks while improving economic outcomes for the company.

The results demonstrate that bridging the historical silos between R&D, Logistics, and Product Management using the tools of the DTA, leads to a validated, operational workflow that ensures transparency and is ready for immediate corporate implementation with high acceptability.

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