Supplementary Material S4 – Inter-item Correlation Analysis

…submitted to the Journal Paper "*Mapping Stakeholder Perspectives for Sustainability Transitions: The Case of Lithium-ion Battery Recycling*" by Rutrecht et al. published at Sustainability Journal of MDPI in 2025.

Inter-item Correlation Heatmaps

To complement the internal consistency analysis based on Cronbach's α, **Pearson inter-item correlations** were computed for all questionnaire dimensions (opportunities, risks, barriers, enablers) to validate literature-derived items. These matrices visualize the **linear associations between individual items** within each dimension and provide insight into potential item redundancy or conceptual spread.
Average correlation values, ranges, and interpretive notes are given below.

General note

All heatmaps are based on **Pearson's correlation coefficient (r)** calculated pairwise across all respondents (n = 21–26, depending on completion rate).
The visualizations use a diverging color scale centered at r = 0 (blue = negative, red = positive correlation).
Diagonal elements (self-correlations) were fixed at r = 1 for reference.

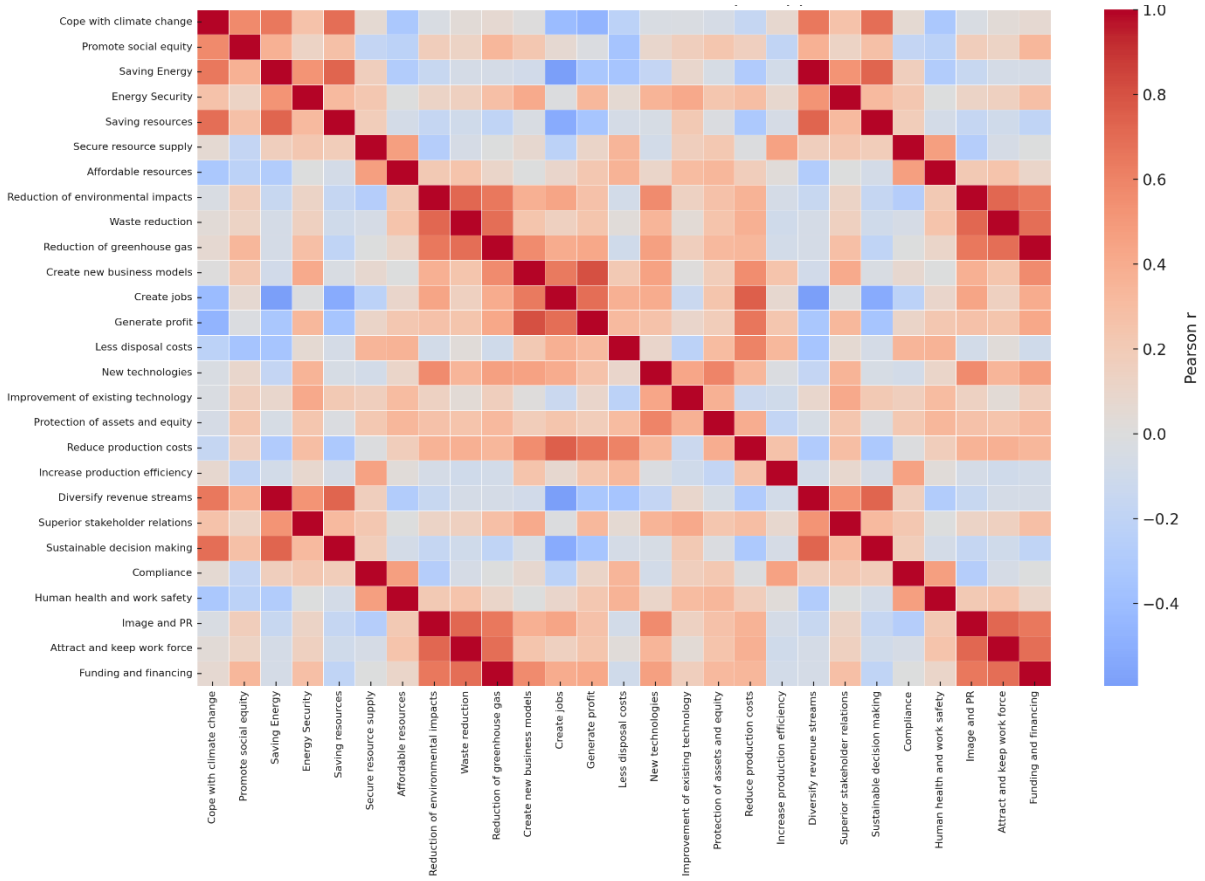


Figure S4.1. *Inter-item Pearson correlation heatmap for Opportunity Items*

Summary statistics:

Mean r = 0.19 Range = −0.59 … 1.00

Interpretation:

The Opportunity items show **low to moderate inter-item correlations**, suggesting that participants differentiated clearly between various opportunity types.

The broad spread of correlation values indicates a **conceptually diverse item set** covering environmental, economic, and social opportunities.

The few high correlations (r > 0.8) point to minor overlaps between closely related items such as *energy efficiency* and *greenhouse gas reduction*.

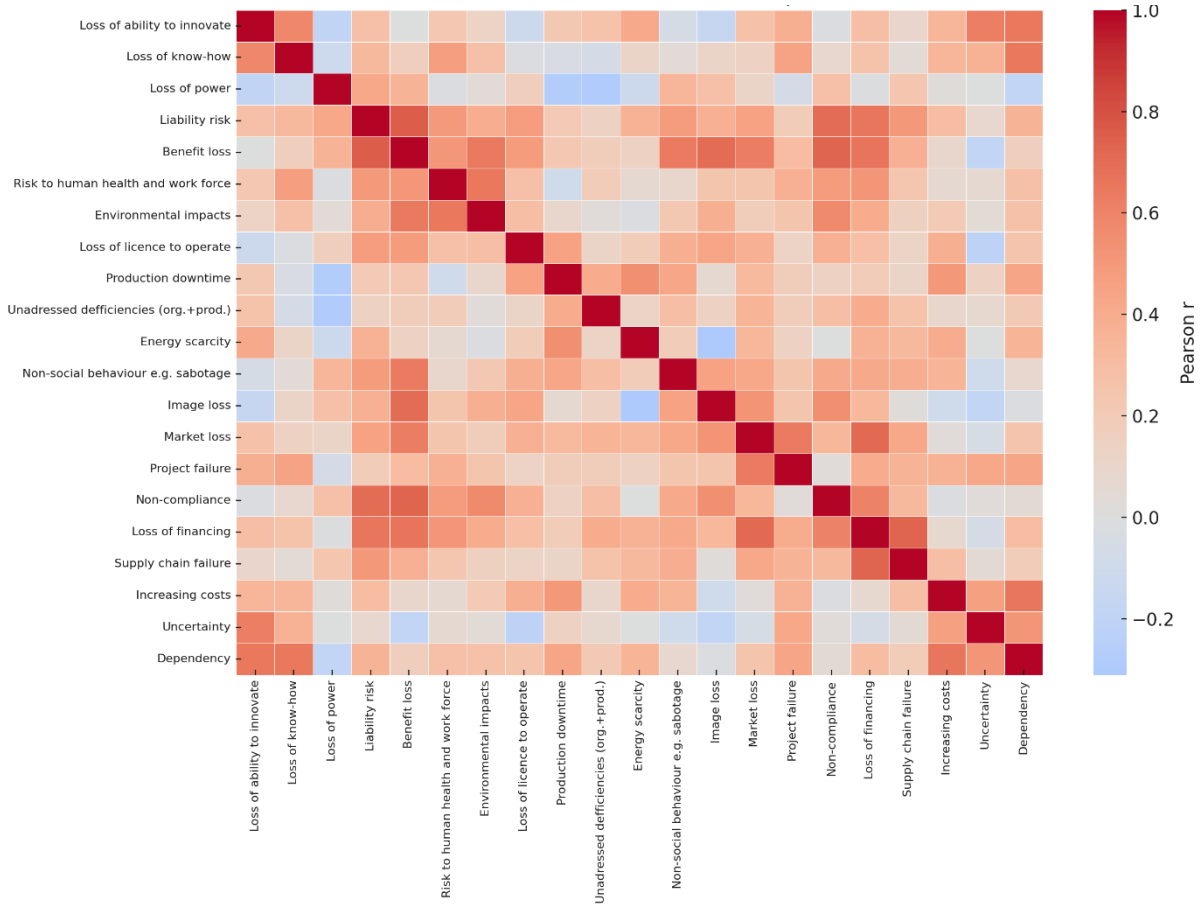


Figure S4.2: *Inter-item Pearson correlation heatmap for Risk Items*

Summary statistics:

Mean r = 0.25 Range = −0.31 … 0.76

Interpretation:

The Risk items display **moderate internal coherence** with some strongly correlated pairs, particularly among economic and regulatory risks (e.g., *market loss*, *loss of financing*).

This pattern suggests a **systemic perception of risks**—respondents tended to rate different risk factors in a related manner.

The limited number of negative correlations reflects distinct conceptual contrasts between technical and organizational risks.

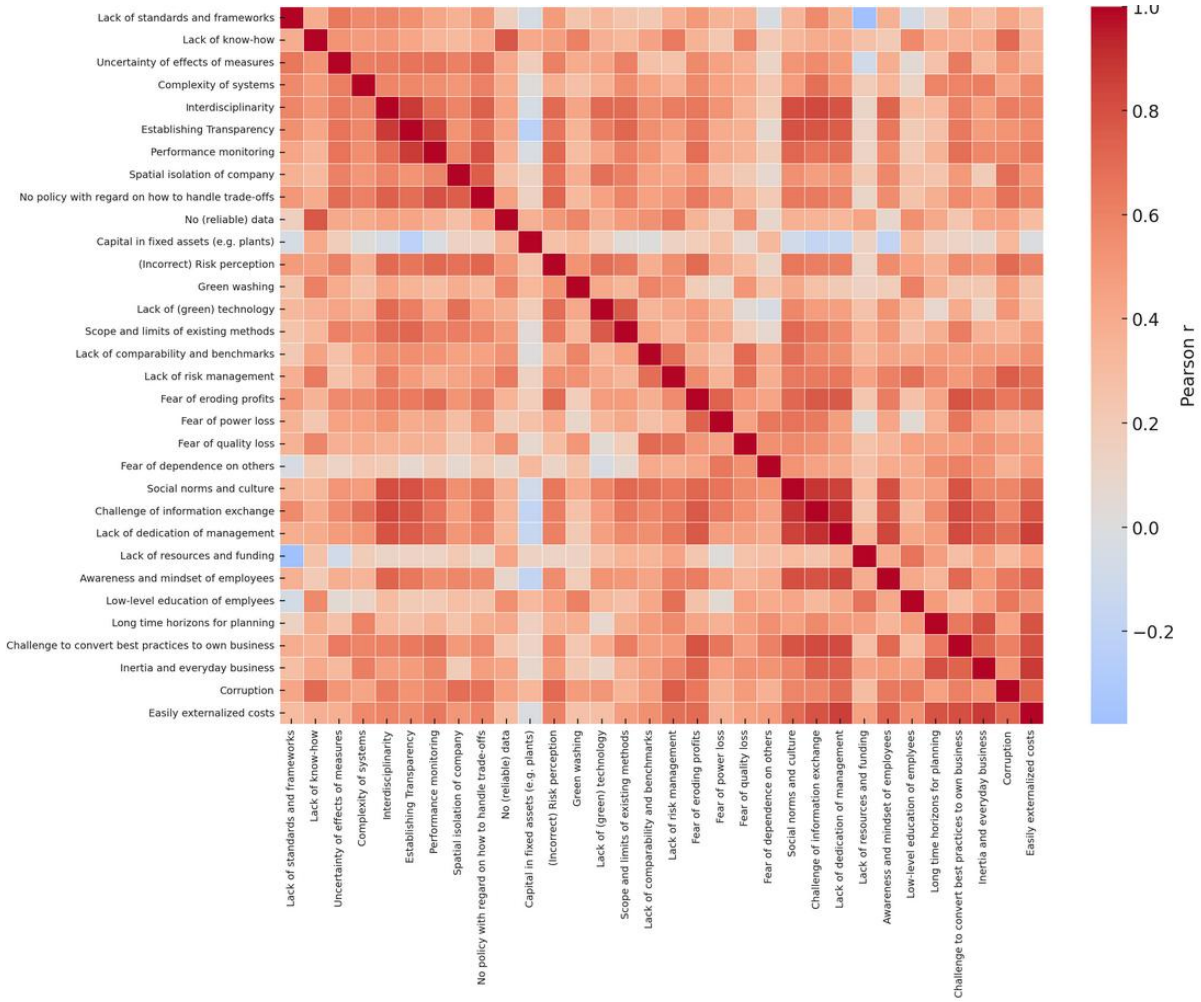


Figure S4.3: *Inter-item Pearson correlation heatmap for Barrier Items*

Summary statistics:

Mean r = 0.45 Range = −0.38 … 0.91

Interpretation:

Barrier items exhibit **strong internal coherence**, indicating that respondents perceived many barriers as mutually reinforcing.

High correlations among *lack of know-how*, *lack of management dedication*, and *lack of resources* reveal partial **redundancy among organizational factors**, consistent with the observed high Cronbach's α.

Despite some negative relationships, the general pattern confirms that **structural and cultural obstacles co-occur** within organizations.

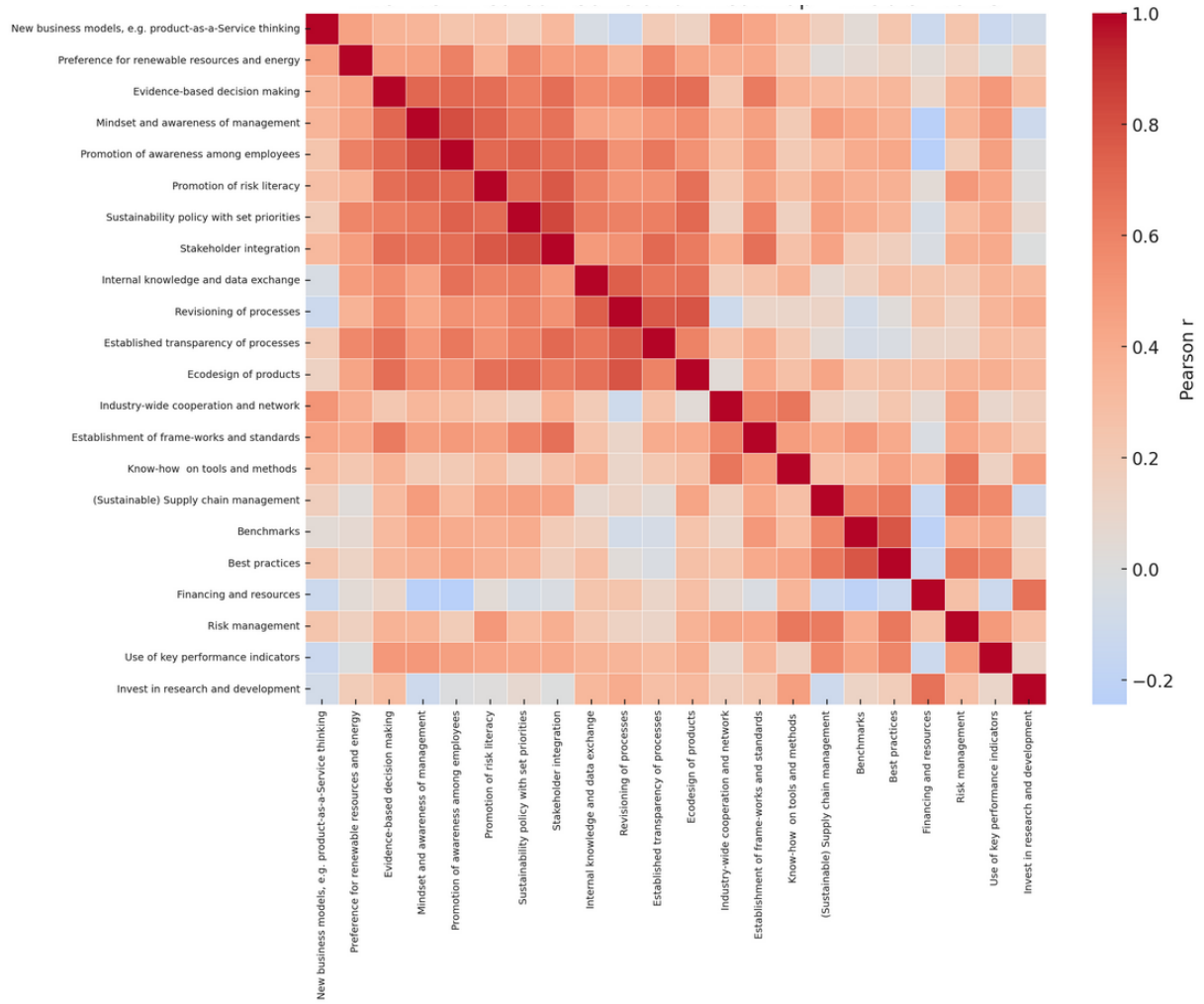


***Figure S4.4**: Inter-item Pearson correlation heatmap for Enabler Items*

Summary statistics:

Mean r = 0.35 Range = −0.24 … 0.84

Interpretation:

The Enabler dimension shows **moderate to strong coherence** with several high pairwise correlations among managerial and organizational enablers such as *awareness*, *transparency*, and *knowledge exchange*.

The results indicate that these enablers are **perceived as interlinked mechanisms** rather than isolated drivers.

Overall, the moderate average correlation supports the construct's **internal consistency** while still preserving differentiation across technological, strategic, and cultural factors.