EXECUTIVE SUMMARY

NEB Self-Assessment Tool:
Evaluating the Adaptive Reuse of the 'Magazzini Raccordati' through Sustainability, Beauty and Inclusion

MASTER THESIS IN ARCHITECTURE AND URBAN DESIGN – School of Architecture, Urban Planning and Construction Engineering

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Introduction

The climate emergency and european decarbonization goals have redefined the paradigm of contemporary architecture, establishing its central role in the energy transition process. Consequently, assessment and certification methods have taken on greater importance in defining best practices and the criteria to be incorporated into projects to comply with government directives and incentives. The New European Bauhaus initiative, launched by the European Commission in 2021 as an interdisciplinary component of the Green Deal, alongside the Renovation Wave strategy, which identified the regeneration of existing building stock as a priority lever for achieving climate neutrality, has introduced an evaluation system based on the concept of systemic sustainability. This system is structured around three main pillars, Environmental Sustainability, Beauty, and Inclusivity, whose validity depends on their mutual interaction.

The holistic approach and the pursuit of flexibility, enabling the method to be applied across a wide range of typologies and geographic areas, is stated by the Join Research Centre as the core that makes the NEB Self-Assessment Tool a methodologically ambitious instrument, capable of synthesizing the European vision.

To date, no previous academic studies have been identified that provide a comprehensive application or an exhaustive analysis of the framework, despite its institutional and theoretical significance. This aspect lends the present study significant empirical value in a field of methodological research that has not yet been thoroughly explored.

This gap directly motivates the dissertation's central research inquiry:

To what extent can the NEB Self-Assessment Tool support and guide the design process during the preliminary stages of an urban regeneration and architectural reuse project?

The study addresses this question by testing the Tool's applicability to a multi-scalar interdisciplinary theoretical preliminary project of architectural reuse and urban regeneration of Magazzini Raccordati. The research reveals a structural tension between the holistic foundation, on which the NEB framework arise, and the compartmentalised architecture of the assessment instrument. The final critical discussion, thus, proposes an alternative interconnected evaluation concept, based on cross-dimensional weighting vectors, as an original methodological contribution intended to restore coherence between the Tool's theoretical premises and its operative structure.

Structure and tools

The thesis is organized into three main sections that reflect the logical progression of the research and correspond to the three phases of the work, making them clearly identifiable in the document's table

of contents. The first section establishes the theoretical framework, providing an introduction to European environmental policies and the international certification and evaluation tools scenario. The chapters support the identification of the NEB self-assessment tool as the completer and more articulated framework while underlining the weaknesses of a relatively young method and the literature gap on the matter.
The second section introduces the selection of the evaluation subject and the description of the FARMER project with an in-depth study conducted at the architectural scale regarding the details of the intervention on the two selected warehouses. The main tools that supported this phase are territorial assessments, morphological and functional analyses, SWOT analyses, stakeholder mapping, energy simulations, LCA assessment. The technical outputs of this phase, including a total building energy consumption of approximately 27,200 kWh/year, a photovoltaic coverage ranging from 64% to 101% of demand depending on module selection, and an embodied carbon value of 113 $kgCO_2e/m^2$, served primarily as the empirical basis against which the NEB Tool's indicators and KPIs were tested.
The third section applies the evaluation to the project by subjecting the scenario to a critical review. Therefore, the main focus is assessing the coherence of the choices and call upon this process for simultaneously examining the method's ability to adapt to the project's specific characteristics by analysing the structural and theoretical implementation of the three dimensions. This serves as an interpretive function, aiming to understand the method's analytical framework, the effectiveness of the identified parameters in relation to the scale, type, and phase of the project presented, and, where possible, to identify potential adaptations that allow for a full grasp of the case study's complexity. The thesis thus identify the evaluation process as a source of knowledge and design rather than as an ex-post verification.
The structural separation between design and evaluation was introduced to provide greater clarity and ease of reference but is not intended to imply that the design is fixed in relation to the inputs resulting from the verification phase.

Conclusions

The development of technical calculations and simulations served as the basis for verifying the application of the Key Performance Indicators (KPIs) set forth in the *European framework*. The three dimensions returned the following weighted scores: Sustainability 68.62/100, Beauty 55.94/100, and Inclusiveness 69.29/100.
The use of the NEB Self-Assessment Tool has consequently made it possible to identify the indicators best suited to evaluating the project and to exclude from the process those operations whose details require access to contractual data or technical simulations that are not available for a conceptual design project.
The main consequence of this distinction turned out to be the need to make significant adjustments to the mathematical weighting where no reorganization of the indicator weights had been anticipated or guided based on the specific areas considered in the application. The redistribution of the percentage weights, aimed at producing a result focused on the scope of the analysis, therefore required adjustments within the Sustainability and Inclusivity dimensions. The "Beauty" dimension applied the stated methodological framework differently by formally incorporating variability coefficients to account for the exclusion of unconsidered indicators through a standardized proportional recalculation. Of the three dimensions, therefore, the one that has implemented a more flexible and adaptable structure is the "Beauty" dimension. Overall, the application of the method, even to a project in the conceptual phase, proves to be effective, though it highlights the need to incorporate appropriate variability coefficients into the Sustainability and Inclusivity dimensions as well since the absence of a structured protocol within the Tool to guide this redistribution represents in itself a methodological gap that undermines the comparability and replicability of results across different applications.

An analysis and review of the procedures carried out revealed a fundamental methodological question:

Is the structure of the NEB Self-Assessment Tool actually capable of capturing the complex, interconnected nature of the sustainable transition, which the European Union recognizes as the only effective means of combating the climate crisis?

Critical discussion

At the heart of the NEB vision lies the recognition that sector-based strategies to contrast climate crisis have historically revealed significant systemic inadequacies, demonstrating the inability of isolated interventions to trigger structural transformations. The resulting urgency of a holistic approach has been translated in the affirmation of Sustainability, Beauty, and Inclusivity as inseparable and measurable solely through their mutual interaction rather than by the individual impact of each.

However, the analysis conducted through the progressive application of individual indicators revealed that this holistic approach, strongly emphasized in the manual's theoretical principles, risks being reduced to a one-dimensional breakdown during the quantitative evaluation phase. This can be attributed primarily to the decision to structure the evaluation survey into three separate macro-categories: mapping the three pillars to three independent evaluation dimensions, which do not reflect the strong collaborative character outlined in the theory, made it necessary to identify components capable of capturing the dimensions' interdependence. This attempt resulted in the forced inclusion of inherently cross-cutting indicators within each of the three evaluation areas, leading to operational redundancies and conceptual overlaps. The application of the method has thus highlighted the paradox of a structure that, while aiming for a complex evaluation, fails in investigating the mutual impacts of different domains.

This fragmentation becomes particularly evident when considering the energy supply system - evaluated under KPI S.1.2, whose relevance become evident for the environmental sustainability dimension when considering that 88% of the project's total lifecycle emissions over 50 years derive from the operational energy phase (B6), calculated based on the Italian national energy mix. Yet its consequences extend beyond this single impact: the same decision simultaneously affects the aesthetic and material resolution of the building envelope, where the integration of renewable energy production infrastructure requires careful compositional mediation (Beauty); and contributes, albeit as one factor among several, to reducing the risk of energy poverty by lowering long-term operational costs for economically vulnerable users, a partial but concrete input to spatial accessibility (Inclusiveness). The tool's algebraic structure captures none of these lateral consequences, treating a technically driven decision of this magnitude as though its impact were confined to a single dimension. This mismatch between theoretical principles and structural reality constitutes the method's primary systemic weakness.

One example of this issue is the fragmentation of the life-cycle analysis of materials or the assessment of the interdisciplinary nature of the project team, parameters that are mentioned repeatedly within the framework but lack a synthesis that measures their overall impact. Consequently, the system is inefficient at measuring cause-and-effect relationships among design choices: the tool's algebraic structure is limited to a sum of independent scores for each dimension, without incorporating multipliers or coefficients that calculate how optimizing a parameter belonging to one of the three macro-categories directly affects the project's impact on the other two. To address the methodological weakness identified and restore consistency to the evaluation framework, it is necessary to move beyond the current linear, funnel-shaped architecture in favor of a structural reorganization that incorporates dependency relationships between an indicator and multiple dimensions.

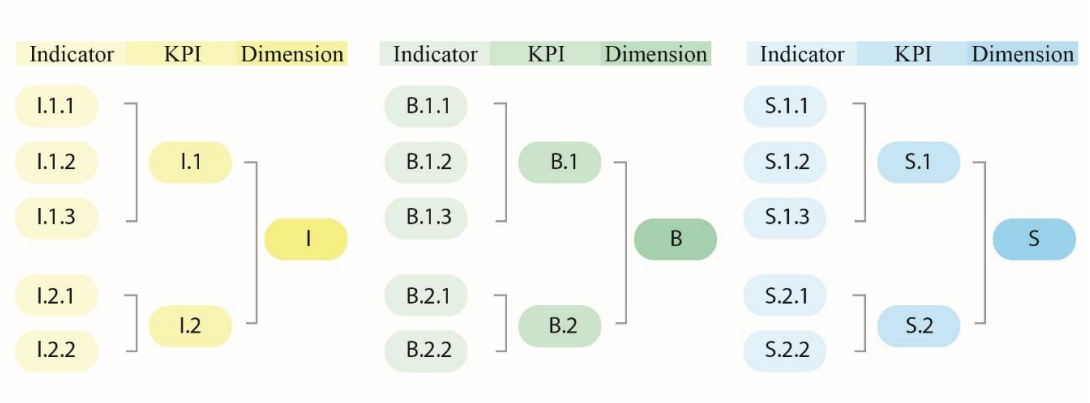

Figure 1. Current evaluation structure

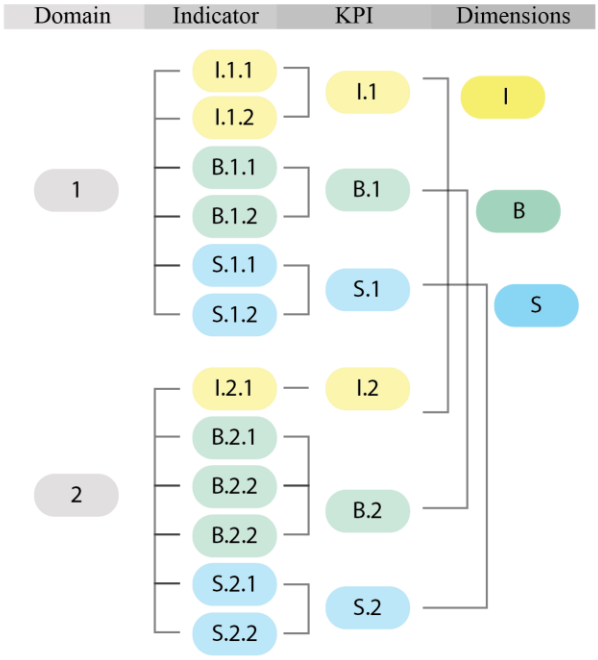

Figure 2. Proposal for an alternative interconnected structure

As illustrated in the conceptual diagram redefining the *framework*, the new theoretical model replaces the unidirectional hierarchical aggregation, in which indicators are aggregated into a single KPI and, consequently, into a single dimension, with an interconnected network system.
This alternative configuration involves evaluating each individual baseline indicator based on its technical or spatial performance and then distributing its value across the relevant KPI. The key difference lies in the assignment of three distinct weighted values for each KPI, whose impact is simultaneously distributed across the three respective dimensions (Sustainability, Beauty, Inclusivity) through cross-derivation vectors.
This outlines an evaluation algorithm that is concretely aligned with the holistic paradigm proposed by the New European Bauhaus and capable of measuring architecture's true potential impact on a sustainable transition.
The ability to unambiguously quantify a specific design choice, while simultaneously measuring its concurrent impacts would also allow designers to manage systemic complexity in a far more straightforward manner. This simplification would not stem from a reduction in the number of alternatives considered, but rather from a methodological approach focused on identifying solutions with high cross-cutting performance and on calibrating performance trade-offs. This approach is fully aligned with the ambitious holistic goals of the European transition.

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