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Multicriteria Evaluation Framework for Industrial Heritage Adaptive Reuse: The Role of the 'Intrinsic Value'

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Abstract: At the end of the 20th century, most industrial cities faced a massive phase of de-industrialisation, resulting in abandoned areas. However, these areas, rich in history and heritage, can represent significant resources for the regeneration of entire territories. Adaptive Reuse (AR) is one of the most appropriate strategies for the sustainable regeneration of brownfield sites: it gives new life to a 'dead' land, extending its use value so that it can continue to be enjoyed both by present and future generations. Decision-making processes concerning Industrial Heritage Adaptive Reuse (IHAR) cannot ignore the role that 'intrinsic value' plays in orienting development choices in such areas. Adopting participatory decision-making processes enables the inclusion of different values and interests of the stakeholders and, at the same time, increasing their awareness about the decision-making problem, thus reducing conflicts. This contribution intends to propose an evaluation framework to assess the multidimensional impacts of IHAR, considering the different values characterising them, and to support decision-making processes for the identification of the 'preferable' transformation scenario. This evaluation framework is applied, through the use of the TOPSIS multi-criteria evaluation method, in the case study of the ex-Italsider area in Bagnoli district (Naples, Italy), an industrial steel plant decommissioned in the early 1990s.

Keywords: industrial heritage; adaptive reuse; multidimensional indicators

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1. Introduction

In the Anthropocene era, the relationship between city, nature, and history has drastically changed, resulting in weakening of the balance between urban areas and natural ecosystems [1]. At the end of the 20th century, most of the industrial cities, mainly for socio-economic reasons, faced a massive phase of deindustrialisation, during which factories moved out of the cities or ceased their production activities, resulting in abandoned and degraded areas. Deindustrialisation led to a significant transformation in the economic, social, and territorial aspects of a once industrially driven society [2].

As defined by The International Committee for the Conservation of the Industrial Heritage (TICCIH) [3,4], the industrial heritage consists of sites, structures, complexes, areas, and landscapes alongside machinery and objects documenting industrial (present and past) processes, including production, raw material extraction, transformation, and associated energy and transport infrastructures. It highlights the connection between culture and nature, as it relies on natural and energy sources for producing and distributing (through transportation networks) goods to wider markets, and on the technical expertise, social and cultural legacy that characterize the industrial organisation of a specific time. This heritage encompasses tangible as well as intangible aspects such as technical expertise, work organisation, and the socio-cultural legacy that impacted communities.

Our industrial heritage represents a rich learning source that should be preserved and passed on to future generations. It provides insight into local history, showcasing interactions across different times and cultures. Furthermore, it demonstrates the creative skills characterising science and technology over time, as well as the dynamics of social and artistic movements [4].

The regeneration of decommissioned industrial areas initially focused on the opportunity to reuse abandoned infrastructure rather than on whole industrial areas. Over the last decades, abandoned industrial areas have been 're-evaluated' as a resource for the regeneration of entire territories, with environmental, economic, social, and cultural implications [5].

Adaptive Reuse (AR) is one of the most appropriate strategies for the sustainable regeneration of brownfield sites [4]. It gives new life to a 'dead' land, extending its use value so that it can continue to be enjoyed both by present and future generations [6]. Thus, it represents an important contribution to a principle of the circular economy, 'decoupling growth from resources consumption' [7], introduced by the United Nations in Goal 12 of the 2030 Agenda [8] and in paragraphs 71–74 of the New Urban Agenda [9] as an overall development model impacting both natural and social systems while simultaneously generating economic prosperity. AR is a strategy to implement the circular economy model, in reference to both the tangible and the intangible flows (related to different values characterising cultural heritage) [6].

New uses identified by AR projects have to be consistent with the principles of industrial heritage significance, authenticity and integrity, respecting significant materials, components, circulation, and activity patterns [4], while satisfying the evolving needs and requirements of the community.

However, addressing issues associated with abandoned industrial heritage poses complex challenges due to the involvement of various conflicting values and interests. In order to address this complexity, decision-making processes have to be supported by appropriate operational tools to identify regeneration strategies. Furthermore, multidimensional evaluation tools are needed to assess the alternative transformation scenarios considering the different dimensions involved (economic-financial, socio-cultural, and environmental).

This contribution intends to propose an evaluation framework to assess the multidimensional impacts of Industrial Heritage Adaptive Reuse (IHAR) projects, considering the tangible and intangible values that characterise them. This evaluation framework, following a value-based approach [10], aims to support decision-making processes for the identification of the 'preferable' regeneration scenario, that is the most consistent with the values, objectives, and preferences expressed by different stakeholders. After a literature review on the evaluation processes in the AR of brownfields (Section 2), the evaluation framework is proposed (Section 3). Then, it is applied in the case study of the ex-Italsider area in Bagnoli district (Naples, Italy), one of the most important ex-industrial steel plants in southern Italy (Section 4). A multi-criteria evaluation, using the TOPSIS method, is elaborated on to compare alternative regeneration scenarios of the study area. The results are then discussed (Section 5). The limits of this study and future research perspectives are described in Section 6.

2. Literature Review

One of the key international documents on the adaptive reuse of industrial heritage is the Nizhny Tagil Charter for the Industrial Heritage signed by TICCIH in 2003 [3,4]. It is the first Charter for the protection of industrial heritage. In 2012, TICCIH also published the Guide to Industrial Heritage Conservation on the preservation, cataloguing, and researching of industrial heritage [11]. It includes a set of good practices for the management and conservation of historical industrial sites. Furthermore, recognising the importance of industrial heritage and the pressures to which it is subjected in today's economic, legal, cultural, and environmental contexts, ICOMOS and TICCIH have drawn up and adopted, in Paris in 2011, the 'The Dublin Principles' [4] to support the documenting, safeguarding, and conserving of industrial heritage as an integral part of human societies' heritage worldwide.

An in-depth scientific literature review has been carried out, through the Scopus Database, using the following combination of keywords: 'industrial heritage' AND 'adaptive reuse' AND 'evaluation' OR 'assessment' OR 'multidimensional indicators'. Firstly, a specific screening was conducted on the language (only English) and on 'article title', 'abstract', and 'keywords'. Considering that the selected keywords are also used in subjects not directly linked to the topic of the present study, a filter of the subject area was also applied. In particular, papers have been selected among 'social sciences', 'environmental science', 'engineering', 'business, management and account', 'decision science', and 'economics, econometrics and finance'. After this screening, a total of 121 documents were found. Then, the filters of 'article' and 'review' were also applied, resulting in a total of 100 documents. Finally, a chronological filter was applied, excluding papers prior to 2020 (only four papers). The screening process then involved the assessment of the abstract of each paper. Starting from this critical analysis of the abstracts, some of the identified papers were not been included in the present study because they refer to topics not closely related to the objective of the present research (e.g., papers on cataloguing industrial heritage), they refer to specific aspects that are strictly technical, they are duplicated studies, or they are mainly characterized by a conceptual approach. Therefore, based on the above filters, the literature review was conducted on 70 scientific papers.

As emerged from the scientific literature review, and also in line with the above analysed documents by TICCIH, one or more new uses are important to ensure industrial heritage sustainability over time but, at the same time, they have to respect the different values of the heritage, regenerating them and generating new ones able to ensure the authenticity of the reuse interventions [12] and to meet the changing community needs [13,14]. The flexibility of the identified uses is considered one of the success factors of the AR projects as it allows to the constant adaptation of space to new requirements. [15,16]. Doing so, the 'musealization', aimed mainly at attractiveness to tourists, and saturating and threatening the heritage, can be avoided [11].

The significance of abandoned industrial heritage goes beyond its productive function and also embraces historical, social, and cultural values [13,14], representing a guide to understand community roots and to orient design choices [17]. Thus, industrial heritage regeneration (and the related choice of new uses) or demolition becomes an evaluative issue depending on the involved values.

The early literature on the evaluation of abandoned industrial assets was focused on economic aspects [18]. Some studies have observed, for example, that property values are negatively affected by proximity to brownfield sites [18–25].

In more recent times, the attention paid to the environmental aspects is growing, especially following the recommendations of international institutions about the achievement of environmental sustainability objectives [3,4]. Ferronato et al. [26] state that the assessment of environmental aspects is linked to the mitigation of the permanent pollution caused by the activities located in these sites. Xie [27] proposes a life cycle model of industrial heritage development to integrate environmental aspects with socio-spatial ones, considering the interrelations among these aspects and the consequent changes in the site's identity. Kyaw et al. [28] use the Life Cycle Assessment (LCA) method to evaluate the environmental impacts of AR compared to new construction, demonstrating that AR design with minimal additional materials is preferable to other transformation scenarios and to new construction in environmental terms.

However, pollution—and more generally environmental issues—is only one of the aspects to be considered in the decision-making processes related to IHAR projects. In this framework, Zhao [29] identifies ecological restoration as a way both to face the problems related to land ecosystem degradation (soil destruction, water pollution, landscape fragmentation) and also the loss of local memory about the area. Also, Faramarzi and Khakzand [30], through a qualitative approach, adapt the landscape model to industrial heritage, the common thread of which is the eco-revelatory approach, an approach that emphasizes the physical relationship between the natural and built environment, and, at the same time, also highlights the cultural effects from such integration. The authors argue that the AR of landscape and industrial heritage produces impacts in terms of socio-cultural sustainability, strengthening and enhancing indigenous traditions, identities, and values. Jamhawi et al. [31] explain the success of a Jordanian case study in which the AR strategies were defined while also considering the non-physical values characterising the building's original use, thus allowing the reintegration of wheat milling buildings in modern urban contexts. Ertaş Beşir and Çelebi Karakök [32] identify a set of conservation and reuse parameters divided into two categories (site areas and the main production building) to assess the sustainability of IHAR projects from a conservation–use balance perspective.

As highlighted by the abovementioned authors, the IHAR processes are characterized by complexity. Thus, the IHAR is a kind of project that requires a holistic approach able to assess both tangible and intangible aspects, including different values and stakeholders' points of view, becoming a multi-criteria decision-making problem. Many authors highlight the potential and effectiveness of multi-criteria decision-making methods in the regeneration processes of industrial heritage buildings/sites [33–36].

Han Han and Zhang [37] highlight that it is absolutely necessary to consider both quantitative and qualitative evaluation methods. To assess the value of industrial heritage, Chen at al. [38] use the Analytic Hierarchy Process (AHP) model and propose a value matrix based on eight dimensions: history, art, society, culture, science and technology, economy, environment, and function. Along this line, Bottero et al. [36] propose a new application of the Preference Ranking Organization METHod for Enrichment of Evaluations (PROMETHEE) to support the design and implementation of AR strategies for abandoned industrial heritage in vulnerable contexts, and evaluate related tangible and intangible effects using a mix of qualitative and quantitative criteria. Claver et al. [39] propose an adaptation of the AHP method for developing and linking two criteria structures (one aimed at assessing heritage and another at analysing spatial compatibility with new uses), aiming at prioritising uses causing minimal harm to the heritage value to be conserved.

Anibarro et al. [33] compare different case studies based on a set of quantitative indicators divided into four main categories (urban, economic, social, and environmental), highlighting the complexity of the IHAR process.

Liu, Yijun et al. [40] propose an assessment model which combines the Delphi method and AHP for evaluating industrial heritage regeneration projects, highlighting that an effective evaluation can enable "the effective use of green technology, reduce construction costs, protect industrial heritage, and inherit historical culture". Bullen and Love [19] analyse, through interviews with different stakeholders, the positive (i.e., environmental benefits due to a reduction in demolition waste) and negative aspects (i.e., reuse costs) of IHAR. These positive and negative aspects concern the impacts strictly related to the industrial built heritage and, simultaneously, the impacts on the surroundings, in terms, for example, of social change and the local economy [41,42].

Knowledge of the existing heritage and its context is absolutely necessary to know its characteristics and values. According to Hu, Linhua et al. [43], detailed historical research and value assessment are necessary to identify the appropriate regeneration strategies. The value assessment needs to consider both heritage values and contemporary values [43,44]. They are different and often in conflict. The knowledge of the existing heritage and its context consists of both expert and common knowledge. Regarding the first, some authors highlight the need for the use of tools for systematizing information (such as BIM). Regarding common knowledge, on the other hand, the need to involve different stakeholders, with a particular focus on the community, emerges several times. The involvement of different stakeholders is important in different phases of the decision-making process. In fact, as many studies highlight [45,46], IHAR requires public participation to reduce the conflict between different interests and values. This aspect emerges from several of the scientific papers analysed.

Masoud and Gharipour [16], involving different exponents of expert knowledge, apply a methodology that integrates the ANP (Analytic Network Process) and Fuzzy-DEMATEL

(Decision Making Trial and Evaluation Laboratory) methods to weigh cultural values in heritage reuse projects. The results of their investigation show that sensory-related values carry more weight than others and that values related to aesthetics and age are the most influential in decision-making.

The inclusion of different stakeholders in the decision-making processes allows the recognition of industrial sites as part of cultural heritage [17,47] and can contribute to fostering collaboration among them towards new innovative circular governance models [48].

Questions and observations from different stakeholder categories can help guide how industrial heritage can be reused. Alavi, Pari et al. [49], starting from a series of interviews, for example, stress that the decision-making and evaluation process of IHAR should not refer to and be limited to the design of a single building, as it can become a catalyst for the regeneration of other buildings and nearby areas and produce impacts, tangible and intangible, on the surrounding environment.

Madani et al. [50] also highlight the importance of knowing the points of view of different stakeholders in identifying effective criteria and indicators for assessing design alternatives.

Vizzarri et al. [51] propose the Optimised Analytic Hierarchy Process (O-AHP) model as a holistic approach able to compare AR projects based on the involvement of different panels of experts. Guo et al. [52] highlight how the lack of quantification of the core driving force of IHAR often causes difficulties for policy makers in planning and identifying development strategies. To this end, they identify, from a scientific literature review and interviews, 25 sustainability drivers that need to be evaluated to understand the sustainability of these projects. Studies by Scaffidi [53] and Ben Ghida [54] demonstrate that the participation of different categories of stakeholders in the decision-making processes for IHAR can foster social innovation, which has a key role in the territorial innovation of cities and fringes and strictly depends on the location, new uses, and regeneration model. Yang [55] analyses the role of a cultural governance and multiple stakeholders' involvement in the social production of cultural spaces in Hong Kong and Taipei and highlights how a culture-led approach guarantees urban regeneration strategies that are more respectful of local communities.

Some studies focused on the aspects linked to the user's satisfaction related to industrial heritage regeneration projects. Meng et al. [56] propose the IPA (Importance–Performance Analysis) evaluation method to evaluate the degree of user satisfaction with the spatial reuse through six dimensions: functional replacement, transportation accessibility, carrying capacity, public space, boundary form, and recognition of value. The IPA method was also used by Han et al. [57] to evaluate tourist satisfaction after the reuse of industrial heritage buildings, demonstrating the tourists' preference for spatial environmental elements, social cultural elements, and landscape and greening elements, despite the low satisfaction with supporting facilities elements and transportation location elements.

Huang et al. [58] combine Structural Equation Modelling (SEM) and Importance–Performance Analysis (IPA) to establish a satisfaction evaluation model of IHAR to support the identification of weaknesses that threaten the heritage. They demonstrate that history, culture, and placeness are the factors that are most influential on the satisfaction level of a project. Bazazzadeh et al. [59] highlight the lack of analysis of the psychological dimension related to industrial heritage and conduct a study on the impacts of reuse of this heritage on distribution patterns of natural movement, showing that industrial heritage has positive impacts on urban networks by positively influencing average rates of movement.

As emerged from the analysed papers, there are different uses that can be localized in the regenerated industrial states, such as cultural, touristic, residential, commercial [60–63], and, more rarely, housing uses [64]. In this framework, Jarczewski and Koj [65] show that commercial services are located mostly in brownfields closer to the city centre, while manufacturing and investment activities are located in areas further away. In addition, the results of their study show that there is also a relationship between the cultural value of heritage and the new functions identified. More public services are located in brownfields characterised by a higher cultural value than commercial services or manufacturing plants and investment zones. With respect to residential use, no significant relationship was observed.

Starting from this complex framework characterising the IHAR processes that emerged from the literature review, the landscape approach is adopted [66] here. It is considered in this study as a 'lens' through which to interpret the different perspectives of the urban system, considered as a complex adaptive system [67]. This approach offers and obliges a systemic view of the landscape and its transformation, and includes all the complex interdependencies between natural and man-made components and the subjects living in them, as also defined by the European Landscape Convention [68]. These tangible and intangible characteristics define the 'unique' character of the landscape, that is its 'intrinsic value', which is the result of the way in which the different components interact and influence each other, determining the complexity of the system. Therefore, as Corboz states [69], "what counts in the landscape is not so much its objectivity as the value attributed to its configuration".

Furthermore, the reference to the intangible dimension highlighted by TICCIH in the aforementioned documents recalls the notion of 'intrinsic value', which, is rather neglected in the existing literature concerning IHAR. Among the papers analysed in this literature review, the study by Meng et al. [56], use the Improved Entropy Technique for Ordering Preferences by Similarity to the Ideal Solution (Improved Entropy TOPSIS) for the assessment of AR potentiality in industrial heritage based on three values in reference to the building and the urban dimension: the autologous value, the retrofitting value, and the potential benefit value. The authors consider the autologous value as an object's inherent value which determines, according to the evaluation results, if the reuse is feasible. The notion of intrinsic value, already introduced by Ruskin [70] and Morris [71] and later taken up by Riegl [72], was introduced in the field of cultural heritage conservation by the Burra Charter [73,74].

The concept of intrinsic value has recently been adopted in a document by the European Parliament [75] which acknowledges culture's dual nature as a value 'in and of itself', separate from instrumental values such as economic and social ones. The intrinsic value is connected to the 'spirit of places' [71] and the knowledge embedded in a certain site that reflects its history, which has given physical-spatial form to the relationship between man and nature over time, resulting in a specific identity.

However, decision-making processes concerning IHAR cannot ignore the role that intrinsic value plays in orienting development choices in such areas. This contribution intends to fit into this gap, adopting a value-based approach for the development of scenarios in IHAR, starting from the tangible and intangible characteristics that define the landscape system.

2.1. Good Practices of Abandoned Industrial Heritage Sites Regeneration

After the industrial crisis, how to extend the life cycle of decommissioned plants became a central issue. To date, many good practices demonstrate that they can be an opportunity for regenerating the whole urban system. Some of them are presented below, selected considering their size, their territorial context (urban centres, peri-urban centres, regional areas), and their characterisation in terms of both historical and productive values [76].

'Seattle's Gas Works Park' (decommissioned in 1956) is significant for the recovery of the coal gasification plant ruins, and is the only one of its kind in the USA. The active involvement of the local community in the regeneration process has significantly oriented the definition of the design strategy towards 'returning' the land to the community and re-generating an emotional connection with the Gas Works Park.

In the vast Ruhr region (Germany), the local government has worked to radically transform the 'rust belt' into a green, modern, and prosperous metropolitan area. Local authorities and communities have actively collaborated in the regeneration project of 'Emscher Park', located in this region, focusing on soil and water decontamination, biodiversity preservation, and industrial heritage conservation. Emscher Park comprises more than one hundred projects that include spaces dedicated to cultural and recreational functions in close relation to the existing factories and organised as a system of interconnected parks (the train tracks have been re-functionalised as cycling and pedestrian infrastructure).

'Parco Dora' is an attractive hub in post-industrial Turin (Italy) resulting from the transformation of the ex-Fiat steelworks area (decommissioned in 1992). Today, after the partial demolition of some buildings, it appears as a large green area organised into five areas, each of which is characterised by specific functions and features of the industrial ruins.

In Paris (France), the 'Jardin de Préfiguration' on Île Seguin is a wide project that valorises the industrial past and the exceptional geographical location of the island. The garden has been designed to enhance the memory of the place by reinterpreting the geometric shapes of the ruins of the Renault factories (decommissioned in 1992) through a temporary landscape of natural plants. The ideas of this project allow the development of contemporary urban spaces, temporary in function but rich in history and identity.

The above good practices demonstrate that the involvement of community is a key factor in the success of industrial heritage regeneration projects. Furthermore, they demonstrate that, while attributing new uses to industrial heritage to meet the needs of the contemporary community, it is possible to preserve the intrinsic value and memory of this heritage, maintaining a synergistic relationship between the past and present and ensuring that these assets—that no longer serve the original function for which they were built—are not 'left to die' (becoming an element of degradation of the territories).

3. Methodology and Indicators Overview

As already discussed in Section 2, intrinsic value plays a key role in the regeneration of historic brownfield sites, orienting their transformation and aiding in determining their use, reuse, and management (Figure 1). The intrinsic value represents a basis for establishing any new use or purpose connected to a new project/strategy, providing a creative synthesis of the hybridisation process between memory and innovation [67]. It provides the 'insuperable' limit in change management [77].

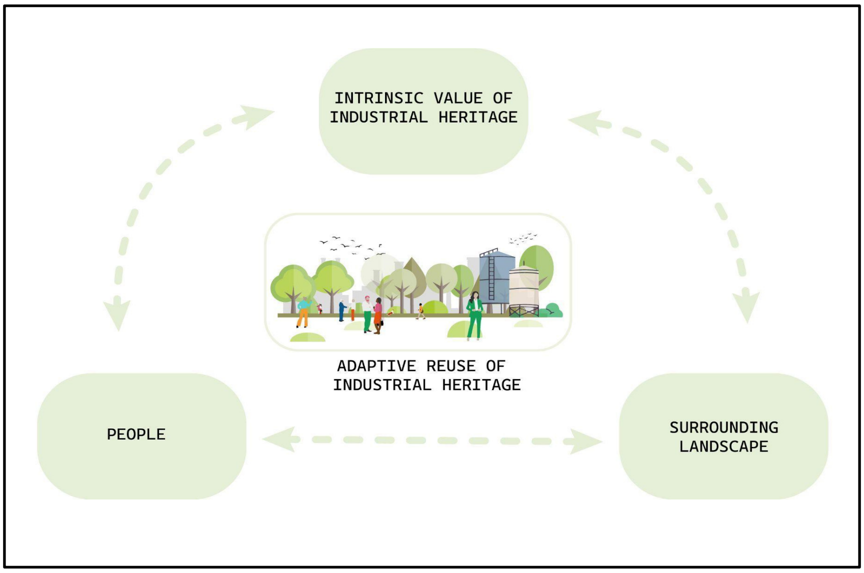

Figure 1. Theoretical background of IHAR from the circular economy perspective.

The evaluation framework for assessing the multidimensional impacts of regeneration projects/strategies, from a circular economy perspective, for brownfield sites characterised by cultural values has to recognize and include this value.

The evaluation framework here proposed is based on a set of criteria and indicators divided into four categories: socio-cultural, economic-financial, environmental, and physical-spatial. The proposed indicators are multidimensional, covering quantitative and qualitative, objective and subjective-perceptual, and tangible and intangible aspects.

The set of indicators has been elaborated starting from research previously developed by the authors concerning literature reviews and case studies of AR [78,79]. These indicators have been appropriately integrated using indicators deriving from the critical analysis of international documents [4] and further scientific papers focused on IHAR from the circular economy perspective (see Section 2). The initial set of indicators has been modified, adapted to industrial heritage and shortened, thanks to the consultation of representatives of expert knowledge through open interviews and consultation sessions with experts in urban planning and in evaluation, as well as with the experts consulted during the participatory process described in Section 4.

The socio-cultural dimension reflects the value-based approach adopted in this study: the indicators concern the social and cultural values that characterise the area and its context, considering the consistency of the regeneration project with the tangible and intangible values. The sense of safety depends on different factors related to tangible aspects (such as the presence of security services, etc.), but also to cross-cultural dialogue and conflict prevention and resolution [80]. The latter is the interpretation adopted in this proposed operational framework, in which the indicator related to the safety concept is linked to the capacity of the IHAR project to meet the interests of different stakeholders, thus reducing conflicts. Furthermore, the IHAR project should reduce possible conflicts between visitors/tourists and the local community [81], thus stimulating integration between their different cultures. Furthermore, the indicators referring to the recovery of traditional know-how, the production of knowledge, and the respect of identity value are linked to the capacity of IHAR to generate and regenerate knowledge over time, passing it on to future generations, which is consistent with the circular economy principles.

The economic-financial dimension aims at assessing the contribution of the regeneration project to the economic attractiveness and vibrancy of the industrial site, while also considering its capacity to self-sustain over time and thus reducing or avoiding financial supports from 'external sources' (public, private, or social institutions), which is in line with the circular economy principle.

The environmental dimension analyses the main components that should characterise AR projects. Actions aimed at promoting the improvement of green areas, the use as far as possible of renewable energy, energy self-sufficiency, and the re-balancing of the relationships existing among the different components of the system need to be implemented [82]. AR is structured by assuming as a reference the organisation of the natural system, based on cooperation/collaboration and the closure of loops, avoiding waste production. The circular relationships within the ex-industrial area and between it and its context can be implemented for restoring the physical connectivity and also the balance between the natural and anthropic ecosystems.

The circular relationships within the industrial area and between the area and its context have direct implications also in the physical-spatial dimension, which also reflects the inter-relationships between the urban and the social form [78,79] as well as how they influence each other. This category examines the transformations of the physical space provided by the project, considering the morphological and functional (circular) relationships with the context. Furthermore, this category focuses on public spaces, as they contribute to a better quality of life [83]. Thus, the indicators include, for example, aspects concerning the conservation of the aesthetic relationship between the site and the context, the space's flexibility (characteristic linked to the circular economy model), and fulfilment of the community's requirements.

However, the four dimensions cannot be considered separately, as they are closely interconnected [78,79].

Furthermore, the evaluation process also includes subjective-perceptual aspects, involving different stakeholders. A participatory dialogue (engaging 'expert' and 'common' knowledge) is necessary to incorporate the so-called 'intrinsic value' into the decision-making process. This value is the product of a 'social construction', and thus local community participation is important for its interpretation [67].

The evaluation framework includes indicators that are linked to the expression of the different factors contributing to the intrinsic value of the heritage. The intrinsic value is irreproducible (unlike instrumental value) and is therefore linked to certain factors of cultural heritage such as authenticity, integrity, and identity value recognised by the community [77]. These factors were included in the proposed evaluation framework through the identification of specific indicators to assess some of the different factors that can contribute to the preservation/regeneration of intrinsic value (which represents the aforementioned 'insuperable' limit to change), while transforming heritage to meet new needs. Furthermore, intrinsic value is generated by people, and, thus, to assess it, the community's involvement is necessary. In fact, some indicators come from the participatory process. Intrinsic value represents a key factor in the proposed evaluation framework as it allows assessing how each regeneration project scenario is able to preserve or enhance the site's historical and cultural values, together with environmental and social ones.

The active involvement of the community runs through the entire decision-making process, from knowledge to the co-design of alternative scenarios, as result of a shared vision. In evaluation terms, participation is also reflected in the attribution of weights to the different indicators.

Multidimensional impact assessment on the basis of the proposed framework necessarily requires the use of multi-criteria evaluation methods, which are particularly suitable for analysing contexts characterised by a high complexity of values [84].

Here, below, the proposed evaluation framework for assessing IHAR is presented (Table 1). For each aforementioned dimension, criteria, indicators (with their identification number), and related units of measure have been identified.

Table 1. The proposed evaluation framework for assessing IHAR.

Dimension	Criteria	Indicator	Unit of Measure
Socio-Cultural	1.1 Safety	Level of capacity of the IHAR project to meet at the same time interests of visitors and local community	Likert Scale
	1.2 Traditional skills	Percentage of new functions aimed at the transmission of traditional skills	Yes/Not
	1.3 Knowledge sharing	Level of capacity of the IHAR project to share knowledge about the story site	Likert Scale
	1.4 Cultural attractiveness	Level of cultural vocation of new functions	Likert Scale
	1.5 Employment	Number of different new direct long-term jobs opportunities (diversification) in the area	No.
	1.6 Associationism	Percentage of associations to be potentially involved in the management of new functions on the total of associations active in the area	%
	1.7 Compatibility with local identity	Level of consistency of the project with identity value recognised by the local community in the area	Likert Scale
Economic-Financial	2.1 Commercial units	Percentage of new commercial functions in the regenerated area on the total of useful surface	%
	2.2 People attractiveness	Diversification of users categories potentially attracted by the new functions	No. of different users categories attracted by the new functions
	2.3 Entrepreneurial attractiveness	Capacity of the IHAR project to attract creative and innovative enterprises in the area	No. of creative and innovative enterprises attracted in the area or Likert Scale
	2.4 Financial self-sustainability	Annually capacity of the IHAR project to self-produce financial resources	€ per year or Likert Scale
	2.5 Financial investment attractiveness	Annually capacity of the IHAR project to attract private and public investments	€ per year or Likert Scale

Table 1. *Cont.*

Dimension	Criteria	Indicator	Unit of Measure
Environmental	3.1 Energy consumption	Level of energy consumed by activities provided by the IHAR project from renewable sources	KWh per year or Likert Scale
	3.2 Greenery	Amount of green areas on the total surface of the site	% or m2
	3.3 City-sea relationship	Level of free accessibility of coastline by the project on the total existing coastline	Likert scale
	3.4 Slow mobility	Number of different kinds of sustainable/slow mobility provided by the IHAR project	No.
	3.5 Functional integrability	Level of integration between new functions in the area and existing functions in the neighborhood	Likert Scale
Physical—Spatial	4.1 Operating costs	Annually costs required for the operation of activities provided the IHAR project	€ per year or Likert Scale
	4.2 Conservation of aesthetic relationship between the site and the context	Level of capacity of the IHAR project to preserve morphological-dimensional relationship between the site and its context	Likert Scale
	4.3 Space flexibility	Level of capacity of the space to be adapted to different functions over time	Likert Scale
	4.4 Publicness	Amount of areas for free public use on the total surface of the site	% or m2
	4.5 Compatibility with community's needs/requirements	Level of capacity of the IHAR project to meet the needs/requirements of the local community	Likert Scale
	4.6 Functional compatibility	Level of compatibility of the new uses with the spatial characteristics of existent buildings/site	Likert Scale

4. Case Study: Ex-Italsider in Bagnoli District, Naples (Italy)

4.1. Historical and Spatial Overview of the Case Study

The proposed evaluation framework was applied in the case study of the ex-Italsider industrial area in Bagnoli, a peripheral district along the north-west coast of Naples (Italy) (Figures 2 and 3).

The industrial plant was built in 1904 following the 'Special Law for the Resurgence of Naples'. The first steel plant (named ILVA), with its 12 hectares and three 150-tonne blast furnaces, constituted one of the most important industrial hubs in southern Italy for thirty years.

After the Second World War, the industrial site, heavily damaged by bombing, was rebuilt, initiating a long period of economic prosperity and, with the establishment of the Italsider company, reached a size of 200 hectares.

Between the 1970s and 1980s, with the decline of the steel industry, the progressive decommissioning of the site began, which lasted until 1991 when the plant closed.

The history of the former Italsider in Bagnoli reflects the complexity of industrial, economic, and social transformations in the 20th century and beyond. The closure of the steel plant, and the consequent abandonment of the site, significantly impacted the city-system in environmental, socio-cultural, and economic terms.

After the closure of the plant, a series of projects (and 'promises') for the regeneration of the ex-Italsider area have followed which, to date, have only been partially realised, with punctual interventions being considerably far from a systemic logic and satisfaction of the community's needs.

In 1994, a first phase of decommissioning and reclamation of the area was initiated, established by a resolution of the Interministerial Committee for Economic Planning and Sustainable Development (Italian: CIPESS). CIPESS identified ILVA (which was closing at that time) as the entity responsible for the reclamation and financed the operation with almost 400 billion lire. However, considering the severity of soil pollution at the site and ILVA's difficulty in carrying out the reclamation activities due to its difficult financial situation, these activities were transferred to other entities. Specifically, in 1996, Bagnoli S.p.a. was established to implement the reclamation works. During investigations, a high presence of heavy metals in the subsoil and traces of iron, manganese, and hydrocarbons in the waters exceeding regulatory limits were found.

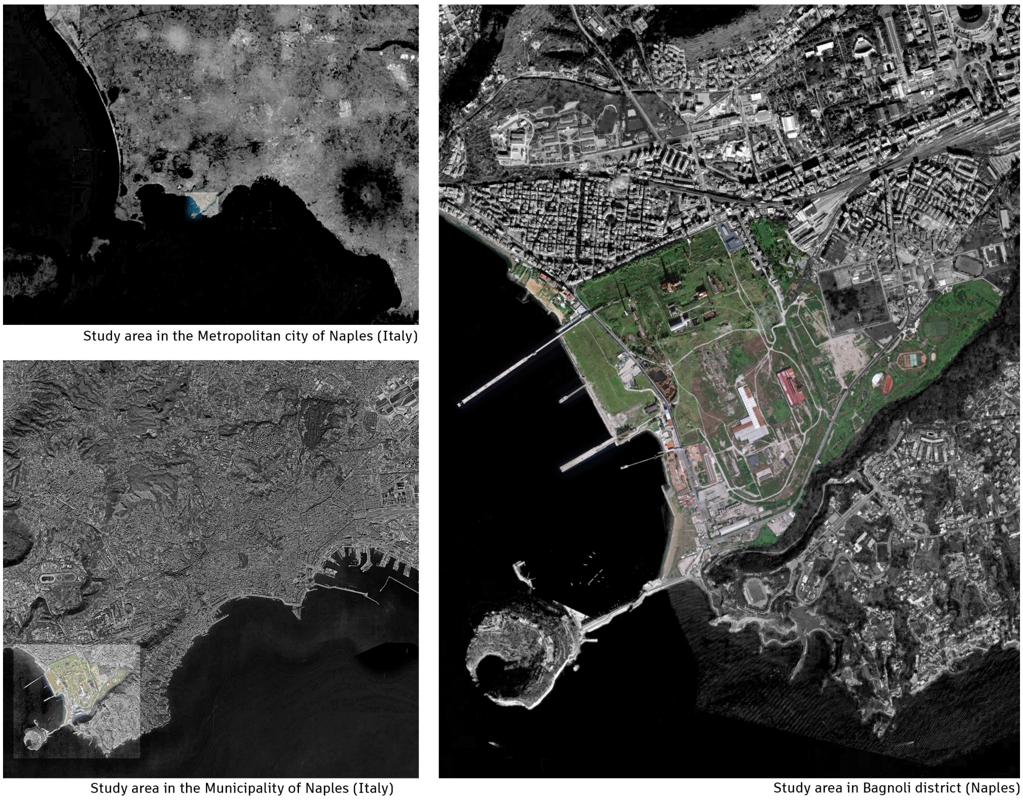

Figure 2. Territorial framework of the study area.

Figure 3. The main elements characterizing the study area.

In 2001, due to delays in the work by Bagnoli S.p.a., the Municipality of Naples decided to fully purchase the ex-Italsider and ex-Eternit area, except for the ex-Cementir area. Having become the owner of the spaces, the Municipality established the Urban Transformation Company (Italian: STU), as provided by the 'Piano Urbanistico Esecutivo' (PUE) Bagnoli-Coroglio. In 2002, Bagnolifutura S.p.a. was founded, replacing the previous Bagnoli S.p.a., and was tasked with managing, reclaiming, and developing the land according to the plan, selling the remaining lots to private entities. At the centre of Bagnolifutura's transformation was the Urban Park project, which included a total area of 160 hectares, with 33 hectares of beach.

The 'Porta del Parco', a large multifunctional centre comprising 12,500 m^2 dedicated to wellness and tourism and designed by Silvio D'Ascia, and the 'Parco dello Sport', at the foot of the Posillipo cliff, were built. Here, the land was reshaped to create a 'crater' system that mimics the typical morphology of the Phlegraean Fields.

In 2011, two of the seven available hectares were seized due to the lack of reclamation, deterring investors and leading the project to fail. In 2013, a series of events, including an arson attack on the 'Città della Scienza', contributed to the crisis of Bagnolifutura, which worsened in April of the same year. The ex-Italsider and ex-Eternit areas of Bagnoli were seized as part of an investigation by the Naples Public Prosecutor's Office, which hypothesized an environmental disaster. A judicial custodian, an official from the Ministry of the Environment and Land and Sea Protection of Italy, was appointed, and at the same time, Bagnoli was recognized as a Site of National Interest (SNI) due to soil and water contamination from past industrial activities. This recognition meant that the reclamation and redevelopment of the area became a national priority, with coordinated state-level interventions.

In 2016, the Italian Government, through Decree Law no. 185/2015, designated Invitalia, the National Agency for Inward Investment and Economic Development, as the implementing body for the remediation and redevelopment of the Bagnoli area. The Environmental Remediation and Urban Regeneration Plan of Bagnoli (Italian: PRARU), developed by Invitalia, was presented. The areas surrounding those included in the Bagnoli-Coroglio Site of National Interest would be involved in integrated and coordinated interventions with those defined in the PRARU.

In 2019, the operational phase of the plan began, with the first reclamation and safety measures for the area. In 2020, Invitalia launched the international ideas competition, 'UrbaNAture', for the urban regeneration of the Bagnoli area. The 'Balneolis and the New Felix Season' project by S.B.Arch Studio Bargone Architetti Associati won the competition in 2021, defining the new landscape of the ex-Italsider area, which included a large urban park spanning 120 hectares of the total 250. The project is divided into three areas: the natural park, with the recovery of natural features and an ecological network connecting the sea to the hills; the productive forest, with the return to ancient and native tree species' cultivation; and the urban park, closer and functional to the residential neighbourhood and new constructions. Finally, in 2022, the Mayor of Naples was appointed Government Commissioner for environmental reclamation and urban regeneration of the Bagnoli Coroglio Site of National Interest, and a technical support structure was established to assist him.

4.2. Structuring of the Decision Problem

The ex-Italsider represents a testimony of the material and immaterial culture that has contributed to shaping the surrounding landscape. It is characterised by a complex system in which various factors interrelate, such as nature, economy, history, culture, and the built environment. It is not only 'history' because of its years of existence and the links with the generations that have lived near it; it is a witness of knowledge and human stories, events, and productive values. In other words, it is a 'cultural heritage'. Therefore, the regeneration of this heritage necessarily requires its deep understanding.

The first step in structuring the decision-making problem was related to sourcing the knowledge of the study area (and its context) through 'hard' data, which are quantitative and can be deduced mainly from official sources, and 'soft' data, which do not come from statistical sources but can be deduced mainly through interviews and observation.

The development of the knowledge framework, covering the economic, environmental, and socio-cultural dimensions, was developed from the timeline reconstruction of events and policies that have characterised the area over time, the analyses of the urban plans in force, the current status (ruins of the industrial heritage), the health status of the soil, the natural system, the road system, the infrastructures and accessibility, and the neighbourhood facilities and services. In addition, thematic maps were drawn up, such as the maps of associations, of active and inactive projects, and of informal uses of the space.

However, the aforementioned analyses, although absolutely necessary, are not sufficient to have holistic knowledge of the ex-Italsider area. They do not capture the intangible values, including the intrinsic value [85]. Moreover, they do not capture all the subjective-perceptual aspects that can be identified through the integration of 'expert' knowledge with 'common' knowledge.

In the complex project of ex-Italsider AR, different (and often conflictual) values, needs, and interests come into play, because different subjects and actors are also involved. Therefore, a participatory process involving both 'expert' and 'common' actors was activated. In the first phase, a stakeholder analysis was elaborated in order to identify the different stakeholders that could be involved.

In the participatory process, both expert and common knowledge have been involved, including interactions with different representatives of institutions, public/private bodies, and the community. In particular, the stakeholders are divided in four categories (Academy, Entrepreneurs, Local and National Government, Third Sector) which are described below.

In the Academy category, researchers and professors from the Department of Architecture of the University of Naples Federico II, Italy (experts in design, urban planning, and evaluation with more than 10 years of experience) have been involved.

In the Entrepreneurs category, a representative of 'Città della Scienza' (a currently functioning science centre in the ex-Italsider area) who also worked there for around 8 years, a representative of the theatre academy located in the 'Porta del Parco' (a functioning cultural hub in the ex-Italsider area), and a representative expert in urban planning of the Invitalia National Agency (PRARU implementing body) have been consulted.

In the Local and National Government category, a representative of the commissioner body (established in 2001) and one of the municipality (expert in urban planning) have been involved.

Finally, regarding the Third Sector category, representatives of three main associations that are active (one of them for nearly 100 years and two of them for around 10 years) in the Bagnoli district and that pay particular attention to the restitution of the ex-Italsider area to the community have been consulted.

Representatives of expert knowledge have been involved through unstructured interviews in which the respondents shared their knowledge related to the study area. These interviews aimed at identifying criticalities and potentialities, as well as possible future transformation scenarios for ex-Italsider sites.

The community was involved through structured interviews. In particular, a structured questionnaire has been administered online (through Google Forms) to identify community needs, desires and requirements, as well as feelings, values, and perceptions regarding the ex-industrial area. The questionnaire was disseminated through social networks and through the associations operating in the area who acted as spokespersons for the distribution of the questionnaires both among their members and the community in general. A total of 108 responses have been collected over a three-month period.

The results of the participatory process were returned through maps and interpretive diagrams related to perceptual aspects, both cognitive and attributive [86], community needs and requirements, and the views of different stakeholders.

A critical-interpretive approach to all the analyses allowed the identification of strengths and weaknesses characterising the area. The failure of the projects developed over the years emerges among the weaknesses, negatively affecting the regeneration potential of the area and the community's interest in and knowledge of the site. These failures continue to make the former Italsider physically and socially perceived as unlinked from its surroundings. Moreover, the high soil pollution is a further critical element that slows down the regeneration of the area and negatively affects the inhabitants' wellbeing. The beauty of the surrounding landscape (near the Posillipo hill and the sea) and the potential of reuse of the industrial ruins, are still identified as the main strengths.

The interaction between experts and local stakeholders contributed to a high level of knowledge and awareness of the area and its context, which is fundamental for developing bottom-up regeneration strategies that are closely linked to the spirit of the place, coherent with the tangible and intangible values, and coherent with the declared objectives and preferences.

4.3. Alternative Regeneration Project Scenarios

Starting from the knowledge phase, five alternative regeneration scenarios have been identified. They include, among the proposed functions, a set of culture-based functions also aimed at preserving and handing down the memory of the area through knowledge sharing. Some of the identified functions are in line with the ones proposed by the PRARU. However, new functions have been identified which are coherent with the strategic guidelines of the PRARU, starting from the participatory processes in order to also meet the emergent community's needs and requirements.

Scenario 0 corresponds to the status quo; three scenarios (1, 2, 3) envisage adaptive reuse of the industrial heritage; and the last scenario (4) provides the demolition of all industrial ruins, turning the area into a post-industrial green park. To facilitate the recognition of the different alternatives, each scenario has been named in reference to its prevailing vocation and the functional mix is detailed below. However, they are all characterized by a mix of functions, as also detailed below. Scenario 0 does not envisage any transformation of the area, without addressing the current fragilities linked to accessibility and usability of the area, as well as to the environmental and social dimensions.

Scenario 1 proposes the transformation of the ex-Italsider into an 'Industrial Heritage Ecomuseum', where original industrial plants are turned into a 'living' testimony of the area's history. The ecomuseum aims to preserve and enhance the landscape, history, traditions, and natural resources of the area, providing an engaging experience for visitors through the support of informative and interactive panels, as well as information points and ticket offices localized at the park's main entrances, from both the Coroglio village area and the Bagnoli district, identified along the perimeter and near Cementir, the north pier, and the chimney. Additionally, this scenario includes a tourist reception and guides, a bookshop, green spaces, cycle paths, bike/scooter sharing stations, exhibition areas, workshop areas, and projection rooms. The bike/scooter sharing stations, the outdoor exhibition, and the workshop areas are distributed within the park, particularly near the steelworks and the water bodies on Coroglio Street. Furthermore, as envisaged in the Invitalia competition, a recreational area with free access to the beach is planned, directly connected to the ecomuseum park. The lighting is designed to enhance the exhibition spaces located near the industrial buildings and to guide visitors along the routes that cross the park.

Scenario 2 envisages a vibrant and attractive 'Tourist-Commercial Hub' providing services able to meet the visitors needs and, simultaneously, stimulating local economic growth and strengthening the bond between the local community and tourists. This scenario includes a large 'diffuse' accommodation facility with recreational and meeting spaces usable by both tourists and the community. In the area of Coroglio Street and the reclaimed land, there are shops, restaurants, and bars that primarily sell local products, as well as tourist services and activities (such as experiential workshops) and a medical service. The beach is transformed into a sustainable and lively space with a small marina (equipped with a 'Bagnoli boat' service) and nightclubs. Slow mobility paths traverse recreational areas and outdoor event spaces envisioned in the heart of the former industrial site, where traces of settlements adjacent to the Morgan sheds are no longer recognizable. This scenario aims to enhance the excellence and heritage of the former industrial area by embracing the tangential marine and hilly contexts, structuring new spatial and functional relationships between the coastline and the adjacent neighbourhoods.

Scenario 3, the 'Socio-Cultural and Sports-Educational Hub', transforms the site into a vibrant socio-cultural and sports-educational centre integrated with a university hub located between the north pier and the overhead crane. The new multifunctional space provides services and opportunities for community wellbeing and promotes learning, entertainment, and socialisation, as well as repurposing the archaeological heritage. The park, designed for pedestrian and slow mobility transport, features educational gardens on sustainable agriculture in the former steelworks area and recreational and sports areas (both indoor and outdoor) that rehabilitate and integrate the existing sports park located on the slopes of the Posillipo Hill. This scenario offers community services, association spaces, multifunctional venues for art exhibitions and cultural events, student accommodation, classrooms, a municipal library, and a museum of memory for making people aware of the local history. Additional facilities include a cinema, spaces to promote the arts, and a market area selling local products, which support and revitalize the local economy. The scenario aims to completely redefine the edge of the former industrial site, fostering integration between new residents of the park and the historic residents of the neighbouring districts of Bagnoli, Coroglio, and Cavalleggeri d'Aosta. The beach is open and equipped for recreational activities.

In Scenario 4, the 'Post-Industrial Green Park', irreversible demolition actions of all industrial plants are planned. It turns the area into a large, equipped park, characterised by the predominant naturalistic component. Picnic areas, urban and theme gardens, and educational farms are conceived to promote a new identity based on km0 production. In addition, the park provides various activities for all age groups both for locals and visitors: outdoor fitness trails, areas for rehabilitation and social reintegration, recreational spaces for the elderly, play areas for children, and an arena space for events. Moreover, this scenario fosters a new identity while preserving 'the past' through information panels and augmented reality related to the area's history located in the exact spot where the industrial buildings once stood. All scenarios are equipped with facilities such as parking spaces, toilets, refreshment areas.

4.4. Multi-Criteria Evaluation

The five project Scenarios were evaluated using the 'Technique for Order of Preference by Similarity to the Ideal Solution' (TOPSIS). This multi-criteria evaluation method is used in different fields to support decision-makers in choosing among different project alternatives because it allows the assignment of cardinal weights through stakeholder participation, considering both qualitative and quantitative data which are referred to the different scales [87].

Based on the evaluation objectives and available data, the TOPSIS method has been considered appropriate among the existing multicriteria evaluation methods. In fact, this method is suitable for comparing alternatives using both quantitative and qualitative data, which are both important in the AR processes. Furthermore, the early stage of design, and related evaluation, is based on strategic project lines rather than detailed projects. Therefore, unlike more advanced and detailed design phases, this is less quantitative information. Moreover, considering the object of the evaluation, characterized both by tangible and intangible values, the qualitative data are important to consider.

As Zeleny also highlighted [88], TOPSIS is used for four main reasons: its logical rationality and understandability, the simplicity of its calculations using matrices in Excel sheets, its capacity to identify the preferable alternatives for each criterion in a straightforward mathematical form, and the integration of weights in comparison procedures. Additionally, TOPSIS allows the assignment of cardinal weights, results in a comprehensive ranking, and facilitates stakeholder participation through weight assignment. This method includes five operative steps [84] that are described below in relation to the project evaluation.

1—Defining decision matrix: the evaluation framework is defined through the decision matrix *X*:

$$X = (x_{ij}), \tag{1}$$

where $x_{ij} \in \Re$. After defining the evaluation framework, the performance of the alternatives is assessed according to each indicator, assigning a numerical value expressing quantitative or qualitative data. The evaluation matrix (Table 2) includes, for each dimension, the indicator, the related unit of measure, and the performance level for each scenario. In the case study of the Ex-Italsider area in Bagnoli, intrinsic value plays a key role in the evaluation process. Incorporating intrinsic value—defined by historical, cultural, and social significance—into the multicriteria evaluation framework ensures that the heritage and identity of the site are preserved and respected. The application of the framework to the ex-Italsider area demonstrates that considering intrinsic value alongside other criteria leads to more balanced and sustainable decision-making outcomes. IHAR projects prioritizing intrinsic value are able to ensure that the benefits are not only economically and environmentally sustainable, but also culturally and socially meaningful.

The proposed evaluation framework allows assessing how each regeneration project scenario would preserve or enhance the site's historical and cultural value. For instance, scenarios that preserve the spatial integrity of historical buildings and sites or promoted community engagement with the site's history were rated higher in terms of intrinsic value.

As the decision matrix shows (Table 2), the indicators are multidimensional. The data to populate the indicators depend also on the level of depth of the project [89]. Since the project described in this document is at a strategic level, quantitative data cannot be identified for all the indicators; thus, the information are qualitative, related to the level of consistency of each scenario in relation to a specific indicator. Therefore, some of the indicators have been assessed through the Likert scale [90] based on the expert knowledge.

Other indicators, instead, are quantitative and have different units of measure. For example, the indicator '1.5 Employment' has been calculated considering the different typologies of the identified functions and the related involved employment categories (i.e., managers of functions, technicians, maintenance staff, security staff, etc.). The indicator '1.6 Associationism' has been calculated considering the percentage of associations that could be involved in the management of the new functions, compared to the total number of associations active in the area, based on their mission identified during the knowledge phase of the decision-making process (mapping of associations). The indicators '2.1 Commercial units', '3.2 Greenery', and '4.4 Publicness' have been calculated considering the buildings/areas that could be potentially reused with the indicator-related function in relation to the total amount of available surface. The indicator '2.2 People attractiveness' identifies user categories which might be attracted to the new functions in the area (i.e., athletes, tourists, local visitors, academics, etc.). Thus, considering the new identified functions, on the basis of market research, the different categories of users for each function have been identified. This indicator helps to understand how varied the new functions introduced in the area are and how widely they attract different segments of the population.

Table 2. Decision matrix for evaluating the performance of project alternatives.

Dimension	Indicator	Unit of Measure	Scenario 0: Status Quo	Scenario 1: Industrial Heritage Ecomuseum	Scenario 2: Commercial Tourist Hub	Scenario 3: Socio-Cultural and Sport-Educational Hub	Scenario 4: Post-Industrial Green Park
Socio-Cultural	1.1 Safety	Likert Scale	1	5	2	3	4
	1.2 Traditional skills	Yes (1)/Not (0)	0	1	0	1	0
	1.3 Knowledge sharing	Likert Scale	2	5	3	5	4
	1.4 Cultural attractiveness	Likert Scale	1	5	2	5	3
	1.5 Employment	No.	9	18	35	46	32
	1.6 Associationism	%	5	70	10	100	100
	1.7 Compatibility with local identity	Likert Scale	2	5	3	4	1
Economic-Financial	2.1 Commercial units	%	0	9	22	15	7
	2.2 People attractiveness	No. of different users categories attracted by the new functions	6	7	13	19	19
	2.3 Entrepreneurial attractiveness	Likert Scale	1	3	4	4	2
	2.4 Financial self-sustainability	Likert Scale	1	3	2	5	2
	2.5 Financial investment attractiveness	Likert Scale	1	3	5	4	2
Environmental	3.1 Energy consumption	Likert Scale	1	3	5	5	2
	3.2 Greenery	%	85	80	65	70	90
	3.3 City-sea relationship	Likert Scale	1	5	2	4	4
	3.4 Slow mobility	No.	0	2	2	2	3
	3.5 Functional integrability	Likert Scale	1	4	3	3	4
Physical-Spatial	4.1 Operating costs	Likert Scale	2	3	5	4	3
	4.2 Conservation of aesthetic relationship between the site and the context	Likert Scale	5	5	4	4	1
	4.3 Space flexibility	Likert Scale	1	3	2	4	5
	4.4 Publicness	%	0	60	40	30	20
	4.5 Compatibility with community's requirements	Likert Scale	1	3	2	3	4
	4.6 Functional compatibility	Likert Scale	1	5	3	4	1

2—Normalising the performance of alternatives: the numerical values expressing the performance of each scenario in relation to different indicators are normalized using one of the most frequently methods used for calculating the normalized value n_{ij}:

$$n_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \quad (2)$$

3—Defining and normalising the weights: a weight is assigned to each indicator by defining the weight vector *W:*

$$W = [w_1, w_2, \ldots\ldots, w_n] \quad (3)$$

where $w_j \in \Re$ and $w_1 + w_2 + w_n = 1$.

Then, the weighted values are normalised to make the numerical values comparable to each other on a common scale as follows:

$$v_{ij} = w_j n_{ij} \text{ for } i = 1, \ldots, m; j = 1, \ldots, n. \quad (4)$$

where w_j is the weight of the j-th criterion, $\sum_{j=1}^{n} w_j = 1$.

To this aim, brainstorming with four different stakeholder categories (Academy, Entrepreneurs, Local and National Government, Third Sector) was conducted to know their preferences. These preferences were transformed into a score using a Likert Scale [91] from 1 to 5 (where 1 identifies the least important indicator and 5 the most important one). Starting from these scores, the Simos method [92] was used to elicit indicators priority by assigning a weight to each of them. As shown in Table 3, the total highest weights were assigned to identity value, cultural attractiveness, and employment in the socio-cultural dimension; people attractiveness in the economic-financial dimension; greenery and city–sea relationship in the environmental dimension; and public space and community's requirements fulfilment in the physical-spatial dimension. The lowest weights were assigned to commercial units and operating costs.

Table 3. Indicators' weights.

Dimension	Indicator	Academy	Entrepreneurs	Local and National Government	Third Sector	Total
Socio-Cultural	1.1 Safety	0.040	0.048	0.068	0.038	**0.045**
	1.2 Traditional skills	0.052	0.030	0.027	0.046	**0.042**
	1.3 Knowledge production	0.059	0.026	0.034	0.054	**0.047**
	1.4 Cultural attractiveness	0.059	0.048	0.034	0.054	**0.052**
	1.5 Employment	0.052	0.017	0.041	0.054	**0.043**
	1.6 Associationism	0.036	0.022	0.027	0.063	**0.038**
	1.7 Compatibility with local identity	0.059	0.026	0.055	0.063	**0.052**
	TOTAL	**0.358**	**0.216**	**0.288**	**0.371**	**0.320**
Economic-Financial	2.1 Commercial units	0.019	0.065	0.034	0.017	**0.031**
	2.2 People attractiveness	0.047	0.065	0.048	0.050	**0.052**
	2.3 Entrepreneurial attractiveness	0.028	0.061	0.055	0.017	**0.037**
	2.4 Financial self-sustainability	0.045	0.056	0.048	0.042	**0.047**
	2.5 Financial investment attractiveness	0.036	0.061	0.048	0.046	**0.045**
	TOTAL	**0.175**	**0.307**	**0.233**	**0.171**	**0.212**
Environmental	3.1 Energy consumption	0.052	0.052	0.062	0.038	**0.050**
	3.2 Greenery	0.057	0.048	0.055	0.050	**0.053**
	3.3 City-sea relationship	0.059	0.048	0.068	0.063	**0.059**
	3.4 Slow mobility	0.043	0.048	0.068	0.038	**0.046**
	3.5 Functional integrability	0.033	0.039	0.048	0.038	**0.038**
	TOTAL	**0.244**	**0.234**	**0.301**	**0.225**	**0.245**
Physical-Spatial	4.1 Operating costs	0.026	0.052	0.027	0.025	**0.032**
	4.2 Conservation of aesthetic relationship between the site and the context	0.047	0.043	0.027	0.038	**0.041**
	4.3 Space flexibility	0.043	0.056	0.041	0.046	**0.046**
	4.4 Public dimension	0.047	0.048	0.048	0.063	**0.051**
	4.5 Compatibility with community's requirements	0.059	0.043	0.034	0.063	**0.053**
	4.6 Functional compatibility	0.056	0.038	0.039	0.059	**0.050**
	TOTAL	**0.279**	**0.280**	**0.218**	**0.292**	**0.274**

As Table 3 shows, turning scores into percentages, the socio-cultural dimension is the most important for the Third Sector (37.1%) and Academy (35.8%). The economic-financial dimension is considered the most important dimension only for Entrepreneurs (30.7%), while it is the least ranked one by the Third Sector (17.1%) and Academy (17.5%). Local and National Government is the only category that attributes the highest weight (30.1%) to the environmental dimension. The physical-spatial dimension is ranked at the second position by the Academy (27.9%), Entrepreneurs (28%), and the Third Sector (29.2%), while for the Local and National Government it is the least important dimension (21.8%). These results converge in the total weights: socio-cultural dimension is the most important criteria (32%), followed by the physical-spatial dimension (27.4%), the environmental dimension (24.5%), and the economic-financial dimension (21.2%).

Figure 4 represents the overall weight for each dimension for the different stakeholders.

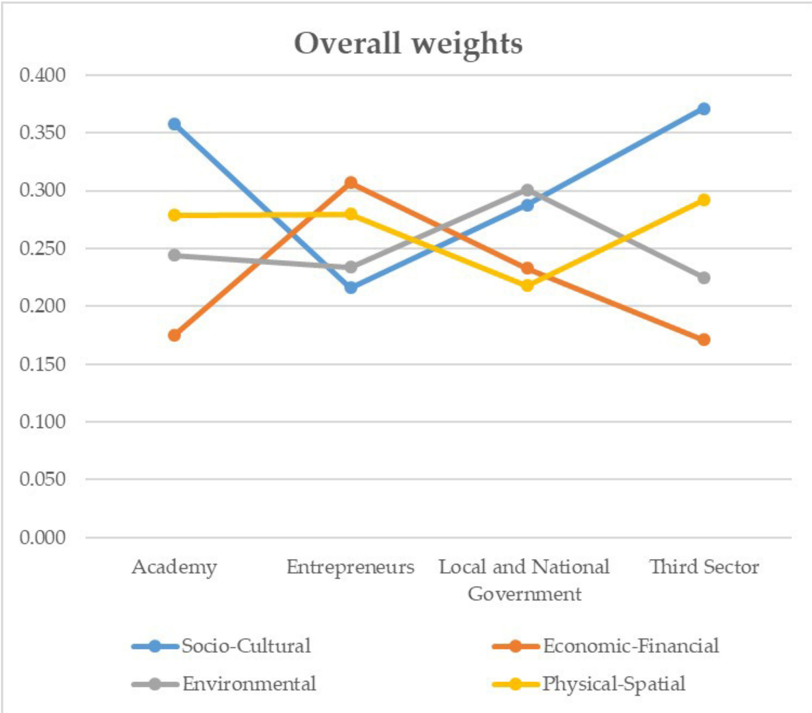

Figure 4. Overall weight of each dimension for the different stakeholders.

4—Identifying the ideal and the anti-ideal solution: the positive ideal solution and the negative anti-ideal solution are identified. The first one represents the scenario in which each indicator reaches the best performance. The anti-ideal solution, on the contrary, is the scenario in which each indicator reaches the worst performance.

The positive ideal solution is defined as:

$$A^{+} = (v_1^{+}, v_2^{+}, \ldots, v_n^{+}) = \left(\left(\underset{i}{macv_{ij}} \mid j \in I \right), \left(\underset{i}{minv_{ij}} \mid j \in J \right) \right) \quad (5)$$

The negative anti-ideal solution is defined as:

$$A^{-} = (v_1^{-}, v_2^{-}, \ldots, v_n^{-}) = \left(\left(\underset{i}{minv_{ij}} \mid j \in I \right), \left(\underset{i}{maxv_{ij}} \mid j \in J \right) \right) \quad (6)$$

where I is related to benefit criteria and J to cost criteria, and where $i = 1, \ldots, m$; $j = 1, \ldots, n$.

5—Ranking alternatives: the Euclidean distance of each project alternative from the positive ideal solution (7) and the negative anti-ideal solution (8) is calculated.

$$d_i^+ = \sqrt{\sum_{j=1}^{n} \left(v_{ij} - v_j^+\right)^2},\ i = 1,\ 2, \ldots,\ m, \tag{7}$$

$$d_i^- = \sqrt{\sum_{j=1}^{n} \left(v_{ij} - v_j^-\right)^2},\ i = 1,\ 2, \ldots,\ m, \tag{8}$$

The 'preferable' solution has the shortest Euclidean distance from the ideal solution and the longest one from the anti-ideal solution [87]. This distance is expressed through the proximity coefficient, ranging from 0 to 1 (where 1 indicates the preferable alternative). By comparing the proximity coefficient of each alternative (the 'relative distance'), a preference ranking is calculated (9) and defined (Table 4).

$$R_i = \frac{d_i^-}{d_i^- + d_i^+} \tag{9}$$

where $0 \leq R_i \leq 1$, $i = 1, 2, \ldots, m$.

Table 4. Final ranking of project alternatives.

Project Scenario	Value	Position
Scenario 0—Status Quo	0.328	5
Scenario 1—Industrial Heritage Ecomuseum	0.657	2
Scenario 2—Commercial tourist hub	0.451	4
Scenario 3—Socio-cultural and sport-educational hub	0.670	1
Scenario 4—Post-industrial green park	0.515	3

5. Discussion of the Results

As emerged from the results of the multi-criteria evaluation, the preferable scenario is the 'Socio-Cultural and Sports-Educational Hub'. It contributes to promoting social inclusion, cultural development, and sports and education, with the area becoming a hub for the growth and wellbeing of the local community. The presence of the university indicates a focus on education and training, providing academic opportunities and promoting skills development. The wide range of activities makes the hub attractive for different age (and thus interest) groups, contributing to an inclusive and dynamic community.

The 'Industrial Park Ecomuseum' being at the second ranking position suggests an interest in the conservation of industrial heritage, which had already arisen in the interaction with local stakeholders. This scenario provides a significant opportunity to 'tell' and hand down the industrial history (related, i.e., to production processes and technological developments), helping to keep the collective memory alive and to provide, at the same time, an educational opportunity.

The 'Post-Industrial Green Park' being third in the ranking indicates a desire to transform the area into a large 'green lung' for Bagnoli and the entire city. It mainly stresses the issues related to environmental sustainability, community wellbeing, and the public dimension. This scenario contributes to improving the quality of life in the area, providing green and open spaces and, therefore, promoting the physical and mental health of the community. However, the demolition of all industrial ruins entails the irreversible loss of tangible historical and cultural memory of the area. This can be considered a high cost in terms of local identity and history. In contrast, the conservation of industrial heritage ruins (an aspect common to the other three scenarios) has a positive impact both in terms of local identity and tourist attractiveness.

The result of the 'Tourism-Commercial Hub', in fourth position of the ranking, suggests that, although this function may have positive economic impacts (especially in the short term), this aspect is not sufficient to consider it as a performing alternative. This result reflects a shared vision that gives higher priority to the valorisation of industrial heritage than to merely touristic or commercial aspects. It is a scenario perceived as overly focused on commercial activities at the expense of other values.

The last position of 'Status Quo' confirms the fragility of the actual situation, which is continuing to produce negative impacts in all the dimensions considered.

As highlighted in the literature review, the results demonstrate that commercial activities are less preferable when the site is characterized by cultural values (as in the case of the former Italsider site). Additionally, in line with some contributions from the literature analysis, functional reuse through a mixed-use approach (characterized by flexibility) represents the most appropriate strategy. Moreover, unlike most of the analysed papers, all the different dimensions (environmental, socio-cultural, economic-financial, and physical-spatial) were simultaneously included in the evaluation of the scenarios, incorporating the perspectives of different stakeholders.

Sensitivity Analysis

The sensitivity analysis is used for assessing whether and how varying the input parameters influences the results of a decision-making model [93].

In this study, the variation of preference ranking in relation to the variation of the weights of the criteria (dimensions in this study) was analysed. The weight of one criterion at a time was increased to 55% while the weights of the other three criteria were equally considered to be 15%. Then, the TOPSIS method was run again for each new set of weights to obtain the related final ranking (Table 5).

Table 5. Sensitivity analysis.

Prevailing Dimension	Scenario 0—Status Quo	Scenario 1—Industrial Heritage Ecomuseum	Scenario 2—Commercial Tourist Hub	Scenario 3—Socio-Cultural and Sport-Educational Hub	Scenario 4—Post-Industrial Green Park
Socio-Cultural	5	2	4	1	3
Economic-Financial	5	3	2	1	4
Environmental	4	1	5	3	2
Physical-Spatial	5	1	3	2	4
Balanced	5	3	4	1	2

Scenario 3 is the 'preferable' alternative in all cases, except when the highest weight is attributed to the environmental dimension. The 'Status Quo' always ranks worst, except when the highest weight is attributed to the environmental dimension. This result derives from the fact that, currently, as the ex-Italsider is an almost completely abandoned area, nature has occupied the place, transforming the area into a mix of industrial ruins and green spaces. However, it needs to be highlighted that, despite this result, these green spaces are neither cared for nor enjoyable by anyone. Furthermore, it is needed to add that these green spaces, in the status quo, are for the most part still to be reclaimed, and therefore polluted. The ranking of the other three alternatives is variable.

As Figure 5 shows, the trend of the weights assigned by the experts (Table 3) is consistent with the results of the sensitivity analysis (Table 5), according to which Scenario 3, Scenario 1, and Scenario 4 constitute the three alternatives that generate the most consensus among the different stakeholders. Further collective interaction and dialogue can integrate them, producing a new alternative that is different from those already defined.

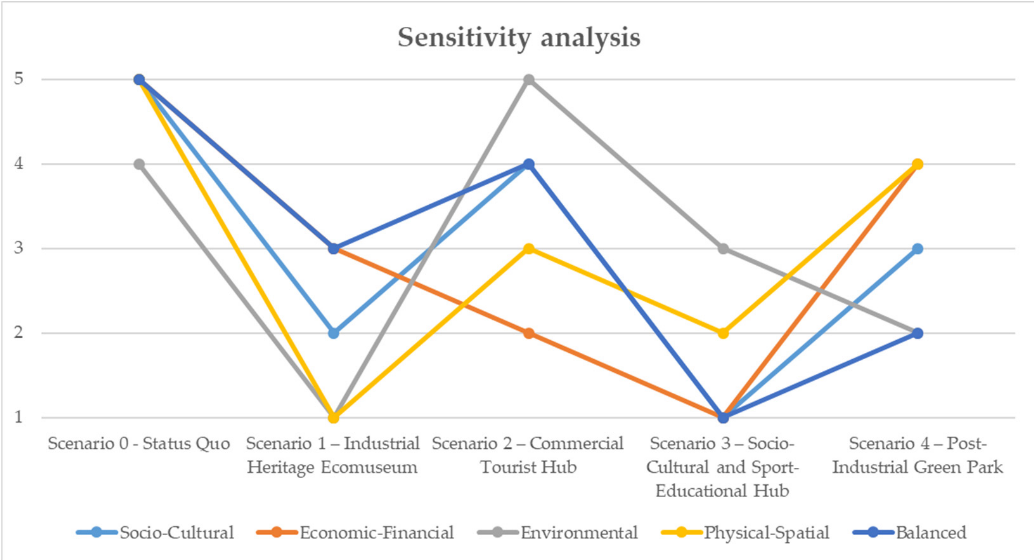

Figure 5. Sensitivity analysis.

6. Conclusions

IHAR aims to preserve material values and, at the same time, the intangible values and the cultural significance for the present and future generations. Integrating intrinsic value, and more generally intangible values, into the knowledge and evaluation processes of regeneration projects is absolutely necessary, as it helps to keep alive a symbol of community identity.

From this perspective, this study discusses the role of multi-criteria evaluations in decision-making processes in IHAR. Particularly, the research describes the application of a multidimensional evaluation framework for the regeneration of the ex-industrial area in Bagnoli district (Naples, Italy).

The use of the multi-criteria evaluation method in assessing IHAR turned out to be an efficient and comprehensive approach, relating economic-financial, socio-cultural, environmental, and physical-spatial aspects in a holistic assessment.

Adopting a participative process enables decision-makers to incorporate various stakeholders' perspectives into the evaluation, reducing conflicts between different interests and creating a broader consensus in complex choices.

The results of the multi-criteria assessment show that the consideration of intrinsic value can significantly influence the selection of regeneration scenarios, thus identifying solutions that are able to maximise the economic benefits and, at the same time, safeguard and enhance the unique and unrepeatable aspects of history and the surrounding environment.

By considering intrinsic value, the historical and cultural aspects of industrial heritage sites are preserved for the current and future generations [94], in line with the principles with the sustainable development goals [8]. Including the intrinsic value in the proposed evaluation framework allows assessing how each regeneration project scenario is able to preserve or valorise the site's historical and cultural values together with environmental and social ones.

By definition, the intrinsic value of cultural heritage is dynamic, influenced by social, cultural, and economic changes over time. To consider the dynamism of the intrinsic value of cultural heritage in regeneration projects, it is important to conduct analyses to identify changes in its social perception and historical importance. Involving the local community, adapting conservation strategies to contemporary needs, and assessing the social and economic impact of transformations are operational means to consider this dynamism.

In order to allow the community to re-appropriate these spaces in the short term, temporary uses may be appropriate. They allow collecting short-term feedback about the capacity of the project to meet community needs and requirements, without committing considerable resources, and if necessary, they allow revising and reshaping the strategic and design choices. This evolutive logic represents a dynamic and flexible approach to urban regeneration processes and emerges as a useful strategy, helping to temporarily re-activate areas before implementing more permanent interventions. Thus, temporary uses constitute 'experimental' elements that can guide long-term planning.

The limitations of this proposal are related to the assessment of intrinsic value, as it may have been influenced by subjective perceptions. Therefore, it is important to involve a significant number of stakeholders through approaches that take into account the complexity of the values at stake and, at the same time, ensure transparency and clarity in the decision-making process.

Future research steps may focus on the application of the proposed evaluation framework to further case studies, to test its replicability and adaptability and, if necessary, refine it, considering possible new criteria or indicators that are also useful for the evaluation of projects with a different level of design depth.

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