Assessing the Potential of a Disused Shopping Village by Comparing Adaptive Reuse Scenarios

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Abstract. Unpredictable events can impact the Real Estate market on multiple fronts, influencing stakeholders' decisions regarding new investment criteria. Within uncertainty, a preliminary analysis strategically supports the Decision-Makers (DMs) in making a more conscious choice. Among the set of complex decisions, the present contribution investigates the topic of adaptive reuse of a disused commercial area where several potential scenarios are compared. Technical requisites in terms of sustainability, feasibility and flexibility are considered. The approach selected to support the investigation is the Multi-Criteria Decision Analysis (MCDA), a family of techniques that allows supporting decision-making processes characterized by multiple objectives to be pursued. Thus, several dimensions are assessed in order to select the most suitable function, namely Economic, Environmental and Social. A sensitivity analysis is moreover performed to measure the robustness of the final rank.

Finally, the applied methodology offers reflection opportunities on the future best reuse scenario for commercial assets in urban and peri-urban areas under Social Governance Criteria and circular economy lenses.

Keywords: Multi-Criteria Decision Analysis · Adaptive reuse · Feasibility analysis

1 Introduction

Major natural disasters resulting from climate and eco-systemic changes such as the COVID-19 pandemic of recent times, like the market inflation due to economic and political crises has resulted in a bitter uncertain panorama for investors. These events have redirected the trends of all markets, not only the Real Estate one, in pursuit of economic, social and environmental sustainability paradigms fostered by international policies that attempt to cope with new emergencies (i.e. the principle of the Circular Economy or to the so called Sustainable Development Goals in the 2030 Agenda) [1, 2].

Indeed, even in the Real Estate field, the combination of low predictability and major impact of all these events make them challenging when making property market

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forecasts and evaluations. Meanwhile, other forces are pushing stakeholders towards new investment criteria, namely the digitalisation and the new evaluations standards of the Economic Social Governance Criteria – ESG. These two aspects are changing the needs and technical requisites of assets in term of sustainability and flexibility in "adaptive reuse" perspective.

The adaptive reuse concept is best described from the Department of Environment and Heritage – DEH as "*a process that changes a disused or ineffective item into a new item that can be used for a different purpose*"[3].

The adaptability criterion stems new opportunities for all involved actors along the lifecycle of the assets to better accomplish to a very concept of sustainability and to avoid land consumption derived from the shift of activities in new areas. Of particular concern, those assets related to industrial, productive or wholesale distribution activities are the most subjected to changes of production factors, technology advancement and consumers' behaviours that guide the entire economic supply chain, object of great concern for Decision Makers (DMs) about which regulative approaches to use [4].

Thus, more attention to this category would actively support future urban and peri-urban development strategies of cities that are no more centred but with sparse and continuous patterns.

Considering the framed topic of adaptive reuse of industrial and commercial assets, this research work attempts to draw an ad-hoc evaluative methodology in support to strategic reuse. Speculations are directly calibrated on a real case study of a disused commercial area, the Shopping Village "Le Acciaierie" in Lombardy Region, Italy, for which several alternative scenarios are considered.

In order to introduce and frame the methodology, the present article is structured in five main sections. Section 2 provides introductory material for the methodology application. After the description of the Italian Real Estate Market trends in major recent pandemic and economic shocks (and thus, providing food for thoughts for possible reuse scenarios), the methodological approach and used evaluative instruments are described. Section 3 introduces the case study under evaluation, by underling not only physical and locational characteristics but through legal, and planning constraints with the aim to refine the selection for the possible urban scenario at stake. Finally, Sects. 4 and 5 present the results of the analysis conducted and provide some future perspectives that could strengthen the methodology.

2 The "Adaptive Reuse": Challenges and Opportunities for Future Built Environment Transformation

2.1 The Real Estate Market Reaction to Uncertainty

Despite significant uncertainty on both the healthcare and political fronts due to last millennium events, Italy's economy and that of the Eurozone has continued to expand at high growth rates until the last 2022 first month's period. In Italy, the trend on real estate market investments has increased of about 17% with respect to 2020 (equal to 9.6 billion of Euros). However, this positive trends are attributed to foreign investors that occupy more than the 80% of investments transactions in the Italian territory [1, 5].

In term of asset class, especially pandemic phenomenon has fostered in the last years some already in act trend or unpredicted new ones.

Primarily, Italian offices asset has remained quite a good investment (especially for core activities) like the retail asset class, with particular reference to commercial buildings in-town. This last category has started to rise in Italian territory especially from the end of 2021, thanks to new few but huge foreign investments around Milan and Rome market stocks. However, as shown in Fig. 1, commercial buildings have seen a constant decrease in asset stock number (about 10% in the last three years) due to a transaction phase started well before the pandemic crisis and associated with the rise of the e-commerce and a decrease of the physical products stocks. Of particular concern, major negative impact has resulted on out-of-town assets, for big building dimension against the interest of investors for smaller size assets devoted to the sale of medium-high/luxury category products in the city centres (the so called in-town stock categories) that has better resisted the competition from e-commerce [1, 6].

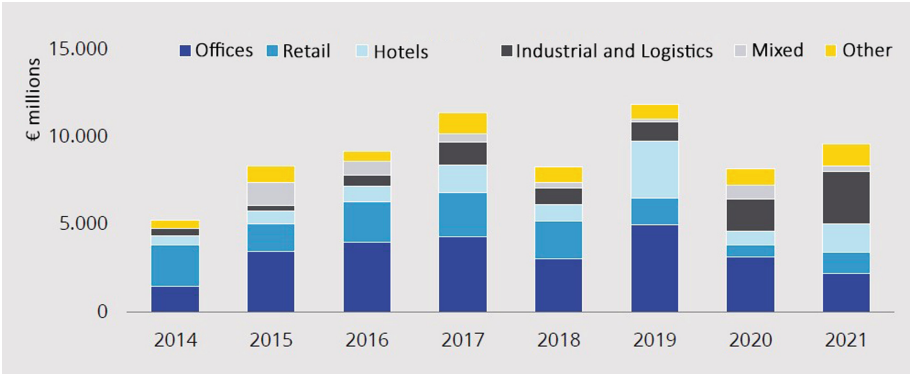

Fig. 1. Real estate investments in Italian territory per asset class between 2014 and 2021. Source: Colliers International, "Il mercato degli investimenti in Italia – Q4 2021".

On the contrary, logistics asset class continues to register a new record at the beginning of 2022: for the first time has become the first asset class on the Italian market, even more than the office category (ref. Figure 2). The attractiveness of investors for the sector began in 2014, with the perception of a diversified risk opportunity, deriving from the strengthening of the logistics activity due to e-commerce expansion and the trend has dramatically increased during pandemic restrictions [2, 7]. Still today, interest in this asset class is linked to the expansion of e-commerce that pushes investors to try to secure the best products or to develop some new in the areas deemed most strategic. Not by chance, technological advancement and new market targets that are oriented to client satisfaction for short delivery times has moved the attention from the centralization of warehouses for strategic distribution to European level, to that of proximity with small warehouses close to places of consumption. Data centres and Dark Stores (i.e. buildings designed as warehouses, but organized like a retail shop category), buildings type of high quality small size are increasing. However, large hubs (over 60,000 sqm) and intermediate size centres (around 20,000–30,000 sqm) still cover an important role [7, 8].

Therefore, the logistics demand is extremely heterogeneous in terms of size, space flexibility and location, which reflects the diversity of companies' nature and their specific needs for a high tech supply chain adaptation process.

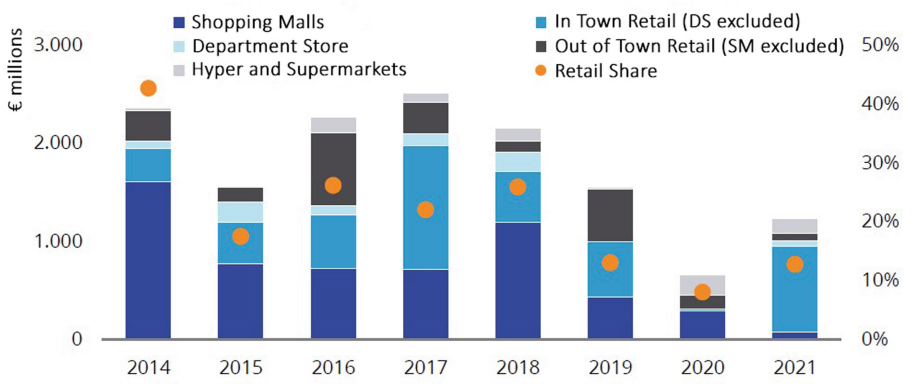

Fig. 2. Italian real estate investments in commercial and retail sector between 2014 and 2021. Source: Colliers International, "Il mercato degli investimenti in Italia – Q4 2021".

This preliminary analysis of the Italian real estate market focused on commercial, tertiary and industrial asset classes allows to better structure the decision problem aimed at evaluating the most suitable adaptive reuse for an ex former commercial area. Where the adaptive reuse, as already mention in the Introduction, is conceived as a process that changes a disused or ineffective item into a new item that can be used for a different purpose [3] and is able to find a balanced trade-off among the dimensions so to influence the final decision [9, 10].

Based on these premises the contribution proposes in the next sub-chapter an evaluation framework based on Multi-Criteria Decision Analysis (MCDA) to support the adaptive reuse process decision guidelines. The MCDA has been considered has a suitable and coherent approach to support the decision process given its robust methodological structure and its application in other similar experimental researches [11–14].

2.2 The Evaluation to Support Adaptive Reuse Processes

This section describes the multi-criteria evaluation process adopted, aimed at identifying the most suitable adaptive reuse scenario to satisfy the economic, social and environmental needs that typically characterise complex investment decisions, such as the transformation of existing real estate complexes [7].

The Multi-Criteria Decision Analysis (MCDA) is a family of techniques that allows to support decision-making processes characterized by the presence of multiple objectives to be pursued [15, 16], mostly conflicting, and to anticipate the impact of alternative scenarios under a multi-dimensional perspective. It is also considered a strategic tool because alternatives are based on heterogeneous measures and with reference to different points of view by considering the stakeholders involved [17, 18]. The transparency of

the process is ensured by the adoption of clear methodologies able to guide the DM in the different phases of the assessment, from the elicitation of the objectives to the final choice. The fundamental steps of the MCDA are briefly described below and presented in Fig. 3:

- Problem definition: elicitation of the objectives to be achieved and consequently structuring of the evaluation framework in criteria and sub-criteria;
- Design of alternatives: identification and/or generation of alternatives aimed at achieving previously identified objectives;
- Performance assessment: measurement of alternative scenarios considering the set of criteria and sub-criteria and their respective units of measurement;
- Standardization: normalization of units of measure (both qualitative and quantitative) into an a-dimensional scale between 0 and 1 (where 0 represents the worst performance and 1 the best);
- Weighting: assignment of weights to criteria and sub-criteria on the basis of their relative importance;
- Partial and final ranking: aggregation of weights and standardized scores, through compensatory or non-compensatory procedures, and display of partial and the overall results;
- Sensitivity analysis: validation of previously obtained results and validation of their robustness to changes.

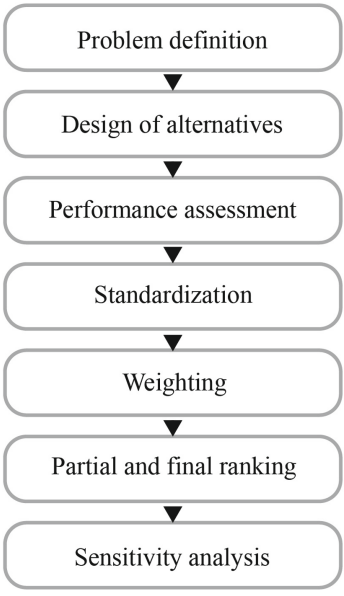

Fig. 3. Methodology flowchart

Within this context, alternatives have been assessed by considering a five-levels scoring system in order to highlight the ability of each alternative to achieve a specific objective, which in the evaluation process is represented by the criterion. The score was subsequently standardized through the use of increasing or decreasing linear functions, so as to specify the direction of preference (criterion/objective to maximize = benefit; criterion/objective to minimize = cost) by taking as reference Eq. (1) and (2):

$$Benefit\ criterion : \frac{score}{highest\ score} \tag{1}$$

$$Cost\ criterion : -\frac{score}{highest\ score} + 1 \tag{2}$$

The next step is the partial aggregation (with respect to each family of criteria) and the final aggregation of scores to obtain the overall ranking of alternatives developed by using the Weighted Sum Model (WSM), a compensative procedure.

Although this is a preliminary application of the MCDA, based on qualitative data, the results obtained can be considered a tool to support and guide the choices of potential investors and developers.

3 The Shopping Village "Le Acciaierie"

This chapter introduces the case study on which the methodology is tested. More precisely, the adaptive reuse problem under analysis concerns the identification of the best alternative reuse scenarios for a disused commercial area, the Shopping Village "Le Acciaierie" in Lombardy Region, Italy.

3.1 Case Study Description

The Shopping Village "Le Acciaierie" is a great disused commercial area of 58,000 sqm approximately in Cortenuova, a minor municipality of about 1,937 inhabitants of Bergamo Province, East to the Lombardy Region [19]. The area is located in a rural context independent from closest urban networks and it tangles the railway line Milano-Brescia, while is about four kilometers from the main highway that directly connects Brescia and Milano cities.

The commercial site includes several buildings of different use, linked together by a system of horizontal connections, and it is in a general abandoned state since 2014. Indeed, this area in Cortenuova municipality was interested by an urban transformation project in 2003, with the aim to provide a multifunctional shopping mall. The aforementioned project wrongly prompted the belief that the "more accessible and livable-decentralized position" of the site was preferable with respect to the congested suburban areas, once transformed into a place of social and work interactions.

On closer inspection of the site, the Shopping Village "Ex Acciaierie" includes mainly three buildings and a group of infrastructures that characterizes the commercial built environment (Fig. 4–5).

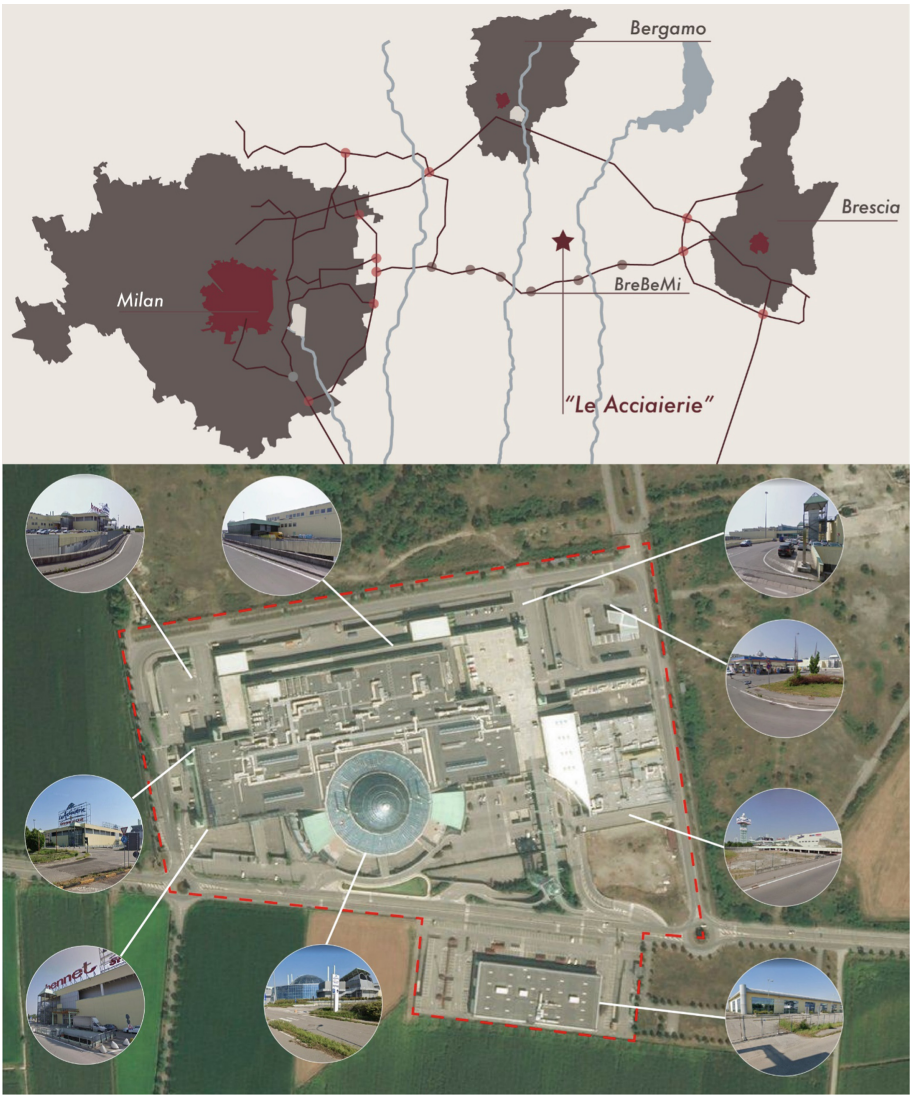

Fig. 4. Location of the analyzed area of the shopping village "Ex Acciaierie" in Lombardy Region and aerial view of the built complex.

The main one is the shopping mall of about 34,000 sqm plant. This building displays a scenic rounded façade with a laminated wood-glass dome that covers the circular-shape entrance hall with connective spaces, restaurants and bars. Sideways the hall there are

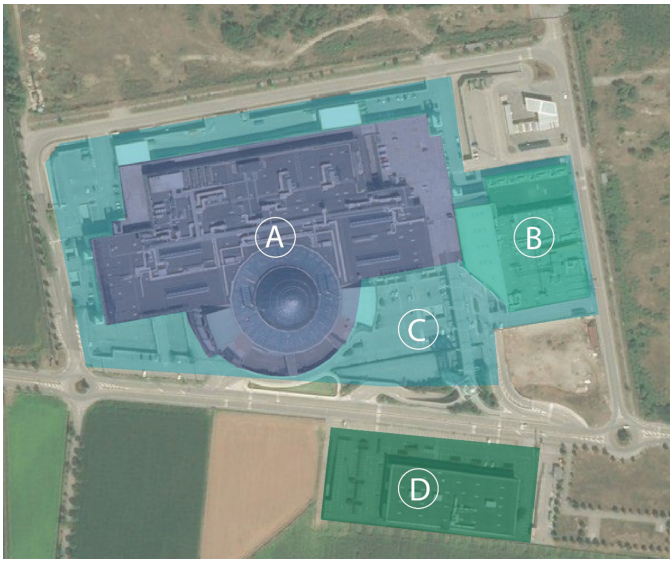

Fig. 5. Aerial view of the shopping village "Ex Acciaierie" complex with intervention areas: A – shopping mall; B – city park building; C – parking area; D – commercial building max Mercatone.

two wings on two floors respectively that host 152 shops together with a hypermarket of 8,600 sqm and other 18 supply activities spaces. The building structure, with the exception of the central square and the dome, is mainly in reinforced concrete and prefabricated technical elements.

East to the mall and the commercial area, the "City park" building offers several recreational activities: a multiplex cinema, a bowling alley, go-kart tracks, game rooms and various amenities for food services and recreational activities. The main body of the City park has a rectangular base (length of 97 m and width of 64 m) with a prefabricated reinforced concrete structure and an annex with a laminated wood roof.

Then, under the surface occupied by the mall, the basement area serves as a parking lot. The parking area is common to both the shopping mall and the City Park building. Similarly, the main structure is in prefabricated reinforced concrete pillars and beams.

Finally, the commercial building "Max Mercatone" is located separately south of the property lot, beyond the access street of the commercial area. This building in prefabricated reinforced concrete has a regular rectangular shape of about 3,950 sqm, including a ground floor (8 m of maximum external height) and an underground one. The industrial type structure with reinforced concrete pillars and beams is limited by an external wall in prefabricated panels.

3.2 Problem Definition

The area of the analyzed case study presented in Sect. 3.1 has remained inactive until today with the progressive worsening in the structure's conservation state due to the not-attracting location conditions and the special type of asset, like the most recent market and pandemic crises.

Currently, the property of the Shopping Village "Ex Acciaierie", the DM of the current research, has commissioned some technical and economic feasibility studies, while looking for possible new transformation scenarios that, in any case, will include the demolition of all the involved buildings, except the so called Max Mercatone one (Fig. 5). However, as the commercial area dimensions like the "non-ordinary" nature of these buildings from technological point of view, demolitions costs will be huge and of high impact for the surrounding context. For all these reasons, the scenarios of adaptive reuse need a solid and accurate methodology to provide a proper evaluation about possible intervention convenience from an economic-social-environmental sustainable point of view [20].

Given the complexity of the decision problem a solid set of criteria has been developed starting from the analysis of the context and consisting in urban and territorial investigations aimed at exploring strengths, weaknesses, opportunities and threats [21]. Three main dimensions have been identified and further divided in sub-criteria:

1. Economic dimension:
    - 1.1. Job opportunities, to measure the new jobs created by the alternative;
    - 1.2. Production of goods and services, to consider the services provided to the community;
    - 1.3. Initial investment, to estimate the initial cost to be incurred;
    - 1.4. Compatibility, to understand the impact of the new function within the territorial and social context;
    - 1.5. Compensations, to evaluate the capital to be paid to the Municipality.
2. Social dimension:
    - 2.1. Perception, to evaluate the negative impact of the new alternative perceived by the society;
    - 2.2. Externalities, to measure the attractiveness of the project;
    - 2.3. Specialized professionals, to understand if qualified operators are needed.
3. Environmental dimension:
    - 3.1. Renewable energy, to evaluate the sources of the energy consumed;
    - 3.2. Building re-use, to estimate the possibility to re-use the existing complex;
    - 3.3. New interventions, to consider under different perspectives the works required to activate the new function;
    - 3.4. Regreening, to measure the provision of new green spaces;
    - 3.5. Soil consumption, to assess if the alternative involves further consumption of agricultural land.

Each criterion is evaluated by assigning a score on a qualitative scale between 0 and 5, where 5 represents the highest value of performance, i.e., the highest ability of an alternative to achieve a given objective.

3.3 Scenarios of Adaptive Reuse

The identification of the most convenient adaptive reuse scenario is set as the final objective for the sake of ownership of the Shopping Village "Ex Acciaierie" case study. Hence, the property needs to identify the most profitable transformation of the abandoned asset while, as already mentioned, satisfying needs of economic social and environmental dimensions, which typically characterize complex investments decision such as the reuse of a multifunctional commercial asset.

With respect to the applied evaluation framework, after the final object definition, the methodology follows the identification of alternatives phase aimed at achieving the previously identified objectives.

In generating the alternatives, the case study under analysis has included the preliminary study of valorisation opportunities of the asset given the location context characteristics, the technical and legal constraints provided by zoning plans and a deep analysis of the real estate market trends from supply and demand sides.

The first condition to be assessed is represented by the legal and technical constraints provided by urban planning normative apparatus.

The Ex Acciaierie commercial centre is zoned under the *Piano di Governo del Territorio* - Territorial Zoning Plan of the Lombardy Region (from now on "PGT") within the "*Sistema funzionale del terziario e del commercio* - Tertiary and Commercial Sector System" that allows the establishment in the area of commercial activities like logistics. Then, the more specific technical norms that regulate the service and zones distribution in Cortenuova municipality specify the possibility to provide complementary activities like tertiary, directional, entertainment, health facilities, and wholesale commerce. Finally, except the already existing commercial area of the case study, no new commercial assets with an area exceeding 1,500 sqm are allowed with the Municipality's administrative boundaries [22, 23].

While considering the normative constraints and so the possible opportunities for the potential valorisation strategy to adopt, the analysis of the real estate market trends has been developed as it is possible to appreciate from the sub-chapter 2.

The normative apparatus and the analysis of the real estate market trend are finally addressed to the potentialities of the Shopping Village "Ex Acciaierie" case study characteristics and the territorial social-economic synergies.

The dimensional, functional and architectural characteristics of the abandoned commercial property would suggest an adaptive reuse with multifunctional activities set. However, commercial functions as a multi-functional shopping mall would not be capable to crowd out the competition of several close commercial centres and to come out as the primary choice of users over a 20–25 min' car accessibility distance, due to the limited catchment area in terms of small number of inhabitants and the vicinity with other major urban poles and competitors.

On the other hand, with a wider gaze, Bergamo Province can appear attractive in investors side for the overall size of the population and the proximity to the highway

North-West arteries, as well as to the Milan suburban area. The close A35 highway called "Brebemi" is increasingly developing as an infrastructure linked to logistic and service functions, while traffic flows decrease in intensity on weekends and during the summer months [24].

Finally, it would important to mention Lombardy Region's most recent regulatory provisions on urban development (PGT): the opening of new commercial polarities in these territorial contexts is discouraged, while favouring good practices of existing structures recovery [22].

All previous considerations reinforce the idea to propose an adaptive reuse of the case study, not oriented to a commercial function but to strategic assets that comply with supply chain changing processes that involve high quality technological spaces and sustainability criteria in terms of building performance and economic activities focused on social and environmental dimensions. Moreover, in line with Lombardy Region urban planning policies, the Municipality Council of Cortenuova issued in 2019 the Municipality policy deed for the functional reuse of the shopping centre "Le Acciaierie": "*Atto d'indirizzo comunale in merito alla riqualificazione e al riuso del centro commerciale Le Acciaierie"* [23]. The Act explicitly allows the implementation of any technical or administrative action aimed at the functional reuse of the property, coherently not only with the local PGT but also with the surrounding urban transformation process and emerging market opportunity (thus, including also other proposed functions as alternatives of a commercial use like the logistic one).

Thus, the MCDA analysis would attempt to compare and weight four possible alternative scenarios that include a logistic asset, a data centre, a recycling plant and a nuclear storage.

The logistic asset would appear to be a medium-large warehouse dedicated to different product categories for last-mile distribution. The warehouse could be equipped with automatic systems for storage management, like for picking and packing processes. The data centre or server farm would include all machinery and equipment for storing, processing or sharing large amounts of data. A good share of space is also devoted to supporting core activity systems that prevent blackouts like Uninterruptible Power Supply - UPS centres, cooling, fire extinguishing and security systems. While a recycling plant is intended (following the last EU Directive 98/2008) as a multi-function centre that could enable, through special types of machinery, the waste management, from waste selection and treating to its transformation or disposal. In line with other European cases [25], the recycling plant could also host other functions like offices, the staff canteen or even an Education Centre (museum). Finally, the alternative scenario with nuclear storage could represent a superficial storage system for intermediate-level-waste (ILW) and low-level-waste (LLW), considering the classification of the International Atomic Energy Agency [26]. The storage system physically represents a closed deposit where nuclear waste is temporarily hosted to wait for its radiological content to decay to lower levels and transfer it to other definite disposal centres.

4 Results

The alternatives have been evaluated by considering the set of criteria defined and their capability to meet each objective through the analysis of similar case studies. The results can be appreciated in Table 1.

Table 1. Performance matrix (where C: cost; B: benefit)

				Alternatives			
Criteria	Sub-criteria	C/B	Scale	Logistics	Data center	Recycling plant	Nuclear storage
1. Economic dimension	1.1 Job opportunities	B	0–5	5	1	3	2
	1.2 Production of goods and services	B	0–5	4	3	4	0
	1.3 Initial investment		0–5	2	3	4	5
	1.4 Compatibility	B	0–5	4	2	1	0
	1.5 Compensations	C	0–5	2	1	3	5
2. Social dimension	2.1 Perception	C	0–5	1	0	4	5
	2.2 Externalities	B	0–5	1	1	1	0
	2.3 Specialized professionals	C	0–5	1	3	2	5
3. Environmental dimension	3.1 Renewable energy	B	0–5	2	1	3	4
	3.2 Building re-use	B	0–5	3	4	2	2
	3.3 New interventions	C	0–5	2	5	2	5
	3.4 Regreening	B	0–5	1	2	2	4
	3.5 Soil consumption	C	0–5	1	0	1	0

Afterwards, performances have been standardized through the use of increasing or decreasing linear functions in relation to the need to maximize (benefit) or minimize (cost) the objective.

In order to obtain a complete ranking of the alternatives, an order of importance have been assigned to the criteria and sub-criteria. In accordance with DM a neutral scenario was selected, where the economic, social and environmental dimensions have equal importance (33, 3%) as well as the sub-criteria.

Figure 6 shows the ordering of the alternatives with respect to each criterion. From the graph illustrating the final ranking, the Logistics function maintains the top ranking with respect to the Economic and Social Dimension, with the Data Centre in second place followed by the Recycling plant and Nuclear Storage. The positions of the alternatives change with respect to the Environmental Dimension, where Nuclear Storage takes the first position, followed by Recycling Plant, Logistics, and finally Data Centre. In this last case, the distance between the first and last alternatives is not very significant, when compared to the partial orders related to the Economic and Social Dimension.

The final ranking confirms an order of preference where Logistics (60%) ranks first, immediately followed by Data Centre (50%). The result is stable, since validated by the sensitivity analysis (ref. Table 2), carried out by assuming three different scenarios, in which greater importance is assigned to the Economic Dimension *(scenario 1: Economic Dimension = 60%; Social Dimension = 20%; Environmental Dimension = 20%),* to the Social Dimension *(scenario 2: Economic Dimension = 20%; Social Dimension = 60%; Environmental Dimension = 20%)* and to the Environmental Dimension *(scenario 3: Economic Dimension = 20%; Social Dimension = 20%; Environmental Dimension = 60%).*

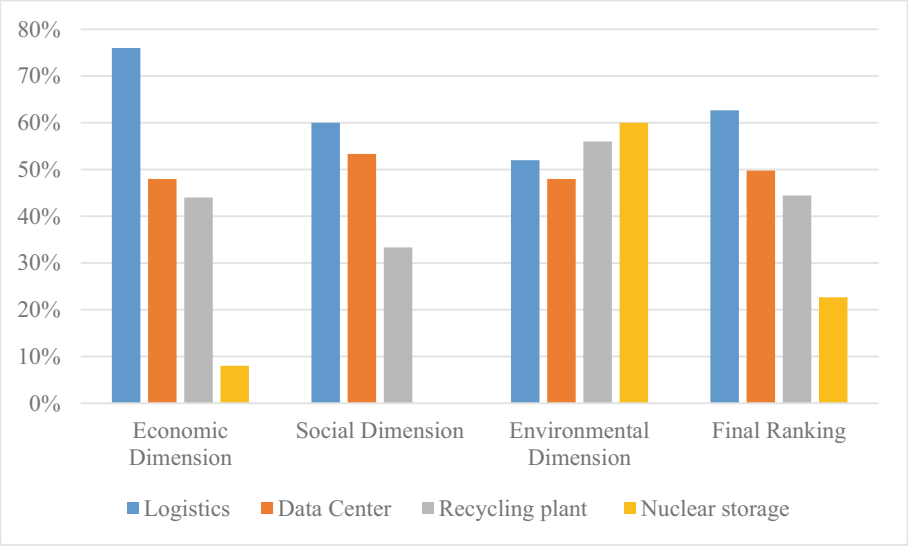

Fig. 6. Partial and final ranking

Table 2. Sensitivity analysis

	Alternatives			
	Logistics	Data center	Recycling plant	Nuclear storage
Scenario 1 economic	68%	49%	44%	17%
Scenario 2 social	62%	51%	40%	14%
Scenario 3 environmental	58%	49%	49%	38%

5 Conclusions

In the light of the urban and multi-criteria feasibility study, it is possible to direct the development of the Shopping Village "Le Acciaierie" property complex towards the conversion to a logistics function, envisaging the implementation of every technical/administrative action aimed at functional upgrading of the property, in a perspective of consistency with the surrounding urban framework and with market opportunities. With the concept of adaptive reuse, it is possible to introduce that of "demalling," conceived as the process that aims to transform a disused shopping centre into something new [27]. This approach can represent an opportunity of urban regeneration to enhance the urban quality of the Municipality where the building is located and, at the same time, a driving factor to promote economic development. In fact, the "demalling" also supports circular economy processes by reducing land consumption.

The analysis of the most suitable adaptive reuse alternative has been based on a robust and transparent methodology. As future perspectives, the research could be further detailed by introducing quantitate and monetary indicators in the evaluation to have a clear idea about the initial cost of the intervention. Moreover, since the decision taken will have an impact on several categories of stakeholders besides the current owner of the area, the generation of alternatives could be developed with a participatory process where round tables are organized to identify and elicit the values and objectives of the actors involved, both private and public.

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