A Cost-Benefit Analysis for the Industrial Heritage Reuse: The Case of the Ex-Corradini Factory in Naples (Italy)

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Abstract. Cost-Benefit Analysis (CBA) is a method to evaluate a project or a policy, considering all costs and benefits to encourage a medium- and long-term vision. The CBA application fields are broad, counting as primary domains: transportation, environment, cultural heritage, energy, research and innovation, and information technology. This paper shows a Cost-Benefit Analysis for the reuse project of a former industrial plant in the city of Naples (Italy). The purpose is to identify the advantages and disadvantages of the cost-benefit approach in the case of industrial building reuse. The preliminary outcomes show that the following social externalities are likely to be subject to a certain risk degree: i) amount of CO_2 emissions saved, ii) benefits for businesses (enterprises and start-ups), iii) benefits for researchers, young professionals and students, iv) impacts on the real estate market, v) technological readiness of the involved innovative processes. The authors highlight that specialists should also search for ways to generate acceptable shadow prices for short-run consequences using empirical data from different sources.

Keywords: Cost-Benefit Analysis · Industrial heritage reuse · Multidimensional impact evaluation · Risk analysis

1 Introduction

Cost-Benefit Analysis (CBA) is a method to evaluate a project or a policy, considering all costs and benefits to encourage a medium- and long-term vision [1]. It can represent a powerful tool to assess the desirability of an investment project as a measure of its impacts on social well-being.

Approximately 60,603 open access publications mentioning CBA in the Scopus database appeared in the last decade, including articles, reviews, conference proceedings, editorials, and others. The CBA application fields are broad, counting as primary domains: transportation, environment, cultural heritage, energy, research and innovation, and information technology. Nevertheless, no publication in scientific databases makes explicit reference to the application of Cost-Benefit Analysis to industrial reuse

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projects. In the industrial field, CBA is mainly adopted to assess the impacts of energy efficiency projects and waste management in working industrial buildings.

A primary principle linked to this tool is inherent to social opportunity cost as the likely gain from the optimal alternative within a set of mutually-exclusive options [2]. This rationale at the foundation of CBA addresses an effort to consider multiple stakeholders' values and interests, which converge into the notion of complex social value [3], trying to include intangible assets in Decision-Making [4]. The final goal of CBA aims to compare aggregated benefits with the costs to estimate the investment desirability in monetary terms [5].

This study aims to identify the advantages and disadvantages of applying a cost-benefit approach in the case of industrial heritage reuse. In particular, the presented CBA relates to the reuse project of a former industrial plant in the Eastern port area of Naples (Italy), referred to as Corradini Factory.

The article proceeds as follows: Sect. 2 focuses on an overview related to applications of CBA in different fields; Sect. 3 describes the proposed methodology; Sect. 4 introduces the case study; Sect. 5 shows the application results; finally, Sect. 6 identifies the potentials and criticalities of the approach and highlights the research follow-ups.

2 Cost-Benefit Analysis: An Overview of the Main Application Fields

As aforementioned, CBA is applied in different fields of knowledge and professions. In the environmental area, several applications of the CBA method to assess benefits and costs linked to ecological scenarios for Ecosystems Services (ES) conservation or restoration have been increasing in recent years [6]. These studies mainly use benefit transfer methods to estimate costs derived from biodiversity loss and degradation of ES due to anthropic land-use changes [7, 8]. Most frequently, at the ground of this research, the goal is to assess government projects at national or regional scales.

Conversely, urban studies focus mainly on costs related to city sprinkling and land consumption [9]. On the other hand, the real-estate market studies address estimating the benefits of the preservation of cultural heritage [10], adaptive buildings reuse [11, 12], or soil saving [13]. As an example, in Balena et al. 2013, the cost-benefit balance of soil conservation in the outer urban fringe of the cities has been estimated to increase the property market values [14].

Within the transportation sector, as widely shown by the literature [15–17], the cost-benefit analysis is, together with cost-effectiveness assessment and multicriteria methods, the main evaluation technique to be used for investigating the feasibility and viability degree of a project. The peculiarity of CBA in transport applications lies in the need of developing a simulation model, replacing demand and supply features, whose output represents the input of CBA. General details on how to model transportation systems can be found in [18]; however, each mobility mode has specific issues to be taken into account (see, for instance, [19–21]).

On one side, cost items to be considered are in common with other CBA applications, i.e., investment and construction costs, as well as operation and maintenance costs; on the other side, benefits to be computed present some noteworthy specific features. First of

all, benefits for users, i.e., travelers who adopt the transport system under evaluation, can be divided into two main categories: perceived and not perceived benefits. The former is mainly related to the reduction in time and monetary cost items to be incurred to make a trip (e.g., highway tolls, waiting times at the bus stop, etc.). Specifically, as shown by [22], such benefits can be computed by evaluating the reduction in the user generalised costs or the increase in travelers' satisfaction in the design scenario with respect to the non-intervention strategy. On the other hand, some instances of non-perceived benefits are represented by the reduction in maintenance frequency or tyre wear associated with lower use of private cars. Such benefits, generally, occur when the choice mode model is involved in the evaluation and, therefore, the modal split is properly simulated. Finally, non-user benefits are related to who, although not directly involved in the use of the infrastructure or service under evaluation, is affected by the impacts of such a project (such as air and noise pollution, accident rate, congestion degree, etc.). An exhaustive list of such externalities can be found in [23].

Both linear infrastructures and transport nodes (i.e., terminals), across every mobility mode option, have been largely analysed by adopting CBA; among the other, new highways [24, 25], railway lines and services [26, 27] and air transport terminals and facilities [28, 29]. In the case of the maritime sector, freight transport represents a particularly crucial factor to be analysed, as shown by [30, 31]; while, concerning maritime terminals, i.e., ports, a specific discussion is provided below, with a particular focus on their interactions with the surrounding urban and suburban environment.

Specifically, as regards the areas of city-port interaction, a CBA process is particularly useful to consider the environmental and social impacts of the actions to be carried out. Furthermore, a CBA analysis has to consider the complex issues that characterize the areas of city-port interaction to encourage a synergic relation between these two polarities. The synergy between the city and the port area represents an essential component for the economic system of the European Union [32]. To operationalize this synergic relation, it is evident the need to define a new process of circular growth of the city-port ecosystem that takes into account the environmental and social challenges, overcoming the conflicts and proposing integrated visions.

Defining the main goals that move the project or the policy is the first step to starting a CBA able to promote and implement a circular growth of the city-port. The definition of the objectives is extremely relevant to CBA, which must demonstrate what kind of results can be achieved through the project implementation [2].

As regards to the areas of city-port interaction and their circular development, it is important to refer to the Sustainable Development Goals (SDGs), drawn up by United Nations [33]. The SDGs approach is particularly significant for addressing the issue of the regeneration of the city-port ecosystem for its capability to address the challenges raised by climate change and to reduce any form of inequality, ensuring the long-term economic, environmental and social sustainability of human communities.

In 2018, the Association Internationale Villes et Ports (AIVP) launched the AIVP 2030 Agenda, the first global initiative that adapts the 17 SDGs to the specific context of the city-port ecosystem. The Agenda is designed to guide the actions and projects of the city-port stakeholders to ensure sustainable relationships between the city and the port [34]. Starting from the SDGs and the AIVP 2030 Agenda, it is possible to deduce a set of

actions focused on the complex urban and maritime transformations affecting the city-port ecosystem and also to consider the impacts of these actions from an environmental, economic and socio-cultural point of view.

Starting from the objectives and the effects generated, CBA measures the impact of a project or a policy on social well-being. In the case of the city-port interaction areas, there are many positive and negative impacts that must be taken into account.

The global dimension of today's traffic has led the maritime transport industry to new technological advances [35]. These changes have brought an expansion of the ports area, in order to meet the standards of ship size and hinterland connection [36].

Land, air and water pollution, noise and visual impact are the main social and environmental effects resulting from a port expansion [37]. It is essential to take these externalities into account in a CBA of port area expansion and transformation project.

CBA is mainly carried out for maritime projects (i.e. terminals and docks design). These are projects of relevant social and environmental impact because they involve both the occupation of areas that could be used for other community-oriented functions and the occupation of (often) polluted areas (that require water reclamation works). In such cases, the CBA pays great attention to the environment and energy since port areas play a key role in climate change issues and in the use of the sea as a common good. The CBA method insists on the definition of objectives and impacts linked to the context and is consistent with the European reference framework.

3 The Methodological Workflow

The research aims to identify advantages and disadvantages of the Cost-Benefit Analysis method applied to an industrial heritage reuse project (see Fig. 1). According to this aim, the proposed methodology consists of five main phases: 1. literature review; 2. testing; 3. indicators sampling; 4. results; 5. follow-ups.

A preliminary review of the CBA literature was conducted in four areas of interest (transportation, environment, port-areas, and industrial heritage), identifying industrial buildings as the main research field related to the selected case study. This led to the testing phase, which considers the analysis of the operational context, the selection of objectives in line with the Sustainable Development Goals (SDGs), and the program of the project functions. The latter was identified through the structuring of a Multi-Criteria Decision Analysis (MCDA) by means of the Evamix method [38], which has allowed the optimal combination of alternative design functions to be determined.

Subsequently, the phase concerning the demand analysis - which identifies the need for investment by assessing current and future demand - has provided the definition of a set of indicators, by prior identification of the selection criteria for them.

The CBA results showed as the output of the financial analysis a negative Net Present Value (FNPV), defined as the sum that results when the discounted expected investment and operating costs of the project are deducted from the discounted value of the expected revenues [2]. This provided the need to perform an economic analysis, which consists of the use of shadow prices to reflect the social opportunity cost of goods and services [2]. This analysis envisaged a series of market distortions adjustments such as correction

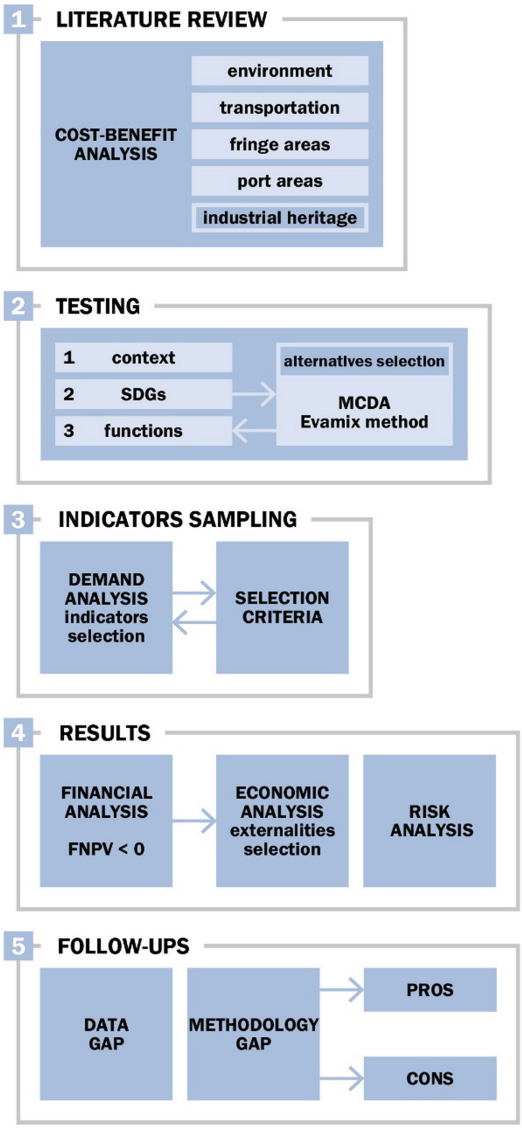


Fig. 1. The methodological workflow

for externalities, i.e. any cost or benefit that spills over from the project towards other parties without monetary compensation [2].

Therefore, a risk assessment has been conducted to deal with the uncertainty that permeates investment projects. In this way, it was possible to identify data and methodology gap in order to define the advantages and disadvantages of the Cost-Benefit Analysis of an industrial heritage reuse project, as envisaged by the overall goal.

4 The Case-Study

The study area is located within the San Giovanni a Teduccio district, which is part of the VI Municipality of the city of Naples, Italy (see Fig. 2).



Fig. 2. The study area (source: Municipality of Naples, www.comune.napoli.it)

4.1 The Project and Its Socio-economic Context Description

The architectural and urban project analysed in this case study intends to activate - through the reuse of a protected architectural site (specifically, an abandoned industrial building) - a process that could generate a cluster district equipped with research structures and companies, promoting new economies and opportunities for social interaction, consumption and information and knowledge exchange. The project provides with cultural services related to education and technological innovation, contributing to the reformulation of local identities, playing a central role in the local economic system and redefining the character of lifestyles and urban consumption models of the San Giovanni a Teduccio district and the city of Naples.

Over the years, the district has been equipped with an infrastructural connection system that has made it one of the most suitable for the location of production plants, most of which are now abandoned.

San Giovanni a Teduccio counts about 24.000 residents (with a slight decrease in the last 20 years according to the Italian National Institute of Statistics census. It is one of the least populous districts in the eastern area of Naples, even though with a relevant population density (about 10,000 inhab/sq. km). The structure of the population shows a strong presence of young people with a low level of education; the unemployment rate

(about 17%, higher than the city of Naples one which is about 15%) is also high. On the other hand, the current economic structure of the district is characterized by a marked vitality of the tertiary sector and the commercial one.

The ex-Corradini building was chosen for the project to provide highly knowledge-intensive structures in a marginalized context characterized by a recent de-industrialization, which in recent years has been experiencing the activation of technological, urban and social regeneration interventions.

For example, in VI Municipality, specifically in Ponticelli district, the Athena Future Technology District is located, whose Fuel Cell Lab (hydrogen) studies, manufactures and develops high-tech systems for mobile, stationary and propulsive applications, with which the project functions intend to activate collaboration and experimentation processes.

In addition, a business incubator is located in San Giovanni a Teduccio district. Its function is to encourage the birth of entrepreneurial projects, support and assist the development of creative and innovative companies, providing spaces and services. The activation of partnerships is foreseen: it will allow the incubator to be connected to the industrial and academic sectors of the city, enhancing professional experiences and know-how.

In this regard, it should be highlighted that the Campania region is among the top ones in Italy according to the number of innovative start-ups. In fact, in the last five years, there has been a significant increase in high innovation level start-ups, which made it the third region in the Italian innovation geography, with regard to sustainability issues, circular economy, energy and renewable sources efficiency, and culture.

With respect to the socio-cultural context, the project aims to promote a process of social-centred urban regeneration, in which well-being and social equity are integrated into cultural heritage reuse and valorization strategies [39–41]. Furthermore, this project recognizes the crucial role of energy conversion, the development of renewable energy sources, the implementation of the principles and models of circular economy and bio-economy, the promotion of social inclusion, and the implementation of the 2030 Agenda principles.

About the planned functions, the project intends to develop a pole of technological innovation and new economies, a “Hub & Spoke” structure, connected to a wide network of university laboratories, public and private research centers, local, national and international companies. The project is structured into the following main infrastructures:

– First demonstrator of a Shared pilot facility for the circular bio-economy;
– Experimental Bio-foundry Infrastructure;
– Experimental infrastructure for testing and demonstrating hydrogen technologies;
– Critical Materials Technology Platform - Strategic Raw Materials;
– Bio-Cloud infrastructure.

These infrastructures are integrated by Incubator and Accelerator for Start-ups and innovative SMEs, public and private laboratories, training areas, convention and dissemination areas. Through its functional program, the project intends to oppose the phenomena of migration of qualified individuals, raise the participation rates of young people in tertiary training courses, to integrate an area that is currently marginalized in

a process of territorial regeneration, to support the circular transition production chains and improve the quality of life of the community of the San Giovanni a Teduccio district and the city of Naples.

4.2 Selected Indicators for Demand Analysis

Demand analysis was carried on taking into account the multiple functions provided by the project and three macro-categories of actors who drive the demand, identified with: 1. businesses; 2. researchers, young professionals and students; 3. target population and the general public. The information has been obtained from different sources, such as a statistical analysis of historical data, companies-related databases, new patents and innovation, literature and existing studies analysis, comparison with similar projects, surveys and interviews with stakeholders, expert advice, scientometric analysis of publications and citations in the project sectors.

The following table (Table 1) has been articulated by identifying the driving factors (businesses; researchers, young professionals and students; target population and the general public) and the extractable data, which made it possible to estimate specific values relating to the entire infrastructure.

Table 1. Selected indicators for demand analysis

Driving factors	Extractable data	Estimated data
Businesses		
Average growth of the industrial base in the RDI project field in the last years	Annual number of spin-offs/start-ups expected to be generated/supported by the project	19 spin-offs/start-up
Average annual profitability of the industrial base in the RDI project field	Expected number of businesses using the infrastructure to develop new/improved products and processes	969 businesses
Knowledge intensity of businesses in sectors related to the RDI project	Expected annual number of patents registered by project users	50 patents
Researchers, young professionals and students		
Number of scientists operating in the RDI project field and in the geographical area targeted by the infrastructure	Annual number of researchers who will directly use the RDI infrastructure	2.500 researchers, PhD students and professors
	Number of scientific publications expected to be produced by the project users	3 publications/year for each researcher: 7.500 publications/year

(*continued*)

Table 1. (*continued*)

Driving factors	Extractable data	Estimated data
Number of scientists operating in the RDI project field and in the geographical area targeted by the infrastructure	Stable personnel unit	103 units
Current number of students in the RDI project field or related fields in the geographical area targeted by the infrastructure	Average duration of the training programme at the RDI infrastructure	PhD e Master: 2 years Business training: 2 months
Potential for generating income through student fees and private sponsoring	Revenues from student fees	405.000 €/year, calculated on 150 students
Target population and the general public		
Number of people affected by environmental and health risks and virtually targeted by the RDI project	Annual number of people potentially targeted by the project	3227 persons/year[4]

5 Results

Financial sustainability was drawn up according to the indications provided by regulatory and guidelines, both national and international. They are:

Guidelines for the drafting of the technical and economic feasibility project to be used as a basis for the awarding of public works contracts of the National Recovery and Resilience Plan and National Complementary Plan;
Guide to Cost-Benefit Analysis of Investment Projects. Economic appraisal tool for Cohesion Policy 2014–2020 (European Commission);
Legislative Decree No. 50/2016 (Italian Public Contracts Code).

The financial sustainability of the project - with reference to both the restoration and conservative redevelopment of the industrial archaeology building (the ex-Corradini complex) and the construction of the infrastructural connection - has been assessed, in accordance with the aforementioned regulatory references, through the two financial indicators comparing costs and related revenues: Net Present Value (NPV) and Internal Rate of Return (IRR). The reference time horizon is 20 years (long term), generally adopted for interventions in the research and innovation sector.

In order to estimate NPV and IRR, the project costs and revenues have been identified. In particular, three macro-categories of costs have been considered: contract works and charges; sums available to the contracting station; equipment for the innovation ecosystem. These categories include, among others, the following costs: construction

costs, executive design costs, waste disposal, road connections, taxes and fees. Furthermore, the maintenance and management costs related to the operational phase of the project have been considered.

The total cost of the work, determined through the economic framework consistent with the aforementioned regulatory references, is 25,000,000 euros, while the cost of the technological equipment of the innovation systems has been estimated at 10,000,000 euros.

Revenues from the identified functions were determined parametrically, starting from existing similar cases.

After determining costs and revenues, and taking into account the planned time schedule related to the implementation and operation of the interventions, a financial analysis was carried out to identify the project performance.

The results obtained show that the NPV is negative, and the IRR is lower than the discount rate considered. Therefore, the revenues generated by the project partially compensate for the costs incurred. In this condition, the Guide to the Cost-Benefit Analysis of Investment Projects highlights the need for co-financing.

In addition to the above-described financial assessment, also an economic analysis, taking into account the social, cultural, territorial and environmental benefits of the project, was performed. To this aim, starting from financial data, according to [2], the following phases were developed: i) fiscal corrections; ii) implementation of shadow prices; iii) evaluation of externalities. As regards the estimation of externalities, both a quantitative and a qualitative analysis were carried out. In particular, the monetisation procedure was performed by identifying indicators representing a proxy for users' WTP/WTA (i.e., Willingness-To-Pay/Willingness-To-Accept), as well as by implementing the benefit transfer method, after an accurate evaluation of the comparability between the selected studies and the analysed case.

The markedly innovative and sustainable features of the research laboratories involved ensure considerable benefits from an environmental perspective and in terms of upgrading the industrial know-how.

The main benefit is certainly given by the amount of CO_2 emissions saved thanks to the adoption of innovative circular bio-economy techniques, bio-tech methods and hydrogen exploitation technologies. In this regard, the savings in terms of avoided emissions have been estimated and appropriately monetised through the adoption of a unit shadow price expressed in €/tonCO_2. It is worth noting that a correction coefficient was also considered thus taking into account the growing importance of environmental sustainability during the analysed time horizon. The high-efficient energy-saving technological solutions, implemented as building elements, further contribute to the aforementioned environmental benefits. Indeed, in addition to a certain amount of avoided emissions, they also generate benefits in terms of demand reduction and energy self-conversion chances. In environmental terms, the only factor that generates a negative externality is related to an increase in mobility flows in the area, given the level of attractiveness that the hub aims to achieve. They were characterised not only in terms of passenger flows, but also as heavy vehicle flows connected to the logistic systems supporting the research activities in the hub (e.g., hydrogen cylinder wagons, articulated trucks for moving equipment, etc.). Specifically, such an effect has been monetised by

computing the increase in demand trends, in terms of vehicles-km, and considering the unitary emission factor for each vehicle category and each micropollutant element analysed. Then, the global warming effect was added and, finally, a proper unit shadow price expressed in terms of €/tonCO_2-eq has been applied [23]. However, this negative effect can be considered significantly lower than the benefit, in terms of CO_2 saved, due to the factors highlighted above. Further, it is worth noting that the modal share concerning private transport modes (cars and motorbikes) will experience a significant decrease thanks to the presence of the designed cycle-pedestrian promenade which strongly enhances the accessibility levels of the area.

Another significant benefit, as already highlighted, is represented by the increase in the know-how level of the companies operating in the bio-economic and bio-tech field which generates an avoided cost in terms of acquisition of the technologies developed in the hub. Indeed, the research activities of the hub will lead to an increase in the so-called readiness level of the technologies involved, with a consequent benefit in terms of the development of new products and processes which, in some cases, could lead to patents or other forms of intellectual property protection. These innovations also have a positive impact on the number and survival rate of start-ups belonging to the reference sectors. All such benefits were monetised in terms of shadow prices and profit values by analysing similar business contexts.

Other benefits, in terms of knowledge spillover and learning-by-doing, concern researchers, young professionals and students involved. Indeed, on the one hand, researchers will benefit in terms of quality and number of publications; on the other hand, students may benefit from supporting actions to experimental and highly innovative thesis activities.

In addition to the above, there are several benefits that, although not directly monetisable, turn out to be crucial for the social profitability of the project and, therefore, were properly considered. Firstly, significant urban regeneration effects will be obtained thanks to functional and territorial synergies between the external spaces of the renovated hub and the surrounding urban environment, as well as in terms of purchase and rental prices of properties (residential or commercial) and lands. Further, benefits in terms of increased levels of employment and improvements in accommodation facilities in the area were properly assessed. Anyway, from a social perspective, the resident population, and especially young people, will gain confidence in their own territory and, potentially, they will not necessarily have to move to meet professional growth and fulfilment chances. This is closely linked to the benefits that the technological pole could provide to the cultural ecosystem of the area, such as synergies between companies and research institutions, networking chances, intellectual osmosis phenomena, etc.

The above-mentioned evaluations, related to indirect and external costs and benefits of the project, allow, starting from the financial analysis, to carry out the economic assessment.

Socio-economic attractiveness, instead, was assessed on the basis of the results of the economic analysis and, in particular, by the verification of a positive Economic Net Present Value (ENPV). As far as the financial coverage plan is concerned, it is necessary the public capital participation, which will allow the construction of infrastructure, and the private capital, which will be involved in the implementation of civil works.

As already explained, according to the methodology suggested by the aforementioned documents, the economic analysis is based on the financial analysis regarding the determination of direct economic costs and benefits and is complemented by determining the indirect and external costs and benefits.

In general terms, it can be observed that the "direct" internal economic costs and benefits are those related to the subject in charge of the realisation and management of the work. "Indirect" costs and benefits are those generated indirectly by the construction and management of the work, to which a market price can be attributed. "External" costs and benefits (or externalities) are those costs and benefits to the community from the construction and management of the work.

Similarly, to the financial analysis, the Economic Net Present Value and the economic Internal Rate of Return have been determined. The analysis of the socio-economic convenience is structurally similar to financial analysis, but cannot be based on market prices and has to take into account non-financial economic costs and benefits. In fact, direct costs and benefits are assessed by multiplying the financial values of projects by coefficients, called "conversion factors", in order to "purify" them of positive transfers to the public administration (basically taxes and social charges on labour) or negative transfers (subsidies and other forms of financial or real benefits). From the results obtained (Positive ENPV, EIRR at 20%), it can be deduced that the planned interventions provide a very wide range of social, cultural, environmental and economic benefits, which in turn lead to an improvement in the quality of life, compensating for the investment costs.

Upon completion of the proposed application, a qualitative risk analysis was performed by identifying possible hostile events linked to the significant involved variables; i.e., costs, revenues and externalities. Specifically, investment costs, operation and maintenance costs, as well as the number of years required for the building process, were considered among the factors which could affect cost items.

Regarding revenues, instead, significant adverse events may be related to income from consultancy services and research agreements, together with entry fees to the laboratory and for the use of research equipment charged to researchers and businesses. Further, student and PhD fees, as well as rental income for using spaces for dissemination and outreach activities to the wider public, need to be analysed. Finally, in the case of externalities, the following factors have been identified as liable to a certain risk degree: i) amount of CO_2 emissions saved, ii) benefits for businesses (enterprises and start-ups), iii) benefits for researchers, young professionals and students, iv) impacts on the real market estate, v) technological readiness of the involved innovative processes.

As instructed by [2], each one of the above-mentioned factors was characterised in terms of probability of occurrence (P) and severity (S), whose product represents the related risk level. Finally, according to the determined risk level, prevention and/or mitigation measures were identified and, consequently, the degree of susceptibility left (i.e., the residual risk) was derived. The outcome shows that the success of the initiative is strongly affected by the level of readiness and reliability of the technologies developed, as well as by their availability when the market requires them or when potential fundings occur. Properly meeting such opportunities in a timely manner, therefore, results being the main critical issue to be monitored and tackled.

6 Discussion and Conclusions

This study aimed to show an application of CBA method in the case of industrial heritage reuse through innovation and research functions.

The advantages of CBA are inherent to the efforts to estimate the social values of a project, the use of multi-criteria methods to manage the conflicts related to the choice of best-fit scenarios, the risk analysis implementation to deal with the uncertainties, the knowledge transfer and the in-depth comprehension of the multi-dimensional impacts of choices in decision-making.

The disadvantages are related to several aspects. First, data downscaling can be very difficult to manage since available data referred to national and regional scopes need hard statistical adjustments to adapt to the scale required for the evaluation.

Furthermore, the huge amount of data to be managed certainly makes the process complex and uncertain. The significant number of variables to be managed makes data collection procedures time-consuming.

The specificity of the data needed requires skills that make the application of this tool unfriendly to those who are not technicians.

Specialists should also search for ways to generate acceptable shadow prices for short-run consequences. Using empirical data from different sources - e.g. participatory workshops, surveys, and in-depth interviews with the most-influential stakeholders - can support the determination of shadow pricing linked to the hot topics in social terms.

The follow-up of this application is oriented to the knowledge transfer of skills and techniques to be implemented not only for the CBA investments projects, but also to expand the methodology to larger areas and neighboring.

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