Article

Infrastructures and Sustainability: An Estimation Model for a New Highway Near Genoa

Paolo Rosasco [1,*] and **Leopoldo Sdino** [2]

1   Architecture and Design Department, University of Genoa, Stradone S. Agostino, 37, 16126 Genoa, Italy
2   Polytechnic of Milan, ABC Department, Piazza Leonardo da Vinci, 32, 20133 Milan, Italy;
     leopoldo.sdino@polimi.it
*   Correspondence: paolo.rosasco@unige.it

Abstract: The economic development of a territory is strongly correlated to its level of infrastructure (railway, roads, etc.); the complexity of this type of works requires careful planning and design that cannot be separated from the assessment of the impacts generated on citizenship affected by the new infrastructures. This study deals with the instrument defined by the Liguria Region for the implementation of infrastructures through the instruments called "Programmi Regionali di Intervento Strategico—P.R.I.S." (Regional Strategic Intervention Programs) established by the Regional Law n. 39/2007. The aim of the P.R.I.S. is to guarantee the social protection of citizens that reside (as owners or tenants) or carry out economic activities in real estate units incompatible with the construction of the infrastructure, according to the main Italian law (Presidential Decree n. 327/2001) about the expropriation of private real estate for the construction of public works. In particular, the construction of a new link of the A7-A10-A12 motorway sections near the city of Genoa (called "Gronda") is considered. The new infrastructure involves the expropriation of about 100 residential units and the relocation of about 50 production activities; the related P.R.I.S. defines the conditions that allow social cohesion through the recognition of indemnities for the expropriation of the real estate properties and the compensation of other expenses that the residents have to pay for their relocation. The valuation of the indemnities is developed through a multi-parameter model applicable for the estimation of real estate units (residential and productive) at a large-scale (mass appraisal); it is derived from the Market Comparison Approach and considers the most meaningful real estate characteristics. The aim is to develop a mass appraisal estimation model applicable in an easy way on real estate units with different destinations use. The model can be applied for the estimation of ordinary and special indemnities to be recognized for owners and tenants affected by the expropriation of their real estate units for the construction of public projects.

Keywords: road infrastructures; social sustainability; real estate appraisal; mass appraisal; Regional Strategic Intervention Programs

1. Introduction

The planning and construction of public works and infrastructures—such as roads or railways—are characterized by complex legislative and procedural procedures, which often lead to uncertain times and results. In many countries, moreover, an approximate design of the works is characterized by phenomena of corruption between the client and the contractor, which frequently leads to a significant increase of final costs as well as a poor quality of the works and, consequently, high costs of maintenance over time.

The success of an infrastructure project is strongly conditioned both by a right assessment of the technical feasibility and by the economic, environmental, and social sustainability.

The concept of sustainability and sustainable development has been stated by the Brundtland Commission [1], which defines it as development that meets the needs of current generations without compromising the ability of future generations to meet their needs.

In accordance with the three dimensions involved in the concept of to the sustainable project [2], some recent infrastructure studies have declined them as follows:

- Social sustainability, understood as the impact of the infrastructure on local populations in terms of the possibility, even for those with lower income, to access and dispose of the services generated by the infrastructure (use, etc.) [3];
- Environmental sustainability, understood as an impact of the infrastructure on the quality of services (well-being, quality of life), on the environment (healthiness of the area, water, reduction of urban congestion, etc.) and on natural ecosystems (maintenance of animal and plant species) [4];
- Financial sustainability, understood as a correct evaluation of the economic resources necessary for the construction and management of the works over time [5].

Although the assessment of the sustainability of infrastructure projects has not been investigated as much as those regarding the projects at buildings scale, several authors have addressed the topic by testing or developing evaluation methods that take into account the different aspects of sustainability [6–16].

The social dimension of the project is one of the most critical issues, especially when these are located in densely urbanized areas; it implies the evaluation of many different effects derived from projects as: Creation of jobs; quality change in transport; noise and air pollution; expropriation of real estates; inconveniences derived by the construction sites during the building phase. Within the evaluation of the sustainability, the social dimension is also the least considered [17,18], while the economic performance is always considered [19–21]. If the social dimension of an infrastructure project is not carefully evaluated, this can produce negative effects on the project, society [22,23], and also on future generations [24–26]. One of the main reasons is that many social aspects are difficult to defined and evaluate [27] in qualitative or quantitative way; they depend on the type of infrastructural projects, local territorial characteristics, and participants perspectives [19,28,29].

The criteria and indicators of social sustainability must be defined through the involvement of the different stakeholders (citizens, etc.); one of the most critical aspects of the social sustainability of an infrastructure project is related to the consent of citizenship directed interest to the infrastructure.

To promote a higher level of participation of citizens and other stakeholders within the planning and design phase of public works, the Italian Decree of the President of the Council of Ministers n. 76/2018 have introduced the "public debate". All the interested population can participate in the debate, mediated by experts unrelated to the developers of the infrastructure. It allows citizens to discuss the opportunity to realize a certain project, its main objectives and characteristics, or the objectives of plans and programs, the socio-economic implications, and the main impacts on the environment and on the management of the territory. The public debate and the preliminary consultation also make it possible to discuss the various alternative solutions, including the possibility that the project is not carried out (the so-called "zero option"), and the methods of information and communication that must be guaranteed to citizens during the project realization process.

In order to facilitate the realization of new infrastructures in cohesion with the communities concerned, the Liguria Region has promulgated the Law n. 39/2007, in which the "Regional Strategic Intervention Programs" (P.R.I.S.) are established. With these programs, the Region—in agreement with the local public administrations and with the developers of the infrastructures—pursuing, at the same time, the requalification of the territorial contexts concerned and the social sustainability of the works, reducing the possible negative impacts on the local communities interested.

The projects can be financed with public and private resources, also through a project finance or another public-private partnership systems.

This study deals with the P.R.I.S. activated by the Liguria Region for the construction of the new connection of the motorway sections of the A7-A10-A12, near the city of Genoa. The aspects involved in the social sustainability of the project are investigated; in particular the estimation of the economic compensation that the developer of the infrastructure must pay to the owners and tenants of real estate that are expropriated, through the adoption of a large-scale evaluation method (mass appraisal).

2. The National Legislation on Expropriation Indemnities

The issue of social sustainability of infrastructures is closely connected to the impacts generated on the populations directly interested.

The impacts generated both in the construction phase (construction site) and during the useful life span of the infrastructure are the most critical issues in this type of works; they often create conflict between the citizens and the developers (public or private).

Among the many critical issues, the estimate of the economic indemnities for the expropriation of real estate units is one of the most delicate aspects within the process of planning and construction of an infrastructure.

In Italy, the law that establishes the methods of estimating the economic indemnities in case of expropriation of real estate units for the construction of works of public interest is the Presidential Decree n. 327/2001.

Article 32 of the Decree establishes that in the event of total expropriation of the real estate unit, the economic compensation that must be paid to the owner is equal to the market value of the real estate unit, estimated in relation to the characteristics surveyed at the date of the expropriation decree. This indemnity compensates the owner of the value of the expropriated real estate unit, but does not consider the inconveniences and other damages that arise because of its transfer (moving, notary fees for the purchase of a new home, other inconveniences, etc.). When the expropriation interests production units (companies), they may face additional expenses due to the need of locating their activities in temporary locations while waiting to find a real estate unit suitable to transfer their equipment.

The Decree also does not include any compensation to the tenants of the expropriated properties who must also face expenses for their move or the permanent negative effects caused to the owners of real estate properties located near the new infrastructure (e.g., the noise and atmospheric pollution produced by vehicles, for the negative impact on the landscape, etc.).

3. The P.R.I.S. of Liguria Region

The Law of the Liguria Region n. 39/2007 has identified the "Regional Strategic Intervention Programs" (P.R.I.S.) as tools to facilitate the realization of large strategic infrastructural works of national and regional interest by promoting social cohesion. The projects that can be developed through a P.R.I.S. are also public works that aim to mitigate the hydraulic and hydrogeological risk.

Through the P.R.I.S., the Liguria Region and Local Authorities (Municipalities) identify the solutions necessary to guarantee the sustainability of the impacts on the territory and on the community deriving from infrastructure projects. In particular, adequate economic and social protection measures are established in favor of the citizens that suffer the damages from the realization of the infrastructures (residents or owners of economic activities).

The P.R.I.S. provides—in addition to ordinary indemnity provided by Presidential Decree n. 327/2001—special indemnities for owners and tenants of the real estate units to be paid by the developers of the infrastructure.

This special indemnities compensate:

1.   Costs for relocation, connection of utilities, and renovation in the case of residential properties;
2.   costs for the renovation of the new real estate units;

3. costs for the transfer of the production activity and damage from the temporary production stoppage;
4. temporary and permanent inconveniences (construction site, noise pollution, etc.).

For cases 1 and 2, the special indemnity for each real estate unit is evaluated on the basis of its estimated market value; for cases 2 and 3 is to be determined case-by-case on the basis of an appraisal to be compared with the implementing entity for the verification of their congruity. For case 4, it is established by the Regional Law. Although the special indemnities compensate only a part of the inconveniences suffered by the citizens interfered with by the new infrastructures, it represents a valid and tangible economic aid that allows a more favorable—and in many cases better—relocation than the previous one.

The ordinary and special indemnities established by Presidential Decree n. 327/2001 and by the Regional Law n. 39/2007 are shown in Table 1.

Table 1. Figures and indemnities.

Figure	Ordinary Indemnity Pres. Decree n. 327/2001	Special Indemnity Regional Law n. 39/2007 (P.R.I.S.)
Owners of housing units in which they are residents	Market value of the expropriated real estate unit	40,000 € for adaptation of new accommodation and new connection (art. 6, paragraphs 1–2–3):
Owners of housing units expropriated but not residents	Market value of the expropriated real estate unit	
Tenants of expropriated housing units in which they are residents		- 30,000 € for adaptation of new accommodation - 10,000 € for moving and new connection (electricity, etc.)
Owners of production and/or commercial companies, owners of the properties in which they operate	Market value of the expropriated real estate unit	Removal costs and production stoppages to be estimated by appraisal (art. 6 bis, paragraphs 2–3)
Manufacturing and/or commercial business owners who carry out business in properties where they are tenants		Removal costs and production stoppages to be estimated by appraisal to be estimated by appraisal (art. 6 bis, paragraph 2)
Owners or tenants residing in buildings facing the construction sites (range 30–60 m away) installed for the construction of the infrastructure works.		40,000 € for temporary and permanent inconvenience (art. 6, paragraph 1)

During the 2009/2019 decade of application of Regional Law n. 39/2007, fourteen P.R.I.S. have been activated on the territory of the Liguria Region: seven approved (which will be followed by the signing of the related Program Agreements between the Liguria Region, local municipalities, and others authorities); four in progress; three proposed (Figure 1).

The P.R.I.S. are largely related to the construction of road and motorway infrastructures and involve a large number of citizens affected; less numerous are those activated for railway works, however, they have a great social impact as they are projects involving highly populated areas.

Each P.R.I.S. has a Technical Committee which performs guidance, coordination, and consultative functions regarding the application of the Regional Law (Liguria Region, local municipalities, and any other interested parties compose the Technical Committee.); all social criticalities manifested by citizens are collected by the Technical Committee, which analyzes the different requests presented and tries to solve them together with other local public administrations. In case of need, it activates the social services of the local municipalities concerned for psychological and social support to the citizens.

Taking as reference the project for the construction of the new sections A10-A7-A12 motorway connection, this study reports the estimation methodology developed for the verification of the indemnities to be paid to the owners of residential and production properties that interfere with the construction of the new infrastructure. In particular, a mass appraisal model is applied for the estimation of ordinary and special indemnities for the two types of real estate units.

	Approved		Under construction		Proposed
4	Aurelia bis road Savona	**11**	Railway junction Genoa	**1**	Aurelia bis road Imperia
5	Giotto street Genoa	**12**	3rd railway pass Genoa	**2**	Doubling road Andora-Finale Ligure
6	Fegino road junction Genoa	**13**	Motorway junction A10-A7-A12 Genoa	**3**	New subway section Genoa
7	S. Benigno road junction Genoa	**14**	Maersk platform for container Vado (Savona)		
8	New Polcevera bridge Genoa				
9	Felettino hospital La Spezia				
10	Aurelia bis road La Spezia				

Figure 1. P.R.I.S. (Programmi Regionali di Intervento Strategico—Regional Strategic Intervention Programs) of Liguria Region (Source: Liguria Region).

4. The Case Study: The New Highway Connection Called "Gronda"

The project for the new motorway connection between the sections of the A10-A7-A12 near Genoa (called "Gronda") aims to highlight—from the city of Vesima (Voltri)—the flow of traffic from the A10 and directed towards the A7 (to Milan) or A12 (to Livorno). Today, all the traffic flow passes through the Genoa west node, already heavily characterized by vehicular traffic to the city and goods traffic to the port (Figure 2).

Figure 2. New connection between A10, A7, and A12 near the Genoa junction. (Source: Autostrade per l'Italia S.p.A.).

The project was presented by "Autostrade per l'Italia S.p.A." (ASPI) (concessionaire company) at the Ministry of Infrastructure and Transport in 2008 and the following year (2009), and on the initiative of the Municipality of Genoa, the public debate was launched in which citizenship had taken part; the citizens analyzed five different alternative routes of the new infrastructure.

On the basis of the observations, a new route was therefore identified; decrease the impact on the city by reducing the number of interfering buildings. Following the environmental impact assessment and the following Services Conference (2014–2015), ASPI then presented the final design of the new infrastructure with the required additions (Figure 3).

Figure 3. The new bridge on the Polcevera River. (Source: Autostrade per l'Italia S.p.A.).

In 2017, the Ministry of Infrastructure and Transport approved the final project and declared the public utility of the new infrastructure. On the base of the Regional Law n. 39/2007, the P.R.I.S. and the related Technical Committee was established (The Technical Committee of the P.R.I.S. "Gronda" is composed by the Liguria Region; Municipality of Genoa; the Union of the Chambers of Commerce of Liguria; Chamber of Commerce, Industry and Crafts of Genoa (C.C.I.A.A.); ASPI; Liguria Energy

Recovery Infrastructures (I.R.E.)). In particular, the P.R.I.S. "Gronda" has the objective of addressing the critical issues related to the expropriation of real estate units that interfere with the infrastructure, ensuring adequate compensation for both owners and other interested parties (tenants), with a view to social sustainability.

The real estate units interfering with the infrastructure have residential or productive destination use. With the aim of defining the right indemnities to be recognized for their expropriation, the Municipality of Genoa has instructed the authors to verify the indemnities established by the ASPI technicians, in relation to the indications established by the Presidential Decree n. 327/2001 and by the Regional Law n. 39/2007.

In particular, the request is the estimation of the ordinary and special indemnities that must be recognized to the owners of each expropriated real estate unit.

5. The Estimation of the Indemnities for Residential Properties

5.1. Estimation of Ordinary Indemnities for Residential Properties

For the estimation of the ordinary indemnities for the owners of residential real estate units expropriated, the Presidential Decree n. 327/2001 has been considered; article 32 states that "the expropriation indemnity is established on the characteristics that the unit has at the date of agreement with the Public Administration or at the date of the expropriation decree".

Overall, the residential real estate units under expropriation are 99 (Figure 4); they belong to two different types of buildings:

- Real estate units within multi-family buildings located in the districts of: Bolzaneto (40); Voltri (6); and Sampierdarena (18) for a total of 64 units (Figure 5—left);
- Single-family buildings (called "scattered houses") located in the districts of: Voltri (11), Bolzaneto (15), Rivarolo (5), and Sampierdarena (4) for a total of 35 units (Figure 5—right).

Figure 4. Districts of Genoa where the real estate units are located (blue zone). (Source: www.immobiliare.it).

Figure 5. Example of a condominium building (left) and a single-family house ("scattered houses"—right) (source: Authors).

5.2. The Mass Appraisal Model

For the estimation of the ordinary indemnity related to the expropriation, a multi-parameter model has been applied, derived from the Market Comparison Approach (MCA); this type of estimation model allows for the estimation of large quantities of properties (mass appraisal) considering a series of real estate characteristics [30–36].

In order to define the multi-parameter estimation model, a survey is developed on the real estate market segments in which the real estate units are located; seven characteristics were selected with the collaboration of some local real estate agents and based on the results obtained from previous studies on the local real estate market [30,37,38], in particular:

1. Dimension (sqm);
2. age of building;
3. type of building;
4. maintenance state;
5. floor level;
6. lift (or not);
7. accessibility.

Although in a small number, the characteristics selected are meaningful to represent the value- of residential real estate units that must be estimated (subjects).

For each subject, the qualitative and quantitative status of the selected characteristics are measured.

For the application of the model, in collaboration with some local real estate agents, 24 comparables have been identified (10 for the real estate unit in multi-family buildings, and 14 for the single-family buildings). Priority is given to the location of the comparable within the same OMI (Observatory on Real Estate Market of the Italian Ministry of Revenue) zone; when this is not possible, an adjustment is made to the unitary price of the comparable by calculating a "zonal adjustment" coefficient (Kz) by comparing the average unitary value of the OMI zone within the subject is located with the average unitary value of the OMI zone where the comparable is located.

The values assumed by the Kz coefficient vary from 0.55 to 1.00.

Following the evaluation of the qualitative status of the selected characteristics, a coefficient is therefore associated for each subject and comparable; it represents how the value of the real estate units (subjects and comparables) varies compared to the price of a "new" real estate unit (that is, in excellent general condition) located within the same zone of real estate market.

The coefficients associated with the state of each characteristic are determined from the literature. With regard to the maintenance state, the age and type of building is assumed to be a single coefficient, as reported in the following Table 2 [39].

Table 2. Coefficients adopted for the age, quality, and condition of the residential real estate units.

Age and Type of Building	Excellent State	Good State	Mediocre State	Bad State
New				
Luxury	1.10	-	-	-
Stately	1.05	-	-	-
Medium	1.00	-	-	-
Popular	0.90	-	-	-
Ultra-popular	-	-	-	-
Very recent				
Luxury	0.95	0.90	0.85	-
Stately	0.90	0.85	0.80	-
Medium	0.85	0.80	0.75	-
Popular	0.80	0.75	0.70	-
Ultra-popular	-	-	-	-
10–20 years				
Luxury	0.90	0.85	0.80	-
Stately	0.85	0.80	0.75	-
Medium	0.80	0.75	0.70	-
Popular	0.75	0.70	0.65	-
Ultra-popular	-	-	-	-
21–40 years				
Luxury	0.85	0.80	0.75	0.65
Stately	0.80	0.75	0.70	0.60
Medium	0.75	0.70	0.70	0.60
Popular	0.70	0.65	0.60	0.50
Ultra-popular	-	-	-	-
41–60 years				
Luxury	0.80	0.75	0.70	0.60
Stately	0.75	0.70	0.65	0.55
Medium	0.70	0.65	0.60	0.50
Popular	0.65	0.60	0.55	0.45
Ultra-popular	-	-	-	-
Over 60 years				
Luxury	0.75	0.70	0.65	0.55
Stately	0.70	0.65	0.60	0.50
Medium	0.65	0.60	0.55	0.45
Popular	0.60	0.55	0.50	0.40
Ultra-popular	0.55	0.50	0.45	0.35

For the accessibility to the building and the floor level (with or without lift within the building), the coefficients shown in Tables 3 and 4 are adopted.

Table 3. Coefficients by level of accessibility to the building.

Building Accessibility Level	Condominium Properties	Single-Family Buildings
Easy accessible	-	1.00
Accessible	1.00	0.90
Moderately accessible	0.95	0.80
Accessible with difficulty	0.90	0.70

Table 4. Floor level coefficients in the presence and absence of the lift.

Floor	With Lift	Without Lift
Underground/basement	0.850	0.800
Ground level	0.900	0.900
Between ground level and 1st	0.900	0.900
1st	0.980	0.960
2nd	1.000	1.000
3rd	1.000	0.950
4th	0.980	0.920
5th	0.970	0.850
6th	0.960	0.750

The values are determined by analyzing previous studies [39–44] and taking into account the specific building characteristics of each subject.

Based on the analysis of the qualitative state of the characteristics, for each subject "i" three coefficients "k_i" are then calculated.

- The first (ki_1) is expressive of the age, the type of building, and the maintenance state of the real estate unit. For the subjects analyzed, it varies from 0.35 to 1.10;
- The second (ki_2) is expressive of the level of accessibility to the building. For the subjects analyzed, it varies from 0.70 to 1.00;
- The third (ki_3) is expressive of the floor level in the presence or absence of the lift. For the subjects analyzed, it varies from 0.750 to 1.00.

Similarly, for each comparable "j"—with a selling price equal to P_j—the same three coefficients "k_j" (k_{j1}, k_{j2}, k_{j3}) are calculated.

For each real estate unit, the total coefficient and the sum of the coefficients attributed in relation to the characteristics of the three state are then calculated, namely:

- For subjects:

$$Kt_i = k_{i1} + k_{i2} + k_{i3;}$$

- for comparables:

$$Kt_j = k_{ij1} + k_{j2} + k_{j3}$$

The difference between the total coefficient calculated for the subject "i" (Kt_i) and for each comparable "j" (Kt_j) therefore represents the correction (positive or negative) to be applied to the price of each comparable. The "adjusted" price is the price that the comparable "j" should have had in the case of perfect equality of characteristics with respect to the subject.

The coefficient KT_{ji} is given by:

$$KT_{ji} = Kt_i - Kt_j$$

The "adjusted" price $P_{j'i}$ of the comparable "j" is therefore given by:

$$P_{j'i} = P_j \times KT_{ji}$$

For each comparable the "adjusted" price is then calculated with respect to each subject "i"; dividing each "adjusted" price $P_{j'i}$ by its dimension (SC_j), the "adjusted" unitary price $p_{j'i}$ is then determined:

$$p_{j'i} = P_{j'i}/SC_j$$

The average of the "adjusted" unitary prices therefore determines the average unitary value Vu_i of the subject "i".

$$Vu_i = p_{j'i} \text{ average}$$

The most probable market value V_i of each subject "i" is obtained by multiplying its dimension (SC_i) by the unitary value Vu_i.

$$V_i = Vu_i \times SC_i$$

Considering that the selected comparables were sold in 2016, the estimated values were therefore referred to in the second half of 2008, as established by the agreement between the Liguria Region, the Municipality of Genoa, and ASPI. In particular, to each estimated price is applied an "adjustment" coefficient calculated on the basis of the percentage change in the unitary average prices of residential properties detected within the OMI zone where the subject is located.

5.3. Results

The analysis of the results obtained from the model shows that the unitary values of the subjects vary between a minimum of 1074 €/sqm and a maximum of 1589 €/sqm. It should be noted that in the Campasso zone (Sampierdarena district—OMI zone C21), the minimum estimated unitary value (equal to 1074 €/sqm) is slightly below the minimum unitary value detected by the OMI in 2008 (1180 €/sqm) while in the Voltri district (OMI zone D34), the maximum estimated unitary value (equal to 1227 €/sqm) is higher than the maximum unitary value reported by OMI (equal to 1109 €/sqm).

A careful check shows that the minimum value of Sampierdarena relates to a real estate unit in poor maintenance conditions, while the second relates to a real estate unit in excellent condition (recently renovated and a high level of finishes); both belong to the type of real estate unit located in multi-family buildings.

5.4. Estimation of Special Indemnities for Residential Properties

The special indemnities are estimated according to the Regional Law n. 39/2007. The values are established by the Regional Law and no expert report is required (Table 1).

These indemnities are equal to 30,000 € for the adaptation costs (building renovation) of the new real estate unit and 10,000 € for the costs of moving house and connection of the new utilities (electricity, gas, etc.). In the case of a leased real estate unit, the special indemnity is due to the resident tenant.

Furthermore, the Regional Law n. 39/2007 recognizes to residents who live within the range of 30 to 60 m from the new infrastructure (not affected by any expropriation), a special indemnity equal to 40,000 € for the damage caused by temporary (building site) and permanent inconvenience (noise, atmospheric pollution, negative landscape impact).

5.5. Estimation of Ordinary Indemnities

The real estate units are located in the districts of Voltri (2-OMI zone D35), Cornigliano (2-OMI zone D46), and Bolzaneto (32-OMI zone D29). The properties located in the Bolzaneto district are all within a building (called "Ciari") built at the end of the 1990s with a prefabricated concrete structure (Figure 6).

Figure 6. "Ciari" building in Bolzaneto district (Source: Authors).

Unlike residential real estate units, at the time of estimation (2018) it was not possible to find a set of comparables in the same market zones where the subjects are located; then a multi-parameter estimating model is adopted based on the analysis of the qualitative-quantitative status of 12 real estate characteristics and their relative contribution (weight %) to the composition of the total real estate value (Table 5).

Table 5. Real estate characteristics considered in the estimate model and weight (%) of total real estate value.

Characteristic	Weight (%)
Road accessibility	12.60
Commercial context	12.00
Vehicle accessibility	10.80
Public transportation available	4.50
Real estate unit size	8.00
Internal distribution of real estate unit	6.90
Structure, cover, windows	10.30
Building maintenance	12.30
Electrical system	7.30
Heating system	4.50
Accessory systems	3.50
Plant maintenance state	7.30
TOTAL	100

For each productive real estate unit (subject) "i", the real estate value (V_i) can be estimated as follows:

$$(10 - 6){:}(910 - 630) = (S_i - 6){:}(V_i - 630)$$

Then:

$$V_i = 630 + ((770-630) \times (P_i-6)){:}(10\text{-}6)$$

where:

- S_i = total score attributed to the subject "i";
- 630 €/sqm = minimum unitary value detected by the OMI for zone D29;
- 910 €/sqm = maximum unitary value detected by the OMI for zone D29.

The unitary value obtained through the application of the estimate model range from a minimum of 420 €/sqm (for a real estate unit located in the OMI zone D35 of Voltri) to a maximum of 762 €/sqm (for a real estate unit located in the OMI zone D29 of Bolzaneto within the "Ciari" building).

5.6. Estimation of Special Indeminties

The estimation of the special indemnities—related to the real estate component only—is considered in article 6 bis—paragraphs 2–3—of Regional Law n. 39/2007; in particular, are estimated the costs of redevelopment (related to the works of adaptation for electrical systems, etc.) of the new real estate unit to which the economic activity will be transferred.

This indemnity is correlated to the state of the expropriated real estate units, i.e., the qualitative state of equipment, spaces, and facilities for complementary activities (offices, meeting room, etc.); in this way, the costs that the owner will incur to reproduce the spaces and fittings necessary for production are recognized, as they are currently detectable in the real estate unit expropriated.

The estimation of the indemnity is developed considering an average unitary cost of restructuring and adaptation of new real estate unit (considering only workings like painting, new connections for electrical and heating systems, etc.) and the unitary cost for the adaptation and restructuring for new office spaces.

The unitary average costs estimated are equal to 200.00 €/sqm for the adaptation and restructuring of production spaces, and 350.00 €/sqm for the adaptation and restructuring of office spaces. In order to estimate the indemnity, the aforementioned unitary costs are therefore referred to the status of 6 (Table 6) of the 12 characteristics considered in the previous estimation for ordinary indemnity (Table 5).

Table 6. Characteristics considered for the estimation of special indemnity.

Characteristic	Weight (%)
Structure, cover, windows	10.30
Building maintenance status	12.30
Electrical system	7.30
Thermal system	4.50
Accessory systems	3.50
Systems maintenance status	7.30
TOTAL	*45.20*

The six characteristics considered are relevant for assessing the maintenance and plants status of the real estate units (including office space) and together make up 45.20% of the real estate value.

For each subject, the weighted score obtained for the 6 characteristics (S_{i6}) in the previous estimate is then compared with the weighted score obtained by attributing the score 10 to each of the same 6 characteristics (equal to 4.52).

The unitary cost that is possible to recognize for restructuring and adaptation of productive space in the new real estate unit is equal to:

$$\text{Cu adjustment} = \text{Cu average} \times (S_{i6}/4.52)$$

For the adaptation of space for production uses, the unitary cost (Cup_i) is equal to:

$$\text{Cup}_i = 200.00 \text{ €/sqm} \times (S_{i6}/4.52)$$

For the adjustment of office space, the unitary cost (Cuo) is equal to:

$$\text{Cuo}_i = 350.00 \text{ €/sqm} \times (S_{i6}/4.52)$$

The unitary costs recognized for restructuring and adaptation of productive spaces vary from a minimum of 100 €/sqm to a maximum of 200 €/sqm, while the one for adjustment of office spaces vary from a minimum of 175 €/sqm to a maximum of 350 €/sqm.

Based on the inspections carried out within each properties, it is found that the average incidence of the spaces for production activities is equal to 80% of the total area, while the remaining 20% is for office and meeting spaces.

For each subject, the total special indemnity (Isi) to be recognized for the adaptation works is obtained by multiplying the unitary costs before calculating the total surfaces (for production and office use) detected by design and checked by direct inspections.

$$Is_i = Cup_i \times SC_i \times 0.80 + Cuo_i \times SC_i \times 0.20$$

The values of the indemnities recognized vary from a minimum of 33 thousand € to a maximum of 297 thousand €; the incidence of the special allowance varies from a minimum of 4.2% to a maximum of 27.9% of the overall economic amount paid to the owner (excluding the allowances for the move and for production stoppage). In case of rental of the propriety, this indemnity must to be paid to the tenant.

6. Conclusions and Discussion

The social dimension of infrastructural projects is a very important aspect of global sustainability [19]; it must be considered as the other two dimensions (economic and environmental) because only a correct balance of the three components determines a good project [9].

An important aspect of social sustainability is related to the inconveniences deriving from the relocation of the residents or productive activities whose buildings interfere with the infrastructure.

The negative effects are both economic (related to the need to find a new property in which to reside or carry out productive activities) and psychological. They must be carefully evaluated to avoid that the benefits of the new infrastructure are partially nullified by the negative effects that can be generated during the construction and management phases.

Considering the damage deriving from the expropriations of real estate units, the indemnities to be paid to the owners and tenants of the properties that interfere with the infrastructure must be calculated not only in relation to the market value of the expropriated building, but also of the other damages and inconveniences.

The Law of the Liguria Region n. 39/2007 deals with the issue of the realization of infrastructures of regional and national interest from a participatory perspective aimed at defining and resolving any problems that may affect (directly or indirectly) citizens and economic activities involved. In particular, through the P.R.I.S., the social sustainability of the infrastructure is addressed through the recognition of special economic indemnities for owners and tenants of real estate units that interfere with the infrastructures and other social support.

Unlike national law, the regional one improves social justice in case of expropriation because it recognizes that citizens have greater economic damage than only the market value of their expropriated properties.

Taking as reference the P.R.I.S. for the new A7-A10-A12 motorway connection near the city of Genoa, the paper deals with the estimation of ordinary and special indemnities through a multi-parameter estimation model.

Due to its application method, it derives from the Market Comparison Approach; it is configured as a model for the mass appraisal as it is applicable to a big number of properties in an easy way and represents a valid alternative estimation model applicable in estimative contexts that require reduced time and reliability of results. It can also be applied even in the presence of small data samples, overcoming the age-old problem of the reduced availability of data necessary for the estimates.
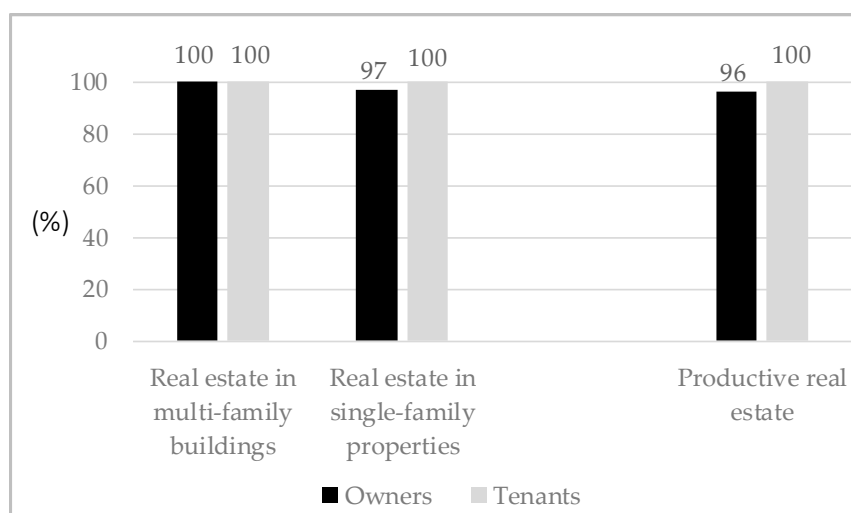
The values of ordinary and special indemnities thus estimated are verified by comparing them with those estimated by the technicians of the expropriating company and shared by the Technical Committee of the P.R.I.S.

Figure 7 shows the acceptance percentages of the economic indemnities by owners and tenants, distinguished by type of property. With regard to productive real estate units, the indemnities estimated through the model must be sum with the other recognized for production stoppage and moving.

The acceptance percentages of the allowances estimated with the multi-parameter model show a high degree of satisfaction, although the indemnities partially compensate all the inconvenience suffered (for example, do not consider for the residents, the damage for the removal from the places, and communities where they grew up and lived).

The economic indemnities—at least in part—contribute to the achievement of that social sustainability of the infrastructures that Regional Law has among the main objectives; at least, it is able to guarantee reasonable transfer alternatives for both residence and economic activities.

By means of the Technical Committee, the P.R.I.S. supports socially and psychologically the citizens interfered with by the infrastructure; for the P.R.I.S. "Gronda", four meetings with residents and business owners were organized to collect their requests and to explain what type of economic compensations will be recognized, how they will be estimated, what damages they will compensate, the estimating method utilized, and the modality for the recognition. During the first meeting, the owners of the residential properties appointed three representatives; they collaborated with the Technical Committee to resolve some specific critical issues related to the relocation of some elderly residents and the collection of technical information on their properties useful for the estimation.

Figure 7. Percentages of ordinary and special indemnities accepted by owners and tenants.

These meetings—foreseen by the Regional Law between the tasks of the Technical Committee—allow from the outset to identify the individual critical issues affecting the individual citizens concerned and to define possible solutions in a coordinated manner with the other public administrations. In some cases, the social services of the municipality of Genoa were activated for the relocation of five residents in public residential buildings.

Today, more than thirty years after the introduction of the three sustainability paradigms, with the contribution of various authors, the concept of sustainability has evolved; among these, Pope Francis' Encyclical "Laudato si" whose concepts introduce new meanings of sustainability of human actions which go alongside the traditional ones and which can be so declined [45]: The project must be "Just" (social sustainability), "Beautiful" (environmental sustainability), and "Truthful" (economic sustainability).

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