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The Social Sustainability of the Infrastructures: A Case Study in the Liguria Region

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Abstract: One of the indicators that measures the economic development of a territory is its infrastructural endowment (road, rail, etc.). The presence of roads, railways, and airports are essential elements in creating the optimal conditions for the establishment or development of productive activities and economic growth; and also to generate benefits. However, the presence of infrastructure can have strong impacts on the environment and the living conditions of the population and infrastructure can be subject to actions related to contrast and opposition. Therefore, in parallel with the economic and environmental sustainability assessment, it is essential to decide whether or not to build new infrastructure. In addition, social sustainability is also pursued on the basis of an assessment that takes into account various aspects that relate the work to the population, also in order to identify the most satisfactory design solution. Alongside the adopted methodology, the assessment must be identified suitable criteria which are capable of taking into account the various impacts generated by the infrastructure, not only of an economic and environmental type, but also social and attributed relative importance (or weight) that is congruous with the correct balance of the three aspects of sustainability. This contribution deals with the identification of criteria for assessing the social sustainability of infrastructure projects, by taking as reference the 24 infrastructure projects in the planning and construction phase in the Liguria Region that make use of the Regional Law n. 39/2007 on the "Regional Strategic Intervention Programs—P.R.I.S." (Regional Strategic Intervention Programs); which guarantees citizens affected by the infrastructure. In this research work, the selection is performed through the involvement of local stakeholders as well as the subjects and institutions that operate within the decision-making process of a work (designers, technicians from public administrations). The selected criteria are then weighted through the pairwise comparison method used in the multi-criteria technique of ThomasSaaty—Analytic Hierarchy Process (AHP). The goal is to identify the useful criteria for assessing social sustainability and the weights attributed by the various parties involved in the decision-making process by citizens directly or indirectly affected by the infrastructure.

Keywords: infrastructures; social sustainability criteria; Analytic Hierarchy Process

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1. Introduction

The concept of sustainability and "sustainable development" was first enunciated by the Brundtland Commission [1], which defines it as those developments that satisfy the needs of current generations without compromising the ability of future generations to meet their own needs.

From its first definition through the following ones that have been added to the concept and implemented (Rio de Janeiro Conference 1992, Agenda 21), different dimensions of sustainability have been identified, such as environmental, cultural, social, economic, and technological—which must co-exist in a logic of integration and development [2,3].

The pursuit of the sustainability of a project related to the transformation of a territory must be achieved through the achievement of an acceptable balance between the different dimensions that characterize it, especially in relation to the three components considered most significant, the economic, environmental, and social one.

With regard to infrastructure projects (i.e., those that have as their object the transportation of goods, people, or energy), the three main components of sustainability are described as follows:

- *Social sustainability*, i.e., the possibility, even for people with a lower income, to be able to use the services generated by the infrastructure (accessibility, use, etc.) [4] and fair actions aimed at minimizing any inconvenience generated both during the construction and management phase of the infrastructure (temporary or definitive relocation of residents, fair economic compensation for property expropriations, etc.);
- *Environmental sustainability*, i.e., the impact of the infrastructure on the environment (environmental pollution produced, increase in urban congestion, etc.) on the quality of services (quality of life and well-being generated, etc.) and on natural ecosystems (conservation of species animals and plants present, etc.) [5];
- *Financial sustainability*, i.e., reliable forecasting and planning of economic resources (public or private) necessary for the construction and management of the infrastructure during its useful life [5].

Since it is impossible to achieve the maximization of all three dimensions of sustainability at the same time, the design solution must be one that—among the different possible alternatives—satisfies the greatest number of subjects—directly or indirectly involved.

Regarding infrastructure projects promoted by public entities, the aspect of social sustainability is however frequently neglected [6,7]. The reason for this lies in the choice of whether or not to implement an intervention—and which solution to adopt—priority is given to the other two aspects of sustainability, such as economic (the project must be economically sustainable, i.e., guaranteeing an effective and efficient use of public resources) and environmental (i.e., the impacts of the projects on the surrounding environment must be sustainable both from the landscape point of view and for the local flora and fauna and to respect the indications coming from the legislation at the national and local level).

However, the social aspect is one of the most critical aspects within the development process of a project, especially if it affects densely inhabited areas and the work generates temporary and/or permanent negative impacts on the population, due to its construction site (acoustic and environmental pollution, disfigurement of the landscape, etc.). A low level of social sustainability can generate negative effects not only in the short term but also in the long term, affecting future generations [8–10].

It is, therefore, important that, from the beginning of the decision-making process, social sustainability be considered in the design and evaluation process of the infrastructure and local stakeholders and representatives of local communities be involved in order to collect legitimate requests also to avoid subsequent discontent and opposition to the realization of the project which often generate delays in the timing of realization and higher construction and management costs.

From an operational point of view, the assessment of the social sustainability of infrastructures is strongly influenced by the assessment method adopted and by the criteria considered in the evaluation method; often they are not clearly defined [10].

The selection of the criteria depends on the application context, the type of infrastructure project being assessed, the subjects involved as well as the moment (or phase) of the project in which it is developed [6,11], characteristics that also influence the weight (or importance) attributed within the evaluation process. These must be selected in order to consider the different impacts (or effects) generated by the project on communities and future generations [9,10] as well as to collect the legitimate requests of the subjects involved in the realization of the project [9,10,12,13].

One of the most critical aspects is precisely related to the method adopted for identifying the criteria; for the purposes of an optimal assessment of sustainability it is important

that not only technicians–specialists in the field of infrastructure projects get involved, but also other interested parties, bearers of different requests and interests; this involvement is also useful to expert technicians as it broadens the spectrum of assessment and knowledge of the problem [14,15] and avoids an overly "technical" approach [9,10] that can lead to incorrect or misleading assessments.

Regardless of the methodology adopted, suitable criteria must therefore be considered in the assessment capable of taking into account the various impacts generated by the infrastructure, not only of an economic and environmental type, but also social and given significant importance (weight) for the correct balancing of the three dimensions of sustainability.

While reference can be made to sufficiently defined and shared indicators and measures for the economic and environmental dimension, for the social dimension it is more difficult to establish which aspects to consider and which measures to use and their inclusion in planning and evaluation is still not well established today [9,10].

This contribution deals with the identification of criteria for assessing the social sustainability of infrastructure projects, by taking as reference 24 infrastructural projects in the planning and construction phase in the Liguria Region that are regulated by the Regional Law n. 39/2007 about the "Regional Strategic Intervention Programs—P.R.I.S." (Regional Strategic Intervention Programs), which provides a guarantee for citizens affected by infrastructure works. The identification of the criteria is carried out through the involvement of local stakeholders as well as the subjects and institutions that operate within the decision-making process of an infrastructural work (designers, technicians of public administrations). The selected criteria are then weighted through the pairwise comparison method developed by Saaty in the multicriteria technique of the Analytic Hierarchy Process [16,17].

Taking as reference the projects relating to the construction of road and railway infrastructures in the Liguria Region (16 projects), the goal is to identify the useful criteria for assessing social sustainability of this type of projects and verify which are the weights attributed by the different parties involved in the decision-making process and by citizens who will be—directly or indirectly—affected by the infrastructure.

The social criteria thus identified (and their relative weight), together with the economic and environmental ones, can therefore be taken into consideration in the sustainability assessment phase of projects relating to road and railway infrastructures in order to select, among different alternatives, the more satisfactory solution capable of guaranteeing an acceptable level of economic, social and environmental sustainability for the different subjects involved in the project.

This article is structured in six sections: in the Section 1, an analysis of the social criteria used in assessing the sustainability of infrastructure projects is developed; the Section 2 introduces the case study and in particular, the 24 infrastructural projects planned—or under construction—in the Liguria Region and the legislative instrument of the Regional Law n. 39/2007 which introduces some important provisions that guarantee social sustainability; the Section 3 explains the case study relating to the identification and selection of the social criteria to be considered for the evaluation of the sustainability of an infrastructure project; in the Section 4 a weighting of the identified criteria is developed, carried out through the pairwise comparison technique developed by Saaty [16,17] in the Analytic Hierarchy Process (AHP) multicriteria analysis technique.

The results obtained are then analyzed in the Section 5, and at the end, the conclusions are developed (Section 6).

2. The Law on P.R.I.S. and Infrastructure Projects in the Liguria Region

The economic development of a territory is closely linked to its infrastructural endowment, which promotes the establishment of productive activities and facilitates the movement of goods and people. The Liguria Region was, until the recent past, characterized by significant infrastructural criticalities mainly linked to the morphology of its

territory, a strip of land that overlooks the Mediterranean Sea for about 200 km and with a mainly mountainous (65%) and hilly (30%) hinterland, aspects that do not facilitate the construction or enhancement of infrastructural works which are nowadays essential to guarantee adequate mobility of goods and people. Precisely to remedy this criticality, the Liguria Region, in concert with the other public and private entities that deal with the planning, construction, and management of infrastructures—and to solve the main criticalities related to the mobility of people and things—started in the early 2000s a program for the construction of new infrastructures or the improvement of existing ones.

To overcome the problems in the design and construction phase essentially related to the complexity of the projects, the number of subjects involved, and the impacts that this types of work have both on the territory and the populations directly or indirectly concerned, in 2007, the Liguria Region promulgated Regional Law n. 39 on the so-called "Regional Strategic Intervention Programs—P.R.I.S."—precisely with the aim of providing guarantees of special protection to those affected by large infrastructural works considered strategic for the development of the territory and regional or national interest, in addition to the DPR (Presidential Decree of the Italian Republic) n. 327/2011 on the expropriation of assets for the construction of public utility works.

In particular, the P.R.I.S. Regional Law has the goal of identifying suitable design solutions to ensure the sustainability of the effects on the territory and on the community deriving from the construction (or strengthening) of the infrastructures, providing for adequate social protection measures to benefit the subjects affected by the project; such measures consist of special allowances and urban planning facilitation that can be adopted by local administrations whose territory is affected by the works and function in the areas affected by the projects.

The infrastructure projects developed under the P.R.I.S. Regional Law include those aimed at economic and social development, rebalancing, and redevelopment of the territory with the contribution of public funding and private resources (Article n. 3 of the Law).

The fundamental aspect provided for by the Law is the analysis of territorial, environmental and public health, economic and social needs relating to the areas affected by the project (Article n. 4). Among the infrastructural works contemplated by the Law, there are also those relating to the mitigation of the hydraulic and hydrogeological risk and to prevent calamitous events or to source the consequences caused by them (Article n. 7 bis).

For those directly or indirectly affected by the infrastructural work, social sustainability is guaranteed by special indemnities for owners or tenants by placing a special economic indemnity on the implementing subjects for each residential real estate unit incompatible with the construction of the infrastructure.

In order to ensure continuity of employment and production, these guarantees are also provided for economic activities; in addition to compensation related to the value of the expropriated properties, compensatory indemnities are in fact provided for the costs of transferring production activity to another place, and the negative effects due to any production stoppage.

The infrastructure projects falling under the Regional Law on P.R.I.S. number, today, 24 in total (Figure 1); among these, five have recently been realized, 10 are under construction, and four are in the start-up phase.

For the purposes of the subsequent identification of the criteria relating to the social sustainability of the 24 infrastructure projects regulated by the Regional Law n. 39/2007 on the P.R.I.S., they directly interfere with 1024 housing units and 109 economically productive activities of various sizes (from small to medium-large); the total economic amount of the projects amounts to about EUR 15 billion.

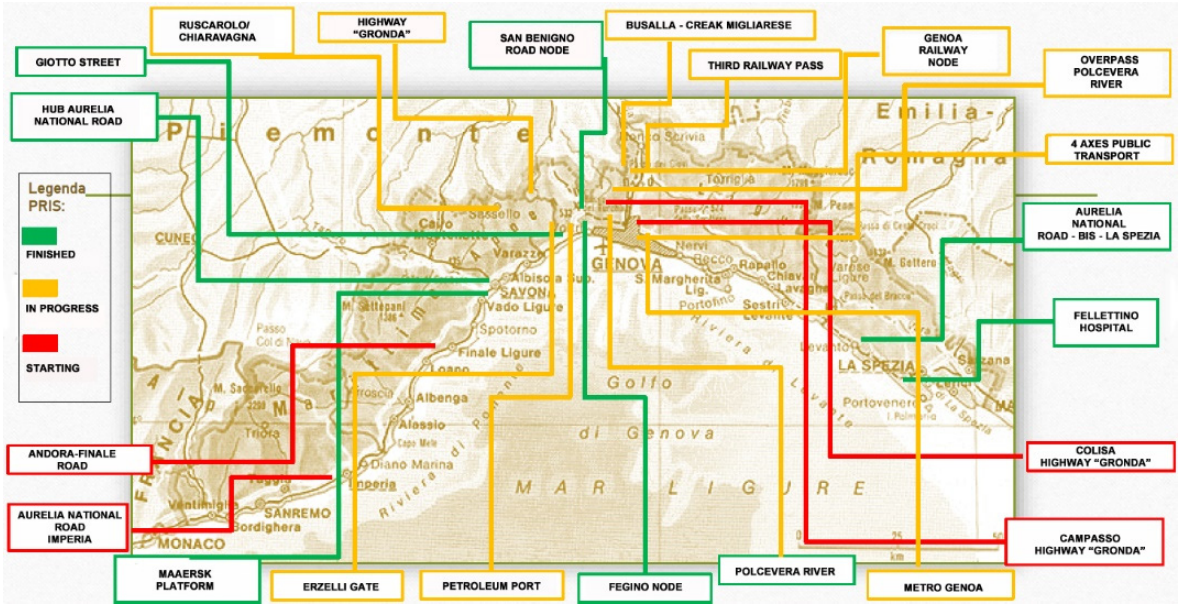

Figure 1. Infrastructure projects in the Liguria Region (source: Liguria Region).

This study aims to identify which are the most significant social criteria for assessing the social sustainability of infrastructure projects located in the Liguria Region, with reference to works intended solely for the transport of people or things (a total of 18 projects) and evaluate their importance (weight); the study is conducted through the involvement of a panel of experts and subjects directly or indirectly interested by these works and bearers, each with legitimate instances and expectations.

The knowledge of which social aspects are to be taken into consideration and their importance is a fundamental aspect to pay attention to this aspect of sustainability—too often neglected or considered secondary to other areas (economic and environmental); moreover, the knowledge of the aspects of social sustainability and their sharing among the various subjects and operators involved in the decision-making process allows the development of integrated and objective assessments, able to guarantee a balance between the different aspects of sustainability.

Regarding the type of infrastructure, they were divided into five categories (Figure 2).

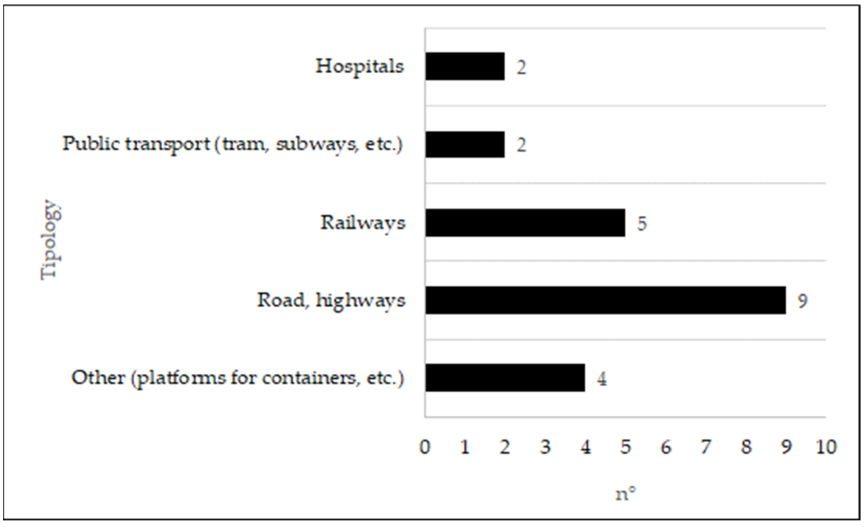

Figure 2. Typologies of infrastructure projects in the Liguria Region.

3. The Selection of the Criteria for Evaluating the Social Sustainability of Infrastructure Projects: Methodology

The search for criteria for evaluating the sustainability of an infrastructure project and determining the relative importance (weight) was undertaken in four phases, as shown in Figure 3.

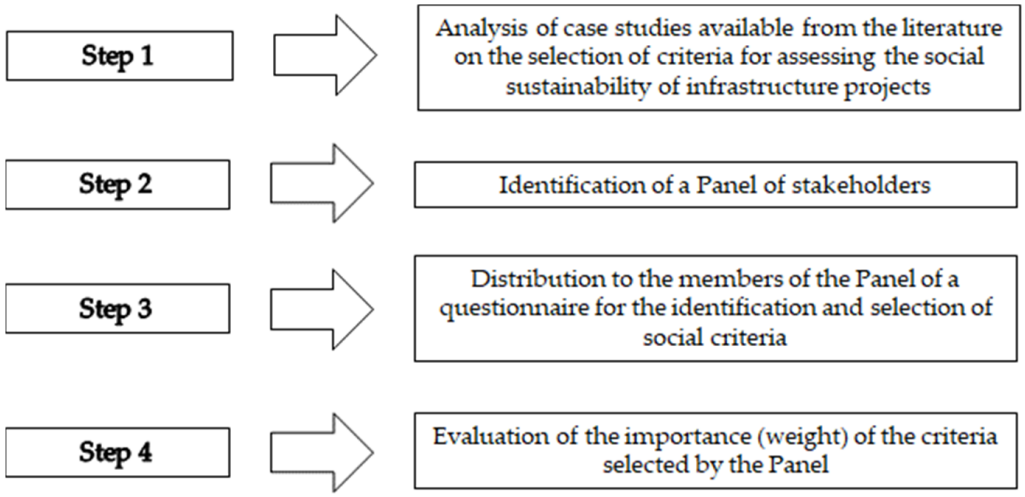

Figure 3. The methodology of the research.

The first step involved identifying the criteria used in the case studies available in the specialized literature related to the assessment of the social sustainability of infrastructural works and their grouping into categories that identify the homogenous characteristics of the criteria; this research was conducted on the basis of a search in the specialized literature of articles dealing with the issue of social sustainability of infrastructure projects.

With this aim, the research system of scientific publications used by researchers at the University of Genoa "UNO per tutto" and the "Google Scholar" database was employed, using the combination of the following keywords: "social sustainability"; "infrastructure projects"; "social criteria"; "multicriteria evaluation" [1]; conversely, no time limits were placed on the research regarding date of publication. Starting from about 100 publications (including articles, book chapters, and reports) initially selected between 2000 and 2022, by reading the titles, the abstracts, and in some cases the entire article, it was possible to exclude those not relevant to the objectives of the investigation; in particular, those case studies related to the assessment of social sustainability in works such as hospitals or industrial projects were excluded, given the small number of projects envisaged of those types in the Liguria Region (six overall—Figure 1). The total number of publications selected for the study was 84.

Each publication was then analyzed and the criteria that were used for the assessment of social sustainability were identified; the total number of criteria that emerged from the case studies was 453; for the purposes of subsequent analysis, they were then grouped, according to homogeneity of characteristics, into 11 groups (or categories) (Figure 4).

The first 10 connote the social criteria most frequently used for evaluating the sustainability of projects, while the eleventh ("11. Others") groups those that have single frequencies and are therefore not sufficiently significant for categorical grouping. Based on the identified categories, it was possible to identify the number of criteria (Figure 4). About 55% of the criteria were concentrated in three categories: "2. Welfare, wellbeing, health, quality of life and safety" (103 criteria—22.7%), "4. Cultural, historical, environmental and social impacts" (82 criteria—18.1%), and "1. Employment and economic impact" (66 criteria—14.6%).

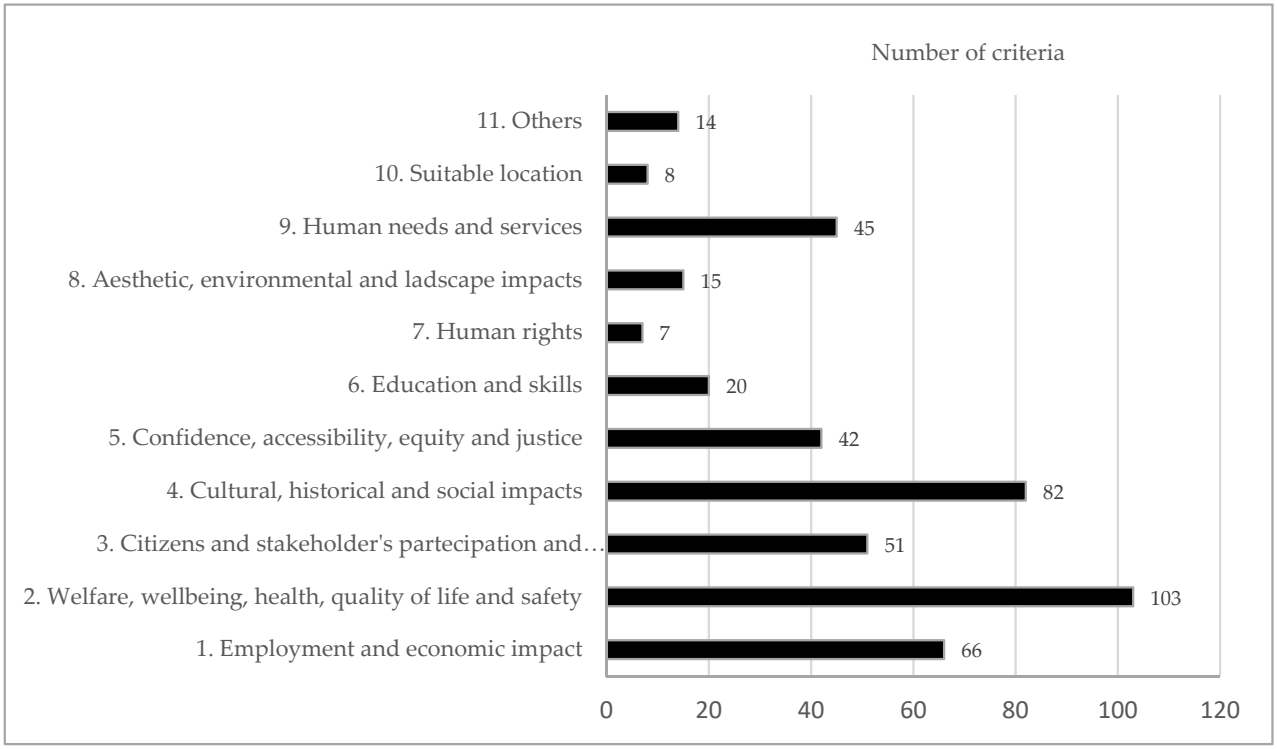

Figure 4. Categories of social criteria used in evaluating applications of infrastructure projects.

These highlight the categories of criteria deemed most significant by the authors and stakeholders for the purposes of assessing the social sustainability of an infrastructure project, namely, the impact on the quality of life of the communities concerned and the level of safety of the work; the impact on cultural (tangible and intangible) and landscape heritage; and the economic impact generated on local communities, both in terms of direct benefits for citizens and development opportunities for the area. The three categories reflect, within the social sphere, the three pillars of sustainability: the social, the economic, and the environmental. Then follow—in descending order of the number of criteria—the categories "3. Citizens and stakeholder's participation and information" (51 criteria—11.3%), "9. Human needs and services" (45 criteria—9.9%), and "5. Confidence, accessibility, equity and justice" (42 criteria—9.3%).

The remaining categories, on the other hand, have fewer criteria, ranging from seven in "7. Human rights" (1.5%) to 20 in "6. Education and skills" (4.4%). What emerges is that the number of different types of criteria used depends on the nature of the infrastructural work considered or on the purposes of the study, on the specificity of the territory on which it is located (in relation to the environmental, landscape and cultural values detected), as well as on the number and type of stakeholders involved (technicians, citizens and their associations, public administrators, etc.) for their identification and selection; for infrastructural projects relating to the transport of people or goods (such as roads and railways), in addition to criteria that take into account the utility to the community and the impacts on the environment and local communities, some authors select criteria related to the social costs of the work [18] and the level of security for users [19–24]. Some authors identify social sustainability criteria with reference to different levels of the communities concerned: local or supra-local [11]. Other authors also consider as social criteria those that can be used to evaluate the impact of the infrastructure on the surrounding environment both referred to the landscape [24–29] and the possible environmental pollution generated (acoustic, etc.) [30–32]. For the selection of criteria, the different authors operate according to two different approaches: the first refers to the analysis of previously developed case studies or reports relating to the evaluation of the sustainability of projects; the second, on the other hand, refers to the involvement of a panel of subjects and stakeholders, involved

in the decision-making or design process of these types of works (technical designers, public administrations, etc.) or citizens with an interest (direct or indirect) by the effects generated by a specific project. Table 1, below, shows, according to the 11 categories of criteria identified, the bibliographic references of the case studies analyzed in the specialized literature, and the categories of criteria identified.

In order to guarantee the independence between one category to another (and therefore avoid overlapping which may lead to unreliable results) each category selected from the literature was defined through a synthetic description which shows which aspects of sustainability it refers to (Table 1). Following this, the categories were then compared, and it was verified that there were no overlaps.

To identify the criteria for assessing the social sustainability of infrastructure projects located in the Liguria Region in the subsequent second phase, a panel of experts and stakeholders was therefore identified to submit a questionnaire on the subject of social sustainability in infrastructure projects.

The categories selected for the composition of the Panel were as follows:

1. Technicians and administrators belonging to public administrations (Liguria Region and municipalities) that deal with the planning and design of road and railway infrastructures. In particular, they were selected from among those involved in the assessment of the technical, urban planning, landscape and environmental feasibility aspects of infrastructural projects;
2. Professionals (architects, engineers) who carry out professional activities in the field of urban planning, in architectural and infrastructural design, also on behalf of the public administration;
3. Academics and researchers who are involved in evaluating the sustainability of projects in the architectural and engineering fields (three urban planners, three designers, three architects and technologists, and three transport engineers). In particular, those who—in addition to their academic activity—have had experience in the field of infrastructure design or have participated as consultants for public administrations for these types of works were selected;
4. Citizens (or their representatives) directly interested in the construction of some of the infrastructural projects planned within the territory of the Liguria Region. In particular, they were selected from among those who participated in the presentation meetings of the projects organized by the public administrations and affected by the actions established by the Regional Law n. 39/2007 ("Regional Strategic Intervention Programs—P.R.I.S.").

Within each of the four categories, the components were then selected according to a series of criteria, which can be summarized as follows:

- For *technicians* of public administrations and professionals: those who have carried out professional activities in the field of planning and design of infrastructural works related to the movement of goods or people for at least ten years;
- For *academics/researchers*: those who have carried out research on issues related to the economic, social, and environmental sustainability of projects on an urban and territorial scale for at least 5 years; researchers were selected from among those who carried out their research activities at the University of Genoa and the Polytechnic of Milan;
- For *citizens*: those who are resident within a municipality affected by the construction of a road or railway infrastructure that determines direct effects on their quality of life (in terms of new mobility services offered, impacts generated on the environment and the landscape surrounding the place of residence, inconvenience caused by the construction site during the construction phase of the infrastructure, direct or induced economic benefits, etc.).

Table 1. Categories of criteria and references.

Category of Criteria	Description	References
1. Employment and economic impact	The criterion refers to the economic impact on local communities and activities by the infrastructure. (wages, GDP, number of new employees, impacts on businesses, local economic benefits, etc.).	[8–10,13,18,20,21,23,25,26,28–30,33–46]
2. Welfare, wellbeing, health, quality of life, and safety	The criterion refers to social services, health, quality of life, and level of security of local communities derived from the infrastructure (wellbeing, happiness, quality of life, social well-being, increase safety and security, living standard, etc.).	[8–11,18,20–24,26,28,29,33,35,38,41–44,47–61]
3. Citizens and stakeholders' participation and information	The criterion refers to the level of participation and information in the decision process about the project participation (public information, engagement with relevant local groups, participation/inclusiveness, integration with the community, open and transparent community involvement, etc.)	[6,9–11,19,22,25,26,28–30,43,46,57,60–69]
4. Cultural, historical and social impacts	The criterion refers to the impact on cultural, historical heritage, demographic and social capital of the local communities interested in the infrastructure (social capital, internal human resources, contribution to social development, settlement cohesion, identity, and culture, the number of new inhabitants, etc.).	[6,8–11,19,20,22–30,35,38,40,44,46,50,51,54–57,61–64,66,70]
5. Confidence, accessibility, equity, and justice	The criterion refers to the level of confidence, accessibility, and justice by the local communities about the project (confidence, equity, accessibility, public access, accessibility of key services, etc.)	[6,8,19,24–26,28–30,32,44,46,47,54,58–66]
6. Education and skills	The criterion refers to the level of accessibility to local schools, the technical and environmental training improvement, and the level of education in the zone (education and skill, People's education, improvement in education in the zone, design team formation, etc.).	[6,8–11,21,23,32,37,46,54]
7. Human rights	The criterion refers to the prevention of human rights abuses or human rights and gender, the respect of private property rights or right refund, and property law (prevention of human rights abuses, human rights, and gender, etc.).	[8–11,29,31,60]
8. Aesthetic, environmental and landscape impacts	The criterion refers to the aesthetic characteristic of the infrastructure and its impacts on the environmental and landscape (aesthetic, surrounding impact, landscape/visual impact, air, noise, and light pollution).	[8,21,22,24–31,37]

Table 1. *Cont.*

Category of Criteria	Description	References
9. Human needs and services	The criterion refers to the expressed needs of the population in terms of housing provision, transport service, enhancement of public space, mobility, and transport for older adults and disabled persons (transport infrastructure in remote areas, housing policy, housing and services infrastructure, etc.).	[1–9,18,19,21,26,28,32,35,37,43,46,52,53,58,67,69,70]
10. Suitable location	The criterion refers to a suitable location in terms of protection of cropland, land use, low landscape, and environmental impact (location efficiency, etc.).	[6,20,43,49,52,68]
11. Others	The criteria cannot be categorized in relation to their low frequency of use in the case studies, like: transport to site, ecological mobility, Feng Shui, political impact, road rage, management considerations, corporate social responsibility of the sponsor, etc.	[6,18,21,22,43,50,62–64]

In order to achieve a balance and significance of the indications and requests brought by each member regarding the topic investigated and on the basis of the availability of subjects that could be involved in the study, an attempt was made to select a homogeneous number of representatives for each of the four categories identified; a total of 56 participants were selected, distributed as follows:

- Thirteen technicians from public administrations (local municipalities, Liguria Region, etc.);
- Fourteen professionals (architects, engineers);
- Fifteen academics (three urban planners, three planners, three technological architects, and three transport engineers);
- Fourteen representatives of local citizens.

For the technicians, the selection took place within the offices of local public administrations (municipalities) and of the Liguria Region that deal with the drafting, approval and evaluation of infrastructure projects. The selection of academics was made from among those who teach subjects directly or indirectly connected to the design of infrastructure for the mobility of people or goods (designers, urban planners, technologists, etc.). Citizens were instead selected from among those directly or indirectly affected by infrastructural projects and who participated in various meetings organized by public administrations aimed at presenting projects and solving critical issues affecting the community.

The characteristics of the Panel are shown in Table 2.

Table 2. Composition of the Panel and main characteristics.

Characteristic	Technicians of Public Administrations			Professionals (Architects, Engineers, etc.)			Academics			Citizens		
Number	13	**N**	**%**	14	**N**	**%**	15	**N**	**%**	14	**N**	**%**
Gender	Male:	8	62%	Male:	9	64%	Male:	9	60%	Male:	9	64%
	Femele:	5	38%	Femele:	5	36%	Femele:	6	40%	Femele:	5	36%
Work experience	10–15 years:	4	31%	10–15 years:	3	21%	10–15 years:	6	40%	10–15 years:		
	15–20 years:	6	46%	15–20 years:	5	36%	15–20 years:	5	33%	15–20 years:		
	20–25 years:	2	15%	20–25 years:	5	36%	20–25 years:	3	20%	20–25 years:		
	25–30 years:	1	8%	25–30 years:	1	7%	25–30 years:	1	7%	25–30 years:		
Educational level	Primary school			Primary school			Primary school			Primary school	4	
	High school	5	38%	High school	4	29%	High school		0%	High school	6	43%
	Bachelor/master	7	54%	Bachelor/master	10	71%	Bachelor/master	3	20%	Bachelor/master	4	29%
	PhD	1	8%	PhD	0	0%	PhD	12	80%	PhD		0%

Subsequently, in phase 3, each member of the Panel was then sent a questionnaire in both paper and digital formats, in which they were asked, in addition to some information about age, sex, level of education, and activity/position carried out in the workplace or profession, which criteria they considered important for assessing the social sustainability of an infrastructure project concerning the movement of people or goods (railways, road, motorway).

The questionnaire provided, in the initial part, a brief introduction on the purposes of the survey and some brief references to the concepts of sustainability of a project according to the three areas (environmental, social, and economic) for each of which a concise definition and description taken by some authors [1,2,4,5]. The questionnaire then asked each participant, in relation to the 10 categories previously identified in line with the survey carried out in the specialized literature, which criteria they considered important for the assessment of the social sustainability of an infrastructure project, considering both the construction phase (construction site) and management of the work (i.e., considering it as completed). Regarding the purposes of this study and the case studies taken as reference, the compilers were presented, as examples, the infrastructure projects that fall under the P.R.I.S. law of the Liguria Region. In order to facilitate understanding and compilation, for each of the 10 categories, a brief description of their meaning and the characteristics that the criteria had to have to be assigned to each of them was reported. Despite the open-ended

format, the questionnaire also reported, for each category, some examples of criteria taken from specialized literature to facilitate, even for those who are confronted with these issues for the first time (e.g., citizens), the identification of the criteria; each member of the Panel was also instructed to report the criteria without any preferential order (or of importance), because only in a subsequent phase, once the criteria had been defined, would they be asked to define their weight (or importance). The compilation also took place through meetings (roundtables) organized by the authors (either in presence or remotely) in order to assist in the compilation; the various members of the Panel then indicated the criteria within each category.

After the completion of the questionnaires, the Panel identified 49 overall criteria; each criterion initially selected by the members of the panel was then defined in relation to the aspects of sustainability to which it referred and compared with the others of the same category. A check was also carried out to ensure that there were no criteria belonging to different categories related to similar aspects of social sustainability.

After this verification, the criteria were therefore reduced to 36. This was because some criteria were redundant in that they were either explained differently but represented the same aspect, or were reported in two (or more) categories. The definitive criteria were then communicated to each member of the Panel in order to share them definitively.

The criteria were distributed differently, by number, within the 10 categories identified: they vary from a minimum of two for the categories "6. Education and skills" and "7. Human rights" to a maximum of six for the category "1. Employment and economic impact" [2].

Table 3, below, shows the criteria definitively selected within the 10 categories with a brief description of their meaning defined by the authors.

Table 3. Table of selected criteria.

Category and Criteria	Description
1. Employment and economic impact	
1.1 Toll/tickets price	Discounted toll for local residents.
1.2 Employment/job opportunities	Increase in numbers of employments at the local, regional or national level.
1.3 Economic development	Opportunities for economic development at the local/regional level.
1.4 Economic benefits	Economic benefits at the local or regional level in terms of tax reduction, economic contribution to local municipalities, etc.
1.5 Economic compensations	Economic compensation in case of temporary relocation of inhabitants or expropriation of properties.
1.6 Economic impacts on real estate properties	Economic impact (positive or negative) derived from the infrastructure on properties value.
2. Welfare, wellbeing, health, quality of life, and safety	
2.1 User security	Securities of infrastructure for the users.
2.2 Residents security	Securities of infrastructure for the local residents (in case of incidents, etc.).
2.3 Public health	Impacts of the infrastructure on the health of residents during the construction and management phases.
2.4 Working safety	Safety of workers during the construction phase of the infrastructure.

Table 3. *Cont.*

Category and Criteria	Description
3. Citizens and stakeholders' participation and information	
3.1 Stakeholder–citizen participation	Stakeholder and citizen participation during the design phase.
3.2 Provision of information	Provision of information about the infrastructure (characteristics, impact on local residents' life, etc.).
3.3 Monitoring	Monitoring of citizens during the different stages of project development.
4. Cultural, historical, and social impacts	
4.1 Preserve historic, cultural, and community values	Preserve the local historic and cultural communities' values and traditions.
4.2 Preserve built heritage	Preserve the existing building heritage (existing historical building).
4.3 Social cohesion/low rate of delocalization's/expropriations	Impacts of infrastructure on social cohesion, sense of community, and social characteristics. Temporary or permanent relocations.
5. Confidence, accessibility, equity, and justice	
5.1 Social justice	Social justice in terms of fairness of treatment for the different subjects and categories affected by the infrastructure.
5.2 Confidence in the project	Citizens' trust in the infrastructure derived from correct communication by promoters and local, regional, and national public administrations.
5.3 Equity of project	Equity of the project towards the different subjects and categories involved in the project.
5.4 Assistance to local residents by public administration (local municipalities, etc.).	Assistance from local public administrations (Region, local municipalities) to the resident citizens.
6. Education and skills	
6.1 Develop local skills and capabilities	Possibility of developing the level of professional skills for local citizens (improvement of working conditions, etc.).
6.2 Raising the level of training and education	Possibility of developing the level of education (ease of access to schools, universities, etc.).
7. Human rights	
7.1 Government/regional/regulation	Availability of national, regional, and local laws and regulations that protect citizens from negative impacts and inconveniences (temporary or permanent) deriving from the infrastructure.
7.2 Prevention of human rights abuses	Prevention of possible human rights abuses by private individuals, and institutions against citizens.
8. Aesthetic, environmental, and landscape impacts	
8.1 Landscape and environmental impact	Environmental end landscape impact of the infrastructure (air, noise, and light pollution, etc.)

Table 3. *Cont.*

Category and Criteria	Description
8.2 Aesthetics of the infrastructure	Aesthetic quality of the infrastructure perceived by local citizens and users
8.3 Impact of the construction site on the surroundings	Impact of the construction site on the surrounding environment and resident communities (noise, dust, traffic congestion, etc.).
9. Human needs and services	
9.1 Enhancement of public space	Increase or improvement of public spaces for local residents
9.2 Commuter times	Reduction of the time needed for resident commuters to travel.
9.3 Services improvement for the inhabitants	Improvement of public and private services for citizens (commercial services, banks, etc.) connected to the infrastructural and economic development.
9.4 Access for local habitants to transport services	Improvement and ease of access by residents to local and regional transport services.
9.5 Inter-modality of transport	Intermodal transport structures for citizens (car-bicycle-train-highway, etc.).
10. Suitable location	
10.1 Location efficiency	Efficient localization in relation to the distance with inhabited areas, other transport facilities (airports, etc.), and production (industries, etc.).
10.2 Place context	Economic, Social, and Productive Context Present Around The Site Affected By The Infrastructural Project.
10.3 Protection of cropland/natural land	Minimization of the consumption of cultivated or natural land.
10.4 Low impacts on residential and other real estate properties	Minimum possible impact on residences and other buildings (productive, etc.) in terms of demolition or partial demolition.

Each of the four types of compilers contributed differently to the identification of the criteria: out of 38 overall criteria, the technicians from the local administrations identified 33 criteria, the professionals 30 criteria, academics 37 criteria, and citizens 19. The difference in numerical terms is related to the different skills, knowledge, and desires that the members of the Panel have in relation to the investigated topic.

4. The Weighting of the Criteria

Once the criteria had been defined, in the next phase (4), we then proceeded with the weighting of the categories and, within each, of the related criteria previously identified; this allowed us to know what the importance attributed to them was, in order to assess the overall social sustainability of the infrastructure project.

The methodology adopted was that of pairwise comparison, provided within the multi-criteria evaluation methodology of the Analytic Hierarchy Process (AHP) defined by Thomas Saaty [16,17].

The AHP is used for solving complex decision problems when you have to choose the most satisfactory solution (plan, project, technological solution, etc.) within a set of possible alternatives; the assessment takes place with regard to a pre-established objective

and according to a series of criteria of a different nature (quantitative and qualitative) that are recognized as significant for the purposes of correctly identifying the solution.

The impacts of alternative solutions are then assessed with respect to these criteria. Weights are attributed to the selected criteria—i.e., the relative importance is assessed with respect to the objective; the weighting of the criteria and the measurement of the impact of the alternatives for each of them are based on the pairwise comparison tool devised by Saaty.

This is developed by means of a square matrix of order n × n (where n is the number of elements compared to each other), called the "matrix of the pairwise comparison" (Table 4); taking as a reference the weighting of the criteria, the comparison provides for the attribution of a score taken from a nine-point scale according to the prevalence (or not) of one criterion over the other as the superordinate element [3]. Once the square matrix of the pairwise comparison had been compiled, the weight of each criterion was given by the corresponding normalized component of the main eigenvector extracted from the matrix.

Table 4. Paired comparison matrix for criteria weighting.

	Criterion 1	**Criterion 2**	**Criterion 3**	**Criterion . . . .**	**Criterion n**
Criterion 1	1	a_{12}	a_{13}	$a_{1\ldots}$	a_{1n}
Criterion 2	a_{21}	1	a_{23}	$a_{2\ldots}$	a_{2n}
Criterion . . .	$a_{\ldots 1}$	$a_{\ldots 2}$	$a_{\ldots 3}$	1	$a_{\ldots n}$
Criterion n	a_{n1}	a_{n2}	a_{n3}	$a_{n\ldots}$	1

The weighting of the categories and criteria took place in two steps, following the hierarchical scheme of the AHP (represented in Figure 5, below).

- In the first step, the matrix was compiled with the categories of the criteria, with the aim to determining the importance of each in the evaluation of the social sustainability of an infrastructural project;
- In the second step, therefore, the matrices were developed with the criteria related to each category, with the aim of determining the weight of each within the category to which they belong.

The pairwise comparison matrices were compiled after the provision of an explanation of the method, along with examples of compilation, by the authors during special meetings with the members of each Panel. Similar to the identification of the criteria, the compilation of the matrices took place separately, group by group; within each group the compilation was developed collectively, through a sharing of judgments.

When a single unanimous score expressed on the Saaty's scale could not be obtained, the average value of the scores noted by the individual members of the Panel was inserted into the matrix.

Each group then compiled the following matrices for pairwise comparison:

- One matrix of the order 10 × 10, within which the 10 categories of social criteria were compared;
- Ten matrices of a different order (from 2 × 2 to 6 × 6) for the comparison of the criteria within each category.

The compilation of the matrices for the pairwise comparison took place through the use of specific software [4] allowing easy viewing and control of the attributed scores within the matrices as well as the verification of the coherence of the judgments attributed [5].

Figure 5 shows the structure of the analysis carried out with Expert Choice 2000® (Expert Choice Inc.—Pittsburgh, PA, USA) with the categories and corresponding social criteria identified within each by the Panel.

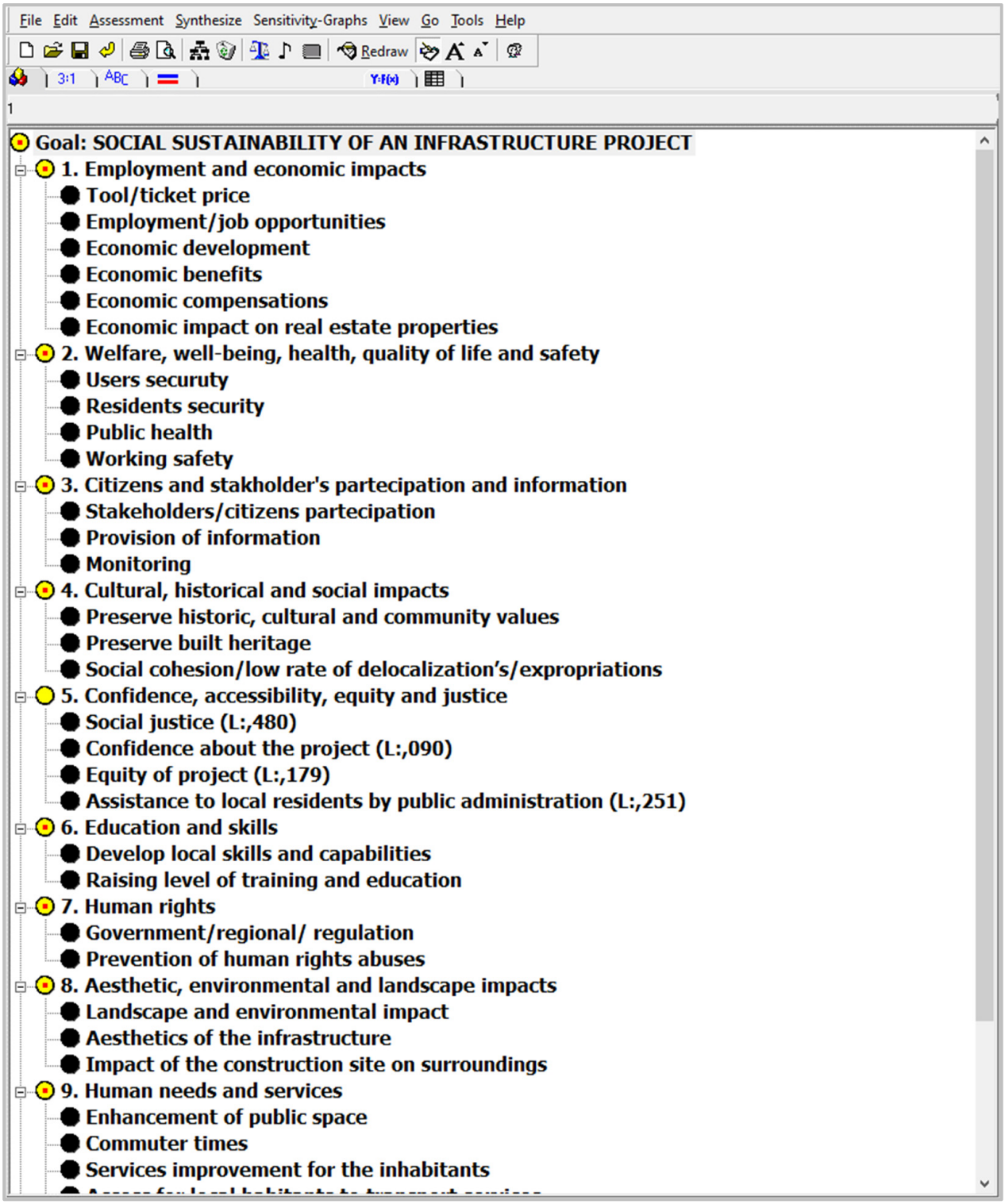

Figure 5. Expert Choice 2000®—hierarchical structure of categories and criteria.

Figure 6, below, shows the matrix of the pairwise comparison for the weighting of the criteria belonging to category "5. Confidence, accessibility, equity, and justice".

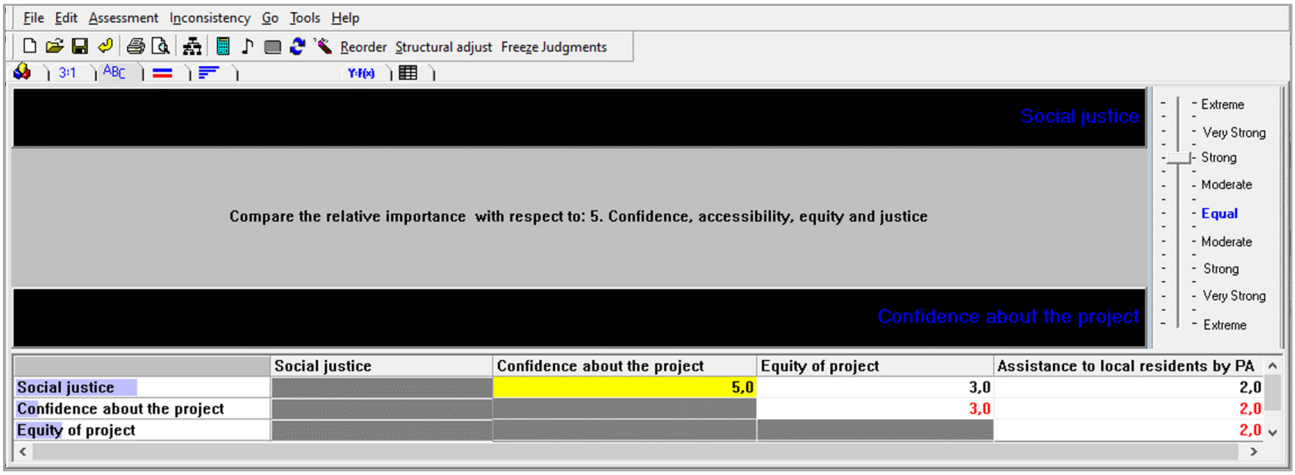

Figure 6. Matrix of the pairwise comparison of the category criteria "5. Confidence, accessibility, equity and justice".

5. Results

Following the compilation of the matrices of the comparison in pairs by the four groups of experts and stakeholders making up the Panel, the weights, that is the relative importance, were then determined for each category and each criterion. The compilation of the matrices took place in two successive phases: first, the components expressed, by employing the Saaty's scale (from 1 to 9), the order and the intensity of the preferences between the categories, so the coherence index (I.C.) was below the maximum threshold; otherwise, the scores expressed were verified, one by one, making the necessary corrections both in the direction of the prevalence and in the intensity until the value was lowered to below the limit; therefore, again by using the software, the values of the weights were determined, and were assumed to be definitive. The process was then repeated for the 10 matrices of the paired comparison between criteria. The results obtained are reported in the following sub-paragraphs.

5.1. Weights of the Criteria Categories

Table 5 shows the values of the weights attributed to the 10 categories of criteria; they represent the importance attributed to each in terms of the social sustainability aspect of an infrastructure project [6].

Table 5. Weights of social criterion categories by Panel group.

Categories of Criteria	Panel Group				Average Value
	1	2	3	4	
1. Employment and economic impact	0.147	0.133	0.141	0.098	0.130
2. Welfare, wellbeing, health, quality of life and safety	0.089	0.079	0.091	0.150	0.102
3. Citizens' and stakeholders' participation and inform.	0.076	0.082	0.096	0.161	0.104
4. Cultural, historical, environmental, and social impacts	0.089	0.098	0.092	0.112	0.098
5. Confidence, accessibility, equity and justice	0.075	0.041	0.035	0.085	0.059
6. Education and skills	0.022	0.022	0.030	0.020	0.024
7. Human rights	0.084	0.053	0.062	0.083	0.071
8. Aesthetic, environmental and landscape impacts	0.125	0.152	0.120	0.071	0.117
9. Human needs and services	0.152	0.181	0.157	0.073	0.141
10. Suitable location	0.141	0.159	0.176	0.148	0.156
TOTAL	1.000	1.000	1.000	1.000	1.000

1 Technicians and administrators of public administrations; 2 Professionals; 3 Academics; 4 Citizens.

The analysis of the results shows that the four groups of the Panel attribute different weights to the categories of criteria that place the categories in a different order of importance for evaluating the sustainability of a project:

1. Technicians and administrators of public administrations attribute more importance to "9. Human needs and services" (0.152) then to the categories "1. Employment and economic impact" (0.147) and "10. Suitable location" (0.141);
2. The group of technicians also attaches greater importance to the "9. Human needs and services" (0.181) followed, however, by the category "10. Suitable location" (0.194) and "8. Aesthetic, environmental and landscape impact" (0.139);
3. The group of academics also attaches greater importance to the category "10. Suitable location" (0.176) followed by the category "9. Human needs and services" (0.157) and "1. Employment and economic impact" (0.141);
4. The citizens' group, on the other hand, attaches greater importance to the "3. Citizens and stakeholder's participation" (0.161) then to categories "2. Welfare, wellbeing, health, quality of life and safety" (0.150) and "10. Suitable location" (0.148).

All matrices of the pairwise comparisons have coherence indices ranging from 0.02 (matrix of technicians and administrators of public administrations) to 0.08 (matrices of citizens), therefore below the threshold of acceptability (0.1).

From the analysis of the results, what emerges is that technicians and professionals attach greater importance to the aspects related to the services generated by the infrastructure for the community, to the economic impact on the territory, and to the correct choice of the site (path) of the infrastructure, while citizens consider more sustainable, from a social point of view, a project that sees their active participation and involvement in the definition of the project and the actions to be taken to mitigate the possible negative effects as well as able to guarantee a better quality of life and level safety.

Academics, on the other hand, attribute greater importance to aspects related to a careful localization of the infrastructure on the territory (and therefore through a careful assessment of possible design alternatives), to the level of services generated for the community, and to the economic impacts generated at the local level, rather than regional and national.

Considering the average values of the weights, the category "10. Suitable location" is the one with the heaviest (average) weight (0.156), followed by the category "9. Human needs and services" (0.141) then from "1. Employment and economic impact" (0.130).

5.2. Weights of the Individual Criteria

5.2.1. Weights Category Criteria: "1 Employment and Economic Impact"

The values of the weights obtained from the comparison in pairs between the criteria belonging to the category highlight the technicians of the public administrations and the citizens attribute greater importance to the aspect linked to any compensation deriving from expropriations or partial relocations that are necessary for the realization of the work (criterion "1.5 Economic compensation for temporary relocation or expropriation of properties") (Table 6).

The aspect of economic compensation for the inconvenience suffered is particularly felt by the two groups of compilers because the national legislation (Presidential Decree No. 327/2001) provides for economic compensation only in the event of partial or total expropriation of an asset, while it does not provide for any recognition of the costs that arise—either for the resident owner or for the tenant—for transfer or temporary relocation to another property.

Table 6. Weights of social criterion by Panel group.

Category and Criteria	Panel Group				Average Value	C.I.
	1	2	3	4		
1. Employment and economic impact						
1 Toll/tickets price	10.2%	11.8%	15.7%	13.8%	12.88%	
1.2 Employment/job opportunities	16.7%	14.2%	16.8%	13.6%	15.58%	
1.3 Opportunities for economic development at the local/regional level	18.7%	21.3%	19.2%	11.7%	17.73%	
1.4 Socio-economic benefits at the local/regional level	14.5%	17.8%	15.9%	16.1%	16.08%	
1.5 Economic compensation for temporary relocation or expropriation of properties	21.4%	18.7%	18.9%	24.7%	20.93%	
1.6 Economic impacts on real estate properties	18.5%	16.2%	13.5%	20.1%	17.08%	0.088
2. Welfare, wellbeing, health, quality of life and safety						
2.1 User security	23.5%	22.5%	19.5%	22.8%	22.08%	
2.2 Residents security	28.4%	24.4%	29.4%	31.7%	28.48%	
2.3 Public health	21.3%	27.3%	25.3%	28.8%	25.68%	
2.4 Working safety during construction	26.8%	25.8%	25.8%	16.7%	23.78%	0.070
3. Citizens' and stakeholders' participation and information						
3.1 Stakeholder–citizen participation	36.9%	31.5%	34.9%	38.9%	35.55%	
3.2 Provision of information through collective audiences	40.8%	35.1%	33.4%	36.4%	36.43%	
3.3 Monitoring of citizens on the infrastructure project	22.3%	33.4%	31.7%	24.7%	28.03%	0.055
4. Cultural, historical, environmental and social impacts						
4.1 Preserve historic, cultural, and community values	30.2%	29.9%	34.1%	27.1%	30.33%	
4.2 Preserve built heritage	33.6%	39.2%	41.2%	35.2%	37.30%	
4.3 Social cohesion/low rate of delocalization's/expropriations	36.2%	32.4%	24.7%	37.7%	32.75%	0.045
5. Confidence, accessibility, equity and justice						
5.1 Social justice	23.3%	22.8%	21.9%	21.8%	22.45%	
5.2 Confidence in the project	24.5%	26.9%	25.2%	26.7%	25.83%	
5.3 Equity of project	21.5%	23.0%	26.8%	18.9%	22.55%	
5.4 Assistance to local residents by public administration	30.7%	27.3%	26.1%	32.6%	29.18%	0.062
6. Education and skills						
6.1 Develop local skills and capabilities	45.6%	46.3%	50.7%	58.4%	50.25%	
6.2 Raising the level of training and education	54.4%	53.7%	49.3%	41.6%	49.75%	0.031
7. Human rights						
7.1 Government/regional/regulation	55.6%	51.7%	54.7%	56.4%	54.60%	
7.2 Prevention of human rights abuses	44.4%	48.3%	45.3%	43.6%	45.40%	0.028

Table 6. *Cont.*

Category and Criteria	Panel Group				Average Value	C.I.
	1	2	3	4		
8. Aesthetic, environmental and landscape impacts						
8.1 Landscape and environmental impact	35.7%	33.5%	36.3%	31.2%	34.18%	
8.2 Aesthetics of the infrastructure	32.4%	35.1%	31.1%	29.5%	32.03%	
8.3 Impact of the construction site on the surroundings	31.9%	31.4%	32.6%	39.3%	33.80%	0.047
9. Human needs and services						
9.1 Enhancement of public space	11.5%	16.5%	13.5%	16.5%	14.50%	
9.2 Commuter times	16.7%	14.7%	23.4%	14.7%	17.38%	
9.3 Services improvement for the inhabitants	25.3%	26.3%	17.1%	26.3%	23.75%	
9.4 Access for local habitants to transport services	22.2%	25.2%	20.6%	25.2%	23.30%	
9.5 Inter-modality of transport	24.3%	17.3%	25.4%	17.3%	21.08%	0.086
10. Suitable location						
10.1 Location efficiency	25.8%	22.8%	22.8%	26.8%	24.55%	
10.2 Place context	26.9%	31.4%	33.9%	24.6%	29.20%	
10.3 Protection of cropland	15.1%	12.1%	12.1%	13.5%	13.20%	
10.4 Low impacts on residential and other real estate properties	32.2%	33.7%	31.2%	35.1%	33.05%	0.065

1 Technicians and administrators of public administrations; 2 Professionals; 3 Academics; 4 Citizens.

This is frequently a source of appeals and disputes by subjects expropriated of their assets (e.g., homes, land, etc.) and considerable delays in the execution of the works as well as discontent on the part of the community.

Within the same category, professionals on one hand, and academics on the other hand, attach greater importance to the economic impacts at the local and regional level generated by the infrastructure (criterion "1.4 Socio-economic benefits at local/regional level").

5.2.2. Weights Category Criteria: "2. Welfare, Wellbeing, Health, Quality of Life and Safety"

The criterion relating to security for residents ("2.2 Residents security") is considered to be the most important by residents, academics, and technicians of public administrations (31.7%, 29.4%, and 28.4%, respectively) while professionals believe that public health is prevalent ("2.3 Public health"—27.3%) (Table 6). In this case, too, it is clear that the public entity and the communities directly affected by the effects produced by the infrastructure attach greater importance to aspects related to the safety of residents, especially for those who live near it.

On the other hand, the criteria considered less important are safety during the construction phase for citizens ("2.4 Working safety during construction"—16.7%), safety for users ("2.1 User security") for professionals and academics (19.5% and 22.5%, respectively), public health for public administration technicians.

These values can probably be explained by the fact that it is assumed that the infrastructure is designed in compliance with European and national regulations, which guarantee not only the safety of users but also public health.

5.2.3. Weights Category Criteria: "3. Citizens and Stakeholder's Participation and Information"

For technicians and administrators from the public administration and professionals, the greatest importance is attributed to the accessibility of information to the citizenship (criterion "3.2 Provision of information through collective audiences") through public meetings to make the community aware of the characteristics of the project (Table 6).

The information must be related to the characteristics of the infrastructure, as well as sharing route alternatives envisaged using the public debate tool introduced by the law on public works (Legislative Decree no. 50/2016); the percentages of the weights are 40.8% and 35.1%, respectively.

For academics and citizens, on the other hand, their direct participation (criterion "3.1 Stakeholder–citizen participation") in defining some aspects of the project is more important (percentages respectively equal to 34.9% and 38.9%); citizens, in particular, highlighted how important it is for the public administration and the entities that promote the infrastructure to involve the communities concerned from the outset, informing them of the impact on the territory at an environmental and landscape level and on private properties. They also feel it is important that the path is chosen from among the alternatives that generate the least negative impacts on residents and the environment, even if this entails a greater economic burden for the construction of the work.

5.2.4. Weights Category Criteria: "4. Cultural, Historical, Environmental and Social Impacts"

For professionals and academics, the criterion with the greatest weight within the category is that relating to the conservation of cultural heritage ("4.2 Preserve built heritage") (weights respectively equal to 39.20% and 41.20%), while for technicians of public administrations and citizens, priority must be given to social cohesion and limiting the relocation of residents (criterion "4.3 Social cohesion/low rate of delocalizations/expropriations", with weights respectively equal to 36.20% and 37.70%) (Table 6).

5.2.5. Weights Category Criteria: "5. Confidence, Accessibility, Equity, and Justice"

Similarly, with what was found for the criteria of the previous categories, there is an alignment of preferences between public administration technicians and citizens regarding

criteria that protect and support the community: for the criterion "5.4 Assistance to local residents by public administration", two groups of the Panel attribute weights of 30.70% and 32.60%, respectively; this criterion is also considered the priority for professionals (weight equal to 27.30%) (Table 6).

For academics, however, the criterion with the greatest weight is that relating to the equity of the project ("5.3 Equity of the project"), to which they attribute a value of 26.8%. To the same criterion, however, the community attributes the lowest weight (18.90%), which can probably be explained by the fact that they consider direct assistance from the public administration and trust in the project to be a priority (criterion "5.2 Confidence about the project—weight equal to 26.70%).

5.2.6. Weights Category Criteria: "6. Education and Skills"

Within this category, the greatest weights are attributed to the criterion "6.2 Raising level of training and education" by the groups of technicians and administrators of the public administration and by professionals (respectively 54.80% and 53.70%) while for academics and citizens it is the most important criterion "6.1 Develop local skills and capabilities" (weights respectively equal to 50.70% and 58.40%).

5.2.7. Weights Category Criteria: "7. Human Rights"

For this category, there is a uniform judgment regarding the prevalence of the criterion: all four groups of the Panel attribute greater weight to the criterion "7.1 Government/regional/regulation" with almost similar values for citizens (56.4%) and public administration technicians (55.6%) (Table 6). The Panel, therefore, considers it a priority and fundamental that the infrastructure project is regulated, in its various stages of development, by an effective legislative and regulatory framework at the national and local levels capable of regulating the various technical, economic, and social aspects connected to the design, construction, and management of the infrastructure.

5.2.8. Weights Category Criteria: "8. Aesthetic, Environmental, and Landscape Impacts"

Within the category, the preferences assigned by the groups of the Panel differ according to their skills and sensitivity: for technicians and administrators of public administrations as well as for academics, the impact of the works on the environment and landscape is a priority (criterion "8.1 Landscape and environmental impact"—weights respectively equal to 35.70% and 36.30%) (Table 6); for professionals, the aesthetics of the infrastructure is a priority ("8.2 Aesthetics of the infrastructure"—weight equal to 35.10%); for citizens, the aspect linked to the impact of the construction site is a priority (criterion "8.3 Impact of the construction site on surroundings"—weight 39.30%); as pointed out by this group of the Panel, they fear, in fact, that the size of the construction sites that characterize these works and their long duration will have negative effects on the quality of life for the residents of the areas concerned.

5.2.9. Weights Category Criteria: "9. Human Needs and Services"

Three groups of the Panel agree in attributing the greatest weight to the criterion "9.3 Services improvement for the inhabitants": technicians and administrators of public administrations (weight equal to 25.30%), professionals (weight 26.40%), and citizens (weight equal to 26.9%) (Table 6); academics, on the other hand, attribute a greater weight to the inter-modality of transport ("9.5 Inter-modality of transport"—weight equal to 25.40%). Citizens also attach great importance to the possibility of using the infrastructure (criterion "9.3 Services improvement for the inhabitants"—weight equal to 25.20%), i.e., that it not only crosses the territory in which they reside, but is also accessible to them.

5.2.10. Weights Category Criteria: "10. Suitable Location"

Regarding this category, which considers the aspects related to the location of the route in the territory, the technicians of the public administrations, professionals and citizens

agree in attributing greater importance to the criterion "10.4 Low impacts on residential and other real estate properties" (weights respectively equal to 32.30%, 33.70%, and 35.10%) (Table 6). For academics, however, the greatest importance is attributed to the "10.2 Place context" criterion (weight equal to 33.90%), which considers the relationship between the infrastructure and the context around the route. On the other hand, all four groups of the Panel agree in attributing the least weight to the protection of agricultural soil ("10.3 Protection of cropland") and to the consequent consumption of natural soil.

6. Limitations of the Research

The results obtained from the survey have limitations in relation to three fundamental aspects:

1. The first relates to the primary identification of the 10 categories of criteria derived from the analysis of the case studies that dealt with the issue of assessing the social sustainability of infrastructures and their proposal to the members of the Panel. This may have influenced the members of the Panel in identifying the relevant criteria within each category. Although the authors explained the meaning of each and the different aspects of sustainability that can be considered for each category, it was in fact noted that some components identified the criteria almost exclusively concerning the terms present in the name of the category, omitting, in fact, the analysis of other aspects related to the social sustainability of this type of infrastructures.
2. The second refers to the specificities of each project and the selection of criteria. The assessment of sustainability (social, economic and environmental) must be developed taking into account criteria connected to the characteristics of each project, and be able to reflect the different impacts generated. This criticality also emerged from the analysis of the case studies in the literature: although they address the issue of sustainability of the same type of infrastructures (railways, roads, etc.), each presents its own approach in defining the categories and criteria for the evaluation. In other words, the assumption of a set of pre-established criteria can generate critical issues in the evaluation.
3. The third, on the other hand, is connected with the method of choosing the Panel and its number of members. The four groups were identified on the basis of the types of people considered to be affected by the construction of infrastructure. For the purposes of the significance of the results, however, it should be noted that the number of people should be greater, and should also include those categories of economic operator excluded in this study (e.g., representatives of production, commercial activities, etc.). Furthermore, a number of components should be implemented; from a statistical point of view, the 56 components involved were in fact a limited number, also in light of the fact that they are distributed within with groups that had very different characteristics (in terms of the professional sphere of activity, level of education, etc.).

However, another important aspect to consider is related to the pairwise comparison technique used for the weighting of categories and criteria. Although widely used in several case studies, it requires some practice, especially for those who have no technical training or have never dealt with this type of issue (for example, citizens). Despite timely assistance from the authors regarding the method of compiling the matrix, a certain difficulty was encountered, especially in the attribution of the scores established by the Saaty's scale with the consequent need to review this in order to respect the maximum threshold of the Coherence Index (C.I.).

7. Conclusions

This research addresses the issue of the social sustainability of infrastructure projects by investigating the criteria that must be considered and their relative importance. The motivation for this research arises from the numerous public works projects planned in Liguria, mostly concerning the movement of goods and people, for which the Liguria Region has promulgated a specific Law (No. 39/2007) defining innovative tools to support

local public administrations and subjects suffering disruption due to the infrastructure, during both the construction and management phases. On the basis of an analysis of the specialized literature, the authors identified 10 categories of criteria, identifying them through a typological grouping of over 400 criteria used in different case studies.

These were taken as macro-criteria against which to identify individual criteria (or sub-criteria) and their weight through the involvement of a qualified Panel of 56 subjects considered to have a direct or indirect interest in the construction of infrastructure, who were divided into four groups: technicians belonging to the public administration; professionals; academics; and citizens. The latter were selected from among the different groups participating in project presentation meetings promoted by the Liguria Region (and provided for the Regional Law No. 39/2007) in collaboration with local public administrations whose territories are affected by the infrastructure.

The identification of the criteria took place through the use of a questionnaire prepared by the authors who assisted the members of the Panel during the compilation phase.

What emerged is that for citizens and technicians of public administrations, the criteria considered most important were those related to three aspects of social sustainability: the involvement of and availability of correct information to citizens regarding the characteristics of the project (e.g., impacts on environment, quality of life, etc.); the definition of legislative and regulatory tools capable of protecting—even economically—those who may suffer temporary or permanent inconvenience or damages resulting from the construction of the infrastructure; and the impact of the infrastructure on the local social fabric, especially when relocations of residents or other activities (commercial, etc.) are envisaged that may lead to the disruption of relations between individuals belonging to a local community.

Knowledge of the criteria that allow social sustainability to be measured and their weight is of fundamental importance for the correct and balanced evaluation of the overall sustainability of any infrastructural project (road, railway, etc.); even with the limitations previously indicated, the 36 selected criteria represent aspects considered relevant from a social point of view. If included in a multi-criteria evaluation technique, they can help decision makers in choosing the most satisfactory design solution that is able to combine the needs of all subjects—public and private—involved in the design process.

The assigned weights can also be taken into consideration by the public administrations for the evaluation of design solutions regardless of the location or the type of infrastructure; this would make it possible to increase the objectivity of the assessment and obtain more efficient results in order to choose the most sustainable solution. The sharing of the criteria by different subjects, as well as their weights, can reduce, if not eliminate, the contrasts and conflicts that emerge between the parties, each of which has their own divergent aspirations and expectations.

Precisely concerning these aspects, the Liguria Region has promulgated a specific Law (Regional Law No. 39/2007) on "Regional Strategic Intervention Programs–P.R.I.S.", which defines innovative tools for supporting the various subjects with an interest in the realization of infrastructural works or the effects generated, thus guaranteeing the social sustainability of the intervention.

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Notes

1 For the research on "UNO per tutto" of the University of Genoa, the keywords were searched, both in Italian and in English, in the following fields: title of the article, abstract; subject, both singly and in pairs. For the search in Google Scholar the words have been entered, both in Italian and in English, in the main search field.

2 The categories were identified taking as reference some case studies analyzed in the analysis of the bibliography which provided for the unification of the criteria into typological categories as well as on the basis of the characteristics of the criteria selected from the literature, considering all the articles analysed.

3 A growing prevalence of an element over another corresponds to a higher score with respect to a higher-level element (with regard to the weighting of criteria, this is the objective of the appraisal); by comparing criterion 1 with criterion 2, if 1 prevails over 2 with respect to the objective, the score given to the pairwise comparison will be a score between 2 and 9; if criterion 2 prevails over criterion 1, the score given to the pairwise comparison will be a fractioned numerical score between 1/2 and 1/9); the score 1 of Saaty's scale is given when a perfect equality between the two compared criteria is acknowledged, that is when they have the same important in order to reach the set objective. If we refer to criterion 1, his weight is given by the first component of the main eigenvector taken from the matrix of the pairwise comparison, obtained through the formula $(1 \cdot a_{12} \cdot a_{12} \cdot a_{1\ldots} \cdot a_{1n})^{1/n}$; once the weights of all criteria have been calculated, normalization is carried out by dividing each of them by the sum of the values. According to this normalization method, the sum of the weights of all criteria corresponds to unit (1,00).

4 The software used is Expert Choice 2000® by Expert Choice Inc.—Pittsburgh, PA, USA.

5 It is carried out through the calculation of the Coherence Index (C.I.) that verifies the congruence of the judgments attributed within the pairwise comparison matrix, both in terms of direction of prevalence and intensity (number of Saaty's scale); the limit value set by Saaty is 10% (0,1). At the end of the matrix compilation, if the C.I. exceeded 0.1, the judgments expressed were checked one by one and those that generated inconsistencies were corrected. The verification and correction of judgments is facilitated by the software Expert Choice 2000® that indicates which judgments generate inconsistency.

6 The weights are expressed, according to Saaty's methodology, with standardized scores ranging from 0 to 1.

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