Development Theories and Infrastructural Planning: the Belluno Province

Giovanni Campeol, Sandra Carollo and Nicola Masotto

Abstract Currently, the English word "smart" has become commonly used in the field of urban and land planning as an adjective referring to an evolving "good", or clever, know-how. It is a word that is usually applied to the process of qualitative urban and land planning, as opposed just to quantitative planning. Since the Conference in Rio de Janeiro in 1992, the urban and planning (but also architectural) disciplines have been accompanied by terminologies that could somehow represent a better way of "carrying out" transformations, passing from an "ecological city" to a "sustainable city" and finally to a "smart city". Each adjective represents a vision of the transformations: for example, an ecological city is a town with more public green areas, the sustainable city pays more attention to the preservation of physical and chemical parameters (air and water quality, etc.), and the smart city is more focused on the realization of efficient technologies. Actually, the above interpretations of transformation do not have a real meaning, as it is absolutely evident that the city and the territory, in compliance with the disciplinary statute, must be transformed by taking into consideration the human, biotic, and abiotic elements, i.e., they must have an environmental approach. The adjective environmental has been defined in the long-standing scientific research (Odum, Leopold, McHarg, Stainer, Nebbia, etc.) which, since the 1930s, has been developing the ability to utilize dynamically and synchronically the three levers that define sustainable development: the economic, the social, and the ecological (biotic and abiotic) levers. Following the historical periods and the geographical contexts, the use of the three levers may

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progressed at different speeds, while yet focusing attention on the feedback among the same levers. In the case study (Belluno province), the environmental (ecological, sustainable, smart) development depends on the infrastructural lever for inverting a phenomenon of social and economic decadence of a territory, also due to pervasive and aggressive competitive policies of the neighboring territories. In fact, in the province of Belluno, environmental development is conditioned by the priority use of the social and economic (primarily infrastructural) levers in the medium and long term. It is evident that this priority in the use of levers is accompanied by the ability to take the opportunities given by the high-quality ecological and landscape conditions existing in the Belluno province.

Keywords Environmental evaluation · Infrastructures · Deficit accessibility · Competitiveness · Population

1 Methodological Introduction

The prior adjectivization of urban and land transformation represents a meaningless exercise, although it is often used to define "policies", because only through the application of environmental evaluation processes (considering abiotic, biotic, and human aspects) is it possible to define the quality of these transformations. As a logical sequence, the environmental evaluation represents the fundamental connecting link between the analysis and the planning apparatus.

The challenge of sustainability in reconciling qualitative (protection of ecologic balance, improvement of the quality of life, etc.) and quantitative (economic growth, increase of per capita wealth, development of production, etc.) development has reinforced the need to evaluate from the environmental viewpoint the implications of human activities in the various fields and has also established the importance of promoting a development able to ensure ecologic compatibility, economic durability, and social participation as a basic condition for a good quality of life. Therefore, the sustainable transformation models need to activate the ecologic, economic, and social levers differently from models based only on economic, ecologic, or prevalently participative transformations. So the concept of the sustainability of transformations must be defined in relation to the mix of natural, economic, and social aspects of a given environment. Hence exists the need for several development models specifically created for an environment, in which the characteristics of ecologic compatibility, economic durability, and social participation are combined in a dynamic balance, although with different weights according to the reference context. In the processes of environmental evaluation, characterized by feed-back between the different planning steps and the consequences on the environmental components, this approach is the element able to provide a valid "aid to decision", and this has resulted from the progress of the discipline Strategic Environmental Assessment. The impact of the planning instruments on the environmental system should be assessed through a diachronic

interpretation of the transformations by using chemical, physical, cartographic, or landscape environmental indicators selected on the basis of clear criteria that directly correlate with planning.

The theories about urban and land planning should always be characterized by an analytical system able to objectively identify the problems of a given geographic area, without being influenced by ideological postulations. In this sense, the adjectives given to the "city", such as those historically most used, i.e., "ecological", "sustainable" and today "smart", have a prevalently cultural meaning linked to the "fashions of the age". Starting from the refutation of the adjectivization given to the urban and land transformations, this paper aims to develop the topic of the development in a mountainous area by adopting a theoretical and methodological approach characterized by the following steps:

- analysis, through objective indicators, of a mountainous territory, the Belluno province, which enables recognition of the most relevant critical elements in the poor infrastructures, especially transport;
- analysis of the transport system of the alpine area, the role of the Belluno province, and the competitiveness of the various territorial systems;
- identification of an environmental evaluation model for choosing the best performing transport scenario for the development of the Belluno province.

This paper therefore does not apply an evaluation model, but it identifies suitable typology intentionally using only some information on transport that is considered strategic. The reference evaluation discipline which is utilized is multi-criteria decision analysis (MCDA) that, through the evaluation methodology called Analytic Hierarchy Process (AHP), enables one to find out alternatives among the transport territorial scenarios for the geographic area of the Belluno province. In identifying the transport solutions, in the case study, the "0" (zero) option has not been considered as a comparable alternative, as this option has proved unable to produce any change simulation with regard to the criticality of the established facts. As a consequence, if this option had been, simulated a faulty methodological approach would have been carried out.

2 The Case Study of the Strategic Plan in the Province of Belluno

The elaboration of the Strategic Plan (SP) in the Province of Belluno started in 2006 and has been characterized by a wide process of participation and the collaboration of all sectors composing the provincial administration, as well as of many external entities and actors. This process has led to the formulation of a shared "operational framework" to implement the projects considered as strategic for the development of Belluno province. This planning document also includes the application of environmental evaluation, which has been realized on two levels:

- the first, on a macro scale (all the province of Belluno), has assessed aggregately all possible positive and negative impacts on the environment since the realization of the "projects" established by the SP, without a precise territoriality;
- the second, on more narrowly-defined geographical areas inside the province of Belluno, has evaluated the "projects" included in the SP, which can be limited in the territory as they can be sources of pressure with precise environmental targets.

The evaluation of the environmental sustainability produced for the strategic plan highlighted the criticalities of the Belluno area, among which the most serious is the absence of a highway system able to connect the Belluno province with the north and north-east of Europe. The analyses carried out at that time, still valid today, showed the substantial weakness of the Province of Belluno in the national context, and even more so in the international context.

> […] In short, Belluno is presently positioned in the high part of the medium-low competitiveness level, with a value of 432 out of 1,000.[1] This value is undoubtedly unsatisfactory, but it should be evaluated considering that Italy as a whole does not present, even in its strongest realities, any values in line with the international best practice. The most competitive Italian realities (which are never mountain areas) have values ranging from 500 to 540 out of 1,000 (evaluated as medium-high competitive potential), compared with European realities whose development models range from 580 to 670 out of 1,000 (high, although not very high competitive potential)[2] (Barnabò et al. 2007).

In 2006 the SP stated that

> […] the main weakness, which slows down the whole system, is the infrastructure in the territory. The value measured is among the lowest in Italy and in Europe; the indicator shows an infrastructural framework (including material and immaterial infrastructures) that hinders not only external relationships (risk of remoteness), but also internal movements (poor territorial and, consequently, social integration). This analysis underlines a global fragility of the current development model in the Province that, without an intentional intervention strongly based upon some priorities, risks of slipping behind. A merely incremental management, made of answers to isolated questions, would not be enough to help Belluno take the challenges of the new century (Barnabò et al. 2007).

The infrastructural system was designed to become the main strategic lever and the SP identified the fundamental goal by the slogan "from isolation to integration". In fact, the critical points of the infrastructural system were well analyzed and studied (Fig. 1):

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[1]It should be stated that, in the elaboration of the model, the value 1,000 is only a theoretical limit, since, to reach it, for example, high potentials should coexist in terms of economic system (typical of high-potential areas) and of incentive systems, typical of less developed areas. Also, among the areas analyzed by PERegions, no Italian area reaches the measured levels of "very high potential" (whereas, in Europe, these levels are reached in the most advanced areas as regards the markets of the most advanced industrial sectors).

[2]It will be useful and somehow necessary, during the implementation of the strategic plan, to carry out comparative analyses of Italian and international territorial situations that can be compared with Belluno as regards the type of development.

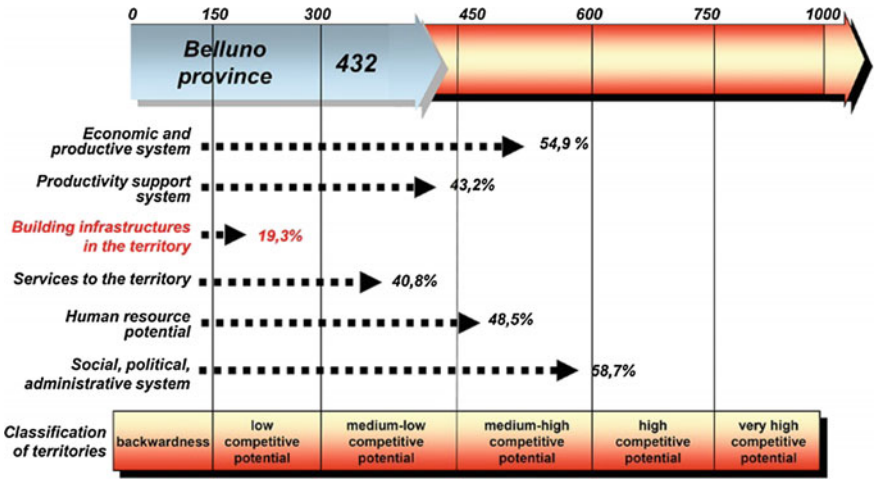

Fig. 1 The present competitive potential of the Province of Belluno (Analysis PERegions 2006)

> […] the general indicator of infrastructure in the province of Belluno rates the province at the 95th position in the list of Italian provinces, penultimate position just before the province of Ragusa.[3] Even analysing the situation more in details, with reference to each infrastructural typology, there are no positive elements as for all typologies the value of the indicator is always lower than the national average (Barnabò et al. 2007).

In addition, the SP explained that:

> […] it is a well-known criticality, worsened by the chronic delay in investment (except for some punctual interventions which have solved some local problems without, however, intervening on the global model) together with a continuously unproductive debate on mobility […] (Barnabò et al. 2007).

The weak infrastructure in the Belluno province is still currently strongly influenced by a road network with a "junction" structure "[…] to which 'major roads', mainly coinciding with other important access roads to the different valleys, are linked […]" (Barnabò et al. 2007). This condition causes:

> […] the relations between municipalities and the traffic on the roads develop essentially on the same routes, because alternative ways can be travelled only coming from outside the province (the two major roads right or left of the Piave valley and the only highway, A27 "Venice-Belluno") […] (Barnabò et al. 2007).

In conclusion, the SP confirmed the weakness of the road network in the province of Belluno so:

> […] the structure of the road network leads the "major roads" to support the traffic of all components transiting through our province, from short-distance mobility for the movements of workers and students to long-distance journeys represented by the tourist flows to

[3]Reference is made to the recent analyses of Istituto Guglielmo Tagliacarne (Rome).

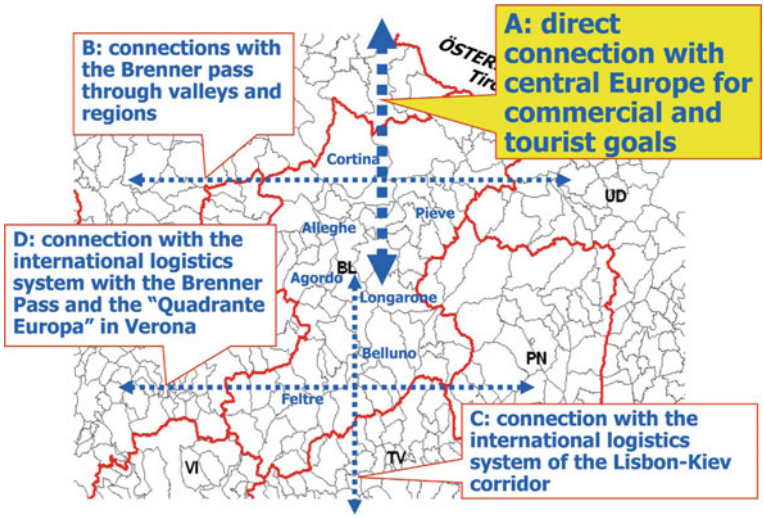

Fig. 2 Guidelines for the definition of mobility objectives (Strategic Plan)

> Cadore, Zoldo or Agordo areas. Apart from the above mentioned tourist components, we cannot forget those tourists simply driving through the province along the A27 Highway, the SS50 State road, and the SR203 Regional road, driving east to west or reaching the Trentino Alto Adige valleys. This element, although less important than global traffic, contributes specifically to the road overloading, in particular on more critical summer, winter or weekend days (Barnabò et al. 2007).

At the start of this situation, the SP of 2006 established the target for the mobility model, characterized by a horizontal networking and especially by the realization of a connection to the North with the tourist market of Central Europe (Fig. 2). In fact:

> […] the strategic goal of the new model is to "network" the province territory inside and, at the same time, outside (regional/inter-regional/state/*interstate*), reaching high performance in terms of effectiveness and efficiency in the supply of transport and related infrastructure, comfort and (low) costs of movements […] (Barnabò et al. 2007).

Even if the SP analysis had highlighted the weakness of infrastructure (especially the road network), considering as a strategic goal the need to "[…] network the province territory inside and, at the same time, outside (regional/inter-regional/state/*interstate*)" (Barnabò et al. 2007), the planning solutions considered at the time were not completely satisfactory since they were based upon the prevailing strategy of horizontal networking, without debating the possible creation of an alpine-motorway pass (Fig. 3).

In fact, Fig. 3 details the layout of the missing territorial relationships of the "international" communication that, consistent with what had been established in the SP, should have been appropriately shown in maps.

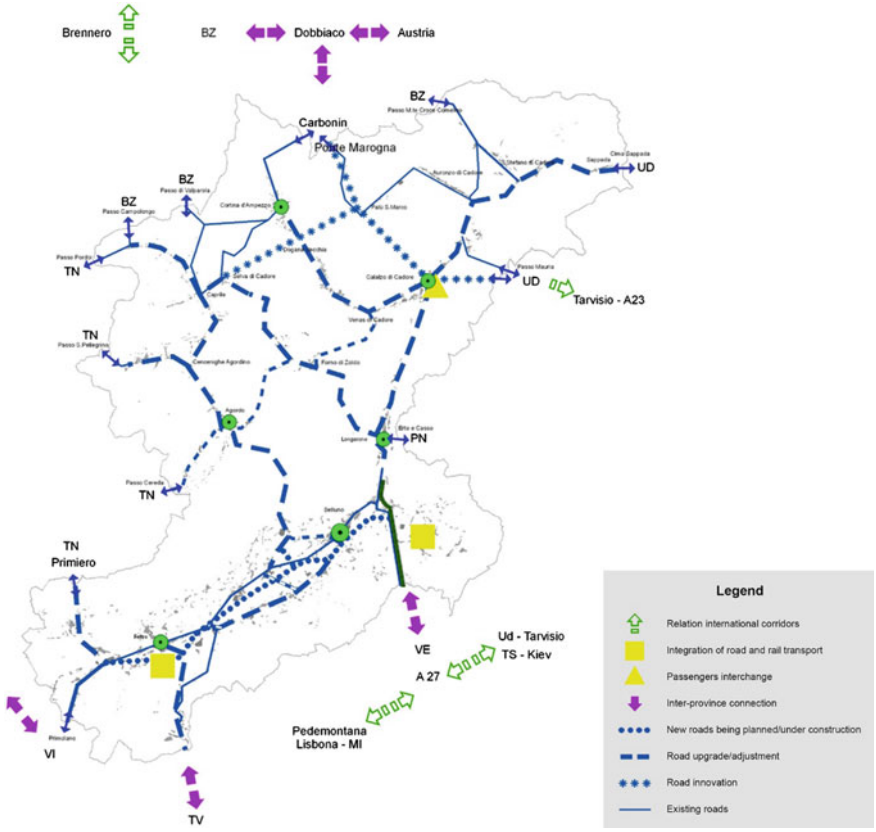

Fig. 3 Projects for the mobility route of the SP: roads (Strategic Plan)

Unluckily, the guidelines of the 2006 Strategic Plan have never been implemented, and this has contributed to accelerate the decline of the Belluno province, also due to a strong competition of the neighboring autonomous provinces of Trento and Bolzano. In these last years in the Province of Belluno, mainly due to the absence of a direct mountain-road pass with the North and North-East of Europe (Fig. 4), the social and economic parameters of the industrial, and especially of the touristic, sectors have worsened, thus becoming the "northern matter" of the Veneto region.

In order to understand this situation, and consistent with the analysis carried out in 2006 by the Strategic Plan of the province of Belluno, it is necessary to briefly analyze the more general trend of alpine movements updated to 2015 and describe the present role of the territory in Belluno province.

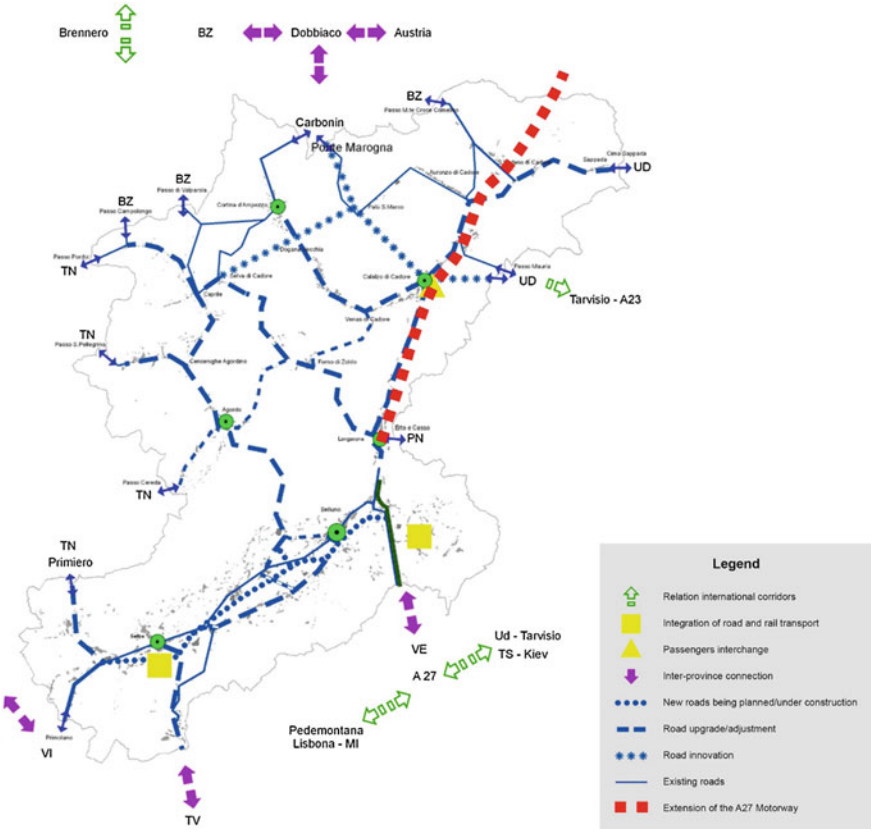

Fig. 4 Projects for the mobility route of the SP: suggested motorway (consistent with the Strategic Plan)

3 Mobility in the Alps

The Italian Alps are characterized by a social and economic structure for which the main source of wealth is supplied by the major roads for cross-border traffic. The only region that does not have an alpine-motorway pass is Veneto, whose border territory to the North is the Province of Belluno. This is actually a *cul-de-sac* between the Trentino Alto Adige and the Friuli Venezia Giulia Regions. In spite of this "communication obstruction" towards northern Europe, the province of Belluno has developed in time strong industry, such as the eyewear district of world-class excellence. However, the globalization processes are seriously undermining the economic model of the province of Belluno because there is no

alpine-motorway pass that enables companies in the province to develop fast interchanges with the European market. This geographic isolation should have been solved through the realization of the Venice-Munich highway, which had already been planned at the end of the 60s. However, it has never been completed (except for the Venice-Belluno section) because of the obstacles created especially by the autonomous provinces of Trento and Bolzano, which were worrying that their motorway (A22 of Brenner Pass) could undergo a traffic reduction and consequently might create a potential threat to their economies (Campeol and Masotto 2015).

3.1 European Corridors and the Trans-European Transport Network (TEN-T)

The network of European traffic routes is changing, both to match the evolving economic geography of these last years and for the localization of productive hubs, logistics, and the demand connected with the transport of goods, reinforced by the provisional directions established at higher levels (starting from the EU level). In all this, also regarding communications with other sectors not directly connected with industry (e.g., the sectors related to tourism, services, etc.) help to complete the framework of the new geography of European communications.

Since the second half of the 80s, the panorama concerning the infrastructural development of traffic routes for the functioning of the internal market of the European Union which is able to ensure the social and economic cohesion has been defined by the Trans-European Transport Network (TEN-T). This network project has been characterized by a series of procedural steps, through which the present planning has been established, but not completed yet (Campeol and Masotto 2015).

In January 2014, the European Union defined a new policy for the transport infrastructure, aiming to connect the east and the west and the north and the south of the continent. This new policy aims at completing the missing connections in the transport infrastructure networks of the Member States and removing the technical bottlenecks and obstacles that still currently hinder the functioning of the internal market.

At the end of the long path in the definition, rethink and reconstruction of forecasting hypotheses on the orientations for the TEN-T, this is today characterized by the integration of the various modes of transport considering road and rail systems, airlines, and inland and sea navigation. Thus, the implementation of the TEN-T requires the realization of intermodal infrastructures for all the Member States included in the Trans-European Transport Network (Campeol and Masotto 2015).

3.2 Territorial Competitiveness

Through globalization, some countries, traditionally considered as developing, are rapidly gaining ground on the more developed economic powers, and coming to play an important role in advance of them.

The European Union has been long rethinking its own economic system, aiming to strengthen the competitiveness by opening the markets to Member States (removing the obstacles that hinder or slow down the growth of the market among Member States), enhancing the resources and distinctiveness of the various geographic areas that characterize the European continent (with the evident reference to the EU Member States). As a consequence, the transport system plays a crucial role in Europe in relation to world competitiveness.

If the new geography of European communications is creating new development opportunities, which need to be carefully managed, on the other hand it is also true that the distance from the most important traffic routes, which are being completed, may be an element for further disparities. In other words, the geography of European communications may lead to territorial disproportionality between the areas directly involved in the trans-European transport network and those outside this network. This phenomenon can worsen the marginalization processes of some European territories, thus being contrary to one of the objectives of the European policy, that is, to improve the connections on all the EU territory with the goal to reduce the isolation of some geographical areas (Campeol and Masotto 2015).

The case of the Veneto Region is emblematic, as it is the only region in the Alps without an alpine-road pass, and this situation is progressively weakening the province of Belluno, an enclave between the two European corridors—"Baltic-Adriatic" and "Scandinavia-Mediterranean Sea"—with which it has no direct connections.

It would be strategic for central Veneto, a geographic area that is still among the most dynamic in Europe, to be able to communicate with the European system through a mountain-road pass, which would create direct access to the north and east of Europe. This access would enable a considerable tourist flow to the UNESCO site of the Dolomites (first of all the Belluno province, as most of the UNESCO Dolomites are located in this area), to the world core of the eyewear production, and to the sea port system of the Northern Adriatic, that is Venice and Trieste in Italy and Koper in Slovenia (but also with the Port of Rijeka and Bakar, after the completion of the motorway section from Trieste to Rijeka, crossing Slovenia for 60 km).

4 Evaluation Models

Assimilating the evaluation into the planning processes of transformations means moving in the direction of the "know-how", of the harmonization of transformations with the environmental context in which ecological, historical, landscape,

functional, etc. elements coexist in dynamic balance. As a consequence, the transformation strategies coming from political decisions, but also from the interpretation of the environmental potentialities and criticalities, can be redefined through the application of evaluation models and techniques on the impacts, always in accordance with the objectives established by politicians, in order to improve the development "lever" (typology) and make it more appropriate to the reference context. Therefore, the application of the environmental evaluation models enables us to establish the type, the hierarchy, and the importance to attribute to strategic actions in order to manage the transformations, in relation to the characteristics of geographical areas, of environmental strengths (potentialities) and weaknesses (criticalities) of both the state of facts and of the wishes of local communities. These evaluation models permit correction of planning mistakes through monitoring.

For the case study represented by the province of Belluno, an enclave between the very competitive territories of the provinces of Trento and Alto Adige, the application of an environmental evaluation model has enabled the identification of strategic actions for the development of this territory within the strengthening of the international infrastructure system as the main lever to develop the Belluno province.

4.1 The Environmental Performance of Motorway Corridors

The geographic, social, and economic conditions, as well as those concerning alpine mobility and the competitiveness of neighboring territories, make it possible to identify the infrastructural lever for inverting the phenomenon of social and economic decadence of the Belluno province.

Among all the infrastructural projects identified, as shown in the 2006 Strategic Plan, the realization of an alpine-motorway pass seems to be the key strategic action to develop the province of Belluno and make it more competitive (Fig. 5).

For at least 40 years, three main corridors were identified (Fig. 6):

- Route A—designed in the 60s with access to the north in Wiesing, in Austria, after driving through the province of Bolzano;
- Route B—designed between 1986 and 1989, with access to the north in Lienz, Austria;
- Route C—designed between 2005 and 2011, with access in Tolmezzo, Friuli Venezia Giulia region.

Only Routes A and B have been analyzed on a macro-environmental scale, with defined environmental pre-feasibility that enables the establishment of the performance level, whereas Route C has been excluded because it was a weird simulation without a real impact on transport or direct usefulness for the Belluno province and, even more, the Veneto region in general.

Fig. 5 The geographic context of the extension of the A27 motorway

Fig. 6 The routes analyzed

Table 1 The environmental pre-feasibility

Indicators	Geographic corridor		
	Route A 1960s	Route B 1986–1989	Route C 2005–2011
1. Geographical interferences	Austria and Province of Bolzano	Austria	Friuli Region
2. Geographical length of the corridor from Pian di Vedoia to arrival point in Austria	183 km to Wiesing (A)	119 km to Lienz (A)	–
3. Distance and time from arrival point in Austria to Munich (D)	126 km (1 h, 22′ via A12 e A8)	220 km (2 h, 56′ via A8)	–
4. FUTURE distance and time from Pian di Vedoia (BL) to Munich (local economies)	309 km (3 h e 5′)	339 km (3 h e 23′)	–
5. PRESENT total distance and time from Pian di Vedoia (BL) to Munich (local economies)	639 km (6 h, 26′)	639 km (6 h, 26′)	–
6. % reduction of time and distance	−52 %	−47 %	–
7. FUTURE distance Venice-Munich (regional economy)	411 (4 h, 7′)	441 (4 h, 25′)	–
8. PRESENT distance Venice-Munich (via A22 of the Brenner Pass)	543 (5 h, 21′)	543 (5 h, 21′)	–
9. Construction costs	Very high	Medium	–
Performance	**Low**	**Very high**	

The indicators utilized to define the environmental performance of Routes A and B are the following (and summarized in Table 1):

- Geographical interferences
- Geographical length of the corridor from Pian di Vedoia to the arrival point in Austria
- Distance and time from the arrival point in Austria to Munich (D)
- FUTURE distance and time from Pian di Vedoia (BL) to Munich (local economies)
- PRESENT total distance and time from Pian di Vedoia (BL) to Munich (local economies)
- % reduction of time and distance
- FUTURE distance Venice-Munich (regional economy)
- PRESENT distance Venice-Munich (via A22 of Brenner Pass)
- Construction costs.

4.2 Multi-Criteria Method Decision (MCMD): the AHP Method

The first results of the environmental pre-feasibility (performance table) have highlighted a complex decision problem, which can be characterized by a variety of important aspects, viewpoints, or even decision makers, which do not permit focus on a single objective. In these cases, it is essential to use multi-criteria analysis models (MCMD) that may make it possible to compare and arrange the options existing in the problem on the basis of data about often-contrasting objectives. The multi-criteria analysis aims at providing a support to the decision maker for realizing an acceptable compromise between the different objectives to be reached, which shall be previously transformed into criteria. The criteria obtained will enable the comparison of the various options present in the problem, and these, in turn, will become part of the whole called "alternative".

The identification of the objectives and criteria is a very delicate stage: it is necessary to specify the objectives and criteria with different levels of detail, as the analysis results could be implicitly orientated. Criteria are quantitative or qualitative variables that measure the performances and the impacts of the analyzed alternatives.

Using the various types of methods related to the multi-criteria analysis, the stage of the weight distribution (concerning the objectives of the decision problem) is particularly important; only after this operation is it possible to establish an order of priorities among all the objectives of the problem. Actually, the term "priority" and "weight" are considered as synonyms.

The weighting techniques are numerous, but the simplest commonly used are:

- direct distribution, where a weight or a judgment is given to a criterion, or an objective, following an evaluation scale previously established;
- pairwise comparison, where the various criteria, or objectives, are compared to one another and the values obtained are reported on a square, positive and reciprocal matrix, called a pairwise-comparison matrix.

Finally, in order to verify whether the evaluation of the objectives of the problem is correct, three types of sensitivity analysis can be realized:

- sensitivity of the method; a different method of data standardization and (when possible) of the computation of final scores is applied. This is used to control the dependence of results on the calculation method;
- sensitivity of criteria; it ensures the validity of the adopted scheme by adding or removing some decision criteria;
- sensitivity of weights (the most used); the value judgments of some criteria are modified in order to find out the degree of influence of each factor on the final decision.

A discipline of the MCMD, aiming to support the decision maker in advance of numerous and conflicting evaluations, is multi-criteria decision analysis (MCDA),

which makes it possible to obtain a compromise solution in a clear way. The multi-criteria-analysis methods support the decision maker during the organization and the synthesis of complex and often heterogeneous information. This methodology enables the decision-maker to analyze and evaluate various alternatives, by monitoring their impacts on the various actors in the decision process. The MCDA is used in various fields, such as finance, planning, ecology, etc. where it is not possible to directly apply an optimization method, due to the numerous decision criteria (Mocenni 2010).

A fundamental problem in decision theory is how to obtain weights for a set of activities/actions in relation to their importance. Establishing that a given activity/action is more or less important than another requires the adoption of decision criteria, which can be totally or partially shared by the activities/actions being analyzed.

A multi-criteria-decision process will develop and subsequently apply a hierarchical measurement system. The fundamental step is to obtain some weights for each activity/action so as to establish the importance level for each. Consequently, it will be possible to determine which activity/action will be allocated a resource or which activity/action to implement. Moreover, it is necessary to classify the various objectives of the process as regards a set of objectives placed at a higher level, which in turn must be classified on the basis of further objectives, and so on, until reaching a single objective at the top of the hierarchy (Forman and Gass 2001).

The MCDA measurement system, among the most widely used, which may solve these kinds of problems and which we have consequently chosen, is called analytic hierarchy process (AHP). It is a hierarchical analytic process that enables us to make a decision among different options when we have multiple criteria.

The AHP method, as a decision-support system (DSS), is developed in five fundamental steps:

- development of the hierarchy (Fig. 7): in this first step the decision maker analyzes all the aspects of the problem and structures it in a hierarchy composed of several levels. This decomposition of the problem leads to its considerable simplification and enables the decision maker to concentrate her/his analysis on a limited number of decisions. At the top of the hierarchy, there is the goal that the decision maker has established, while at the bottom there are the objectives that enable reaching the goal; at an even lower level, there are the criteria necessary to realize the objectives. The criteria, in turn, can be divided into sub-criteria, as far as the decomposition level makes it necessary to understand the problem;
- elaboration of the pairwise comparison matrix: it consists of identifying the weights to match with each criterion in the hierarchical problem, thanks to the use of an evaluation matrix whose single elements are obtained by pairwise comparisons of the problem criteria;
- determination of the relative local weights: once obtained, the pairwise comparison matrix, in the subsequent step of the model the weights to be matched with each criterion, is evaluated;

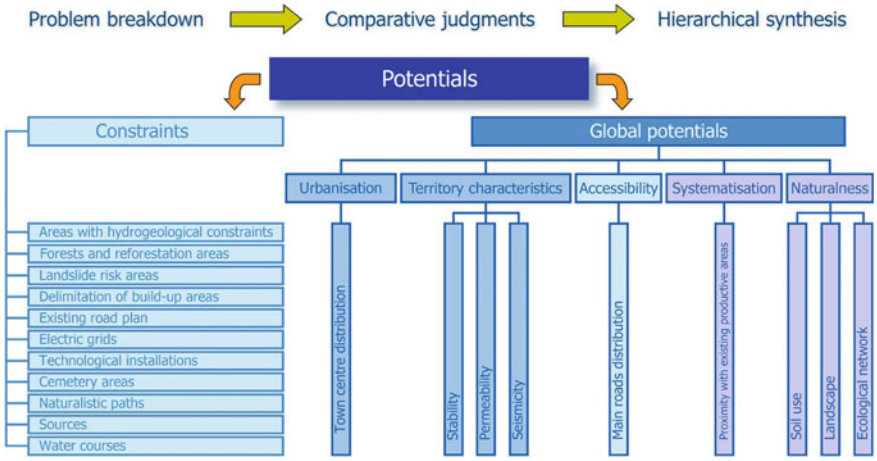

Fig. 7 Diagram of the evaluation method

- analysis of the judgment consistency: in this step of the process, it is necessary to verify whether the weights obtained in the previous step are consistent with the judgments expressed by the decision maker;
- determination of the global weights: the principle of hierarchical composition; this is the final step and it consists of calculating the global weights (or priorities) of the actions. In order to determine the importance of each element in relation to the goal, it is necessary to apply the principle of hierarchical composition (Saaty 1980). The local weights of each element are multiplied by those of the corresponding super-ordered elements and the products obtained are summed up. Proceeding from the top to the bottom, the local weights of all the elements of the hierarchy are thus progressively transformed into global weights. The global weights (or priorities) of the elements placed at the bottom of the hierarchy, in the level after that of the terminal objectives, represent the main result of the evaluation. When the terminal elements are actions, the global weights make it possible to determine an order of preference: the more an action (a project, a strategy, a scenario, etc.) is favored, the more global weight it has.

In the AHP, the weights are determined with the pairwise comparison, and the quantification of the relative importance of the different criteria is derived from the declaration of preference by using the scale of values 1–9. The matrix derived can be analyzed by using a consistency index, which makes it possible to evaluate to what extent the derived weights are consistent with the decision process. In particular, the AHP is a technique that can be easily applied, that is flexible in the choice of inputs, and that enables one to assign priorities to a set of decision alternatives, relating qualitative and quantitative evaluations, otherwise not directly comparable, by combining multidimensional scales of measurements into a single priority scale. Its process structure, well-defined in its consecutive steps, enables

attribution of ponderable values to the various environmental components and, through the use of a reliable software (SuperDecisions), it is able to produce clear decisions and to provide immediate answers to the modification of identified inputs. These factors have been essential in the choice of this methodology so that it may be used to identify the performance of the territorial scenarios for the Belluno province.

5 Conclusions

The quality of urban and land development cannot be defined in advance, but only through environmental evaluation models that use correct techniques for the impact assessment and evaluation of performance alternatives. Therefore, there is not a single definition of development but, according to the social, economic, ecological, geomorphological, etc. conditions, evaluation models make it possible to identify the necessary development typologies and actions. The province of Belluno is a typical case in which the strategic action for development is implemented by realizing infrastructures, among which the realization of the motorway typology through an alpine pass turns out to be predominately important.

What comes out from this survey underlines the importance of further exploration of the vector typology that represents, in this case, the preferences of the decision makers, as it is clear that, on the basis of public priorities, the alternatives could also change. This is the reason why it has become necessary to identify an evaluation methodology, such as the AHP, that may lead to identifying the best alternative among the various territorial scenarios assumed for the Belluno province.

References

Barnabò, L., Bianchini, M., Buggin, A., Campeol, G., & Karrer, F. (2007). *Piano Strategico della provincia di Belluno - Documento Preliminare - vie per il futuro*. Province of Belluno.

Campeol, G., & Masotto, N. (2015). *Nuove Geografie delle Comunicazioni Europee - La Rete Transeuropea dei Trasporti: il ruolo dell'Italia e del Bellunese*. XXXVI Conferenza scientifica AISRe: "L'Europa e le sue regioni. Disuguaglianze, capitale umano, politiche per la competitività", Arcavacata of Rende (Cosenza) 14–16 September.

Forman, E. H., & Gass, S. I. (2001). The analytic hierarchy process: An exposition. *Operations Research, 49* (4), 469–486.

Mocenni, C. (2010). *Analisi multicriterio, sistemi di supporto alle decisioni e algoritmi risolutivi (algoritmo del massimo autovalore)*. Decisions Analysis Course, Department of Information Engineering and Mathematics Sciences - DIISM, University of Siena.

Saaty, T. L. (1980). *The analytic hierarchy process*. New York: McGraw-Hill Book Co.