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Infrastructural projects and territorial development in Veneto Dolomites: Evaluation of performances through AHP

Giovanni Campeol [a], Sandra Carollo [b], Nicola Masotto [c,*]

[a] *University Iuav of Venice, Santa Croce 1957, Venice 30135, Italy*
[b] *Studio ALIA, Piazza delle Istituzioni 22, Treviso 31100, Italy*
[c] *University of Padua, Via Venezia 1, Padua 35131, Italy*

Abstract

The ensemble of European traffic roads is changing in relation to the economic geography that has been developing these recent years and also to the localisation of production centres, logistics and the demand linked to the transportation of goods. The development of communication has been defined through the project of the Trans-European Transport Network (TEN-T). This network has been progressively defined until it has reached the present architecture in which Italy is crossed by four of the nine total corridors that compose the whole network - which means by almost half of the main traffic roads at European level -. Undoubtedly this new geography of European communication offers member States new development opportunities, but it is also true that the distance of the different territories from the major traffic roads can be a disparity factor. In fact, this phenomenon can worsen the marginalisation processes of some European territories, contrary to the objective of the interconnection policy of the EU territories. In front of these possible territorial disparities, the Planning discipline in Italy has not been adequately questioned, aiming instead at the research of the “territorial patching up”, progressively decreasing, rather than at the exploration of new development forms. As a consequence, mobility planning becomes strategic for Italy, especially for its Alpine area. Hence the need to set up valid tools for the environmental evaluation as regards planning and programmes, such as the Strategic Environmental Assessment (SEA), but also projects, as the Environmental Impact Assessment (EIA). The idea to realise an important road infrastructure, which may connect Belluno directly with Austria, is presented in this paper as an emblematic case, in which the application of the Analytic Hierarchy Process (AHP) permits to verify the best performing infrastructure on a territorial scale.

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Keywords: Transport routes, Development, Territorial interconnection, Territorial disparities, Mobility, Tools for the environmental evaluation, Road infrastructures, Territorial performances

* Corresponding author. Tel.: +39-0422-235-343; fax: +39-0422-174-2207.
E-mail address: nicola.masotto@dicea.unipd.it

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1. The Protocol "Transport" of the Convention on the Protection of the Alps of 1991

The deep economic and financial crisis of these last years has undermined the paradigms of sustainable development, established by the Conference of 1992 in Rio de Janeiro, with all the subsequent distorting interpretations that have been more and more focused on a conservative view of "development" until coming to the idea of weird scenarios that can be named "happy degrowth".

This conservative approach, partially justified by the Convention on the Protection of the Alps of 1991 – especially in the Protocol Transport -, risks of conditioning the modes of transport in the Alpine area.

However, the Convention on the Protection of the Alps, which was formally set up to "protect" the Alpine environment, had also to explicitly recall the need to "[...] contribute to the sustainable development of the habitats and economic areas in which people living in the Alpine region dwell and work by implementing a transport policy which encompasses all modes of transport and is harmonized between the various Contracting Parties [...]" (European Union, 2007).

Even if this policy aimed at following the cultural trend of that moment, based on a somewhat apocalyptic vision of the next "environmentalist catastrophe" (Ling, 2012), on the other hand it realized that the transport system and its infrastructures were (and are even more nowadays) at the basis of the functioning of the territories and so of the preservation of the human presence.

In fact, this protocol states that it is necessary to "[...] ensure the movement of intra-Alpine and transalpine transport at economically bearable costs by increasing the efficiency of transport systems and promoting modes of transport which are more environmentally-friendly and more economic in terms of natural resources [...]" (European Union, 2007).

This means that traffic must be guaranteed with a special attention to the technological development, which must have economically bearable costs, in order to reduce emissions.

Although with its "static" vision, this Protocol Transport actually asks member States "to refrain" from building new major roads until these infrastructures are necessary for the social and economic development.

Well knowing the communication difficulties in the Alpine area, the "Protocol Transport" also underlines the need to create infrastructures for improving mobility "[...] However, in view of the geography and the settlement pattern of the Alpine region, which cannot always be efficiently served by public transport alone, the Contracting Parties shall recognise the need, in these remote areas, to create and maintain sufficient transport infrastructures for private transport to function [...]" (European Union, 2007).

The over-30-year-old Italian "dormancy" in the realisation of big infrastructures (especially roads) can no longer be justified in front of the need to overcome the world economic crisis. In any case, this dormancy did not take place in Trentino Alto Adige Region, which fully exploited the Convention on the protection of the Alps to increase traffic on the Brenner A22 highway and the Verona-Munich railway, probably becoming the most important EU fund collector of all the Alpine area. At the same time, important road works have not been realised yet in some Alpine areas as the Belluno province due to weak policies, and therefore the disanthropization processes have considerably increased in this geographical area. Thus, these territorial disparities are contrary to the strategies of the Trans-European Transport Network (TEN-T).

This EU strategic one-sided view for the Alpine area has been eventually overcome in the recent elaboration of the EU Strategy for the ALPin Region (EUSALP) (European Union, 2016).

2. EUSALP 2016

The strategic goals of EUSALP (2016) fully reorient the contents of the Convention on the Protection of the Alps (1991), going from a "conservative" vision (typical response to the capitalist model in the historical stages of strong economic growth and high consumption of energy resources), to an "innovative" vision, typical of mature economies, based on its ability to transform the territory not only in a sustainable, but also in a technologically advanced way (smart).

EUSALP clarifies these innovative actions starting from a revolution of traditional macro-regional strategies through five big general actions.

The first is defined “participatory” as it is based on the consultation of all the countries of the European Alpine region.

The second “broad relational” action aims to connect the wide lowland territories with Alpine areas and to make them communicate.

The third “transport” action is designed to improve the connection between territories in order to have the population live in mountain areas.

The fourth “info” action shall permit the networking of data as well as scientific information.

The fifth “economic-competitive” action aims to increase the wealth of Alpine territories through the economic growth produced by the competitive and innovative development of businesses.

In order to implement these general actions EUSALP has formed “9 Action Groups” with the task to develop in 2016 specific actions which should produce a concrete and rapid impact on the Alpine macro-region, following three main objectives: (1) economic growth and innovation; (2) mobility and connectivity; and (3) environment and energy.

3. Competitive scenarios and evaluation of strategic projects

Once the framework of EUSALP actions has been defined, it is important to understand how the weak territories of the Alpine region can overcome the marginality produced by the attractiveness of the reinforced European corridors, especially the Mediterranean-Scandinavian road, in which the Brenner A22 Highway is a fundamental section.

The Belluno province is an emblematic case, but it is not the only one (for example, also the Province of Sondrio). Due to the absence of an Alpine road pass, it is forced to exchange its goods with the North-East of Europe only by going southward to the Po Valley and then northward, mainly through the Brenner A22 highway and then through the A23 highway of Tarvisio. This fact increases the wealth of the Autonomous Provinces of Trento and Bolzano with motorway tolls and also with the huge flow of money as a result of the treaties on special autonomy allowing these two provinces to absorb most taxation.

The main strategy of the Belluno province, as well as of Veneto region, the only Alpine area that does not have an alpine road pass to the North, is to build its own trans-Alpine communication infrastructure represented by the extension of the A27 highway from Venice, which still ends in Pian di Vedoia (geographically just north of Belluno city).

This strategy had already been devised in the early Sixties, with different route options, and with several recalls in 2005, 2011 and 2013. In any case, they all were focused on connecting with the big markets of Northern Europe (in the past) as well as with those of the North-East and East of Europe (nowadays).

These project options have been radically and decidedly opposed by a part of the Autonomous Provinces of Trento and Bolzano, which have first instrumentally used the general environmental issue and then the contents of the Convention on the protection of the Alps (that, as above seen, does not prevent at all the realisation of big road infrastructures if they are necessary to the survival of Alpine territories).

The opposition from Trento and Bolzano to the extension of the A27 has highlighted the possibility to alternatively realise railways with different routes and potentialities.

In the light of all that an evaluation model has been selected for helping decision-making, with the goal to choose the most performing infrastructure and route.

3.1. The choice of the evaluation technique

Many methods can be adopted for the evaluation of infrastructural projects, but thanks to the scientific debate it is possible to identify the predominant approaches, which can be simplified in three types of analysis schemes (Brambilla, Erba, Ponti, 2005):

- Cost-Benefit Analysis (CBA);
- Input-Output Analysis (IOA);
- Multi-Criteria Analysis (MCA).

The CBA (Adler, 1987; European Commission, 2015) evaluates the returns on investment by comparing investment costs and benefits evaluated through the changes of social surplus. The limits of this approach are well known, and they consist essentially in the assumption of efficient upstream and downstream markets (hence the objections known as the "theorem of the second best"), in the technical difficulties connected with the problem of the "*numeraire*", in the absence of distribution valence (Brambilla, Erba, Ponti, 2005).

The IOA (Leontief, 1986) evaluates the impacts of public funds spending on the whole economic structure. This approach implicitly assumes zero costs-opportunities for the inputs rewarded by the added value (labour and capital). This is a very stringent assumption, which is not generally acceptable as it is not realistic[1] (Brambilla, Erba, Ponti, 2005).

The MCA (Keeney, Raiffa, 1976) is a decision-making tool developed for complex problems. In a situation where multiple criteria are involved confusion can arise if a logical, well-structured decision-making process is not followed. Another problem in decision-making is that it is very difficult to reach a general consensus in a multidisciplinary team. By using MCA the members don't have to agree on the relative importance of the Criteria or the rankings of the alternatives. Each member enters his or her own judgements, and makes a distinct, identifiable contribution to a jointly reached conclusion. One form of MCA that has had many applications both in the private and in the public sectors is the Multi-Criteria Method Decision, also known as Multi-Attribute Decision Analysis (MADA). The methodology adopted in this work is an evaluation typology, which is a part of this large family of decision-making tools.

3.2. Multi-Criteria Method Decision (MCMD): il metodo AHP

The first results of the environmental pre-feasibility have highlighted a complex decision problem, which can be characterised by a variety of important aspects, viewpoints or even decision-takers, which do not permit to 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-taker for realising an acceptable compromise between the different objectives to be reached, which shall be previously transformed into criteria. The criteria obtained will allow 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 a different level of details, as the analysis results could be implicitly orientated. Criteria are quantitative or qualitative variables that measure the performances and the impacts of the analysed alternatives (Campeol, Carollo, Masotto, 2015).

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 (Campeol, Carollo, Masotto, 2015).

A discipline of the MCMD, aiming to support the decision-maker in front of numerous and conflicting evaluations, is the Multi-Criteria Decision Analysis (MCDA), which permits to obtain a compromise solution in a clear way. This methodology allows the decision-maker to analyse and evaluate different alternatives, by monitoring their impacts on the different actors of the decision process. The MCDA is used in different fields, such as finance, planning, ecology, etc. where it is not possible to directly apply an optimisation method, due to the numerous decision criteria (Mocenni, 2010).

A fundamental problem in the 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 needs the adoption of decision criteria, which can be totally or partially shared by the activities/actions being analysed. Moreover, it is necessary to classify the various objectives of the process as regards a set of objectives placed at a higher level, which

[1] Contexts of partial unemployment, phenomena of private investment crowding out or even public budget constraints should be considered (Brambilla, Erba, Ponti, 2005).

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, Gass, 2001).

The MCDA measurement system, among the most widely used, which permits to solve these kinds of problems and that we have consequently chosen, is called Analytic Hierarchy Process (AHP). It is a hierarchical analytic process that permits us to take 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; in this first step the decision maker analyses all the aspects of the problem and structures it in a hierarchy composed of several levels;
- elaboration of the pairwise comparison matrix; it consists in identifying an evaluation of 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 are evaluated;
- 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 in 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).

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 to 9. The matrix derived can be analysed by using a consistency index, which permits to evaluate to what extent the derived weights are consistent with the decision process (Campeol, Carollo, Masotto, 2015).

3.3. Definition of criteria for the application of the AHP

Taking Saaty's diagram (fig. 1) as a reference point, it is possible to identify the characteristics of the "project" scenarios that will be submitted to environmental evaluation through the AHP method, starting from the strategic objective to directly connect the Province of Belluno with the North of Europe through Austria (GOAL).

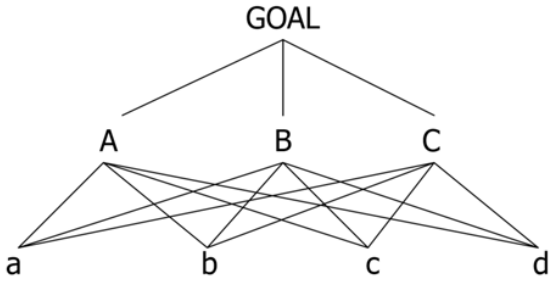

Fig. 1. Diagram of dominance hierarchy (Source: Saaty, 1980).

The following project scenarios have been considered:

- Highway project of the extension of A27 (from Belluno to Austria).
  The analytical and evaluation elaborations, presented at the International Conference on "SSPCR 2015" (Campeol, Carollo, Masotto, 2015), have shown that a road hypothesis able to connect the Belluno province with northern

Europe is possible. This route is the result of an evaluation of environmental pre-feasibility that has compared three highway routes devised in different times.

- Railway projects
  The railway scenario is composed of two sub-projects with different directions, that are:
  1. Rehabilitation of the railway Calalzo-Cortina and extension to Dobbiaco (with prevalently tourist functions);
  2. Railway extension Calalzo-Lienz District (Austria) with two options:
     i. High-Speed/Capacity Railway (HSR-HCR) (transport of persons and goods);
     ii. Passenger trains (prevalently tourist).

Considering these general scenario guidelines, the hierarchical model has been set up in order to apply it on the basis of the following characteristics of attributes, defined in relation to the scenario characteristics:

- Society: effects on social demand and demography;
- Landscape: catching and enjoying the landscape quality along the route;
- Economy: promoting economic development in the territories stretching along the route;
- Time: speed of overall travel times generated by the transport project;
- Territory: possibility to communicate with the local transport network;
- Costs: building costs, Project Financing.

The scenario contents permit to define Saaty's conceptual diagram, as we can see in fig. 2.

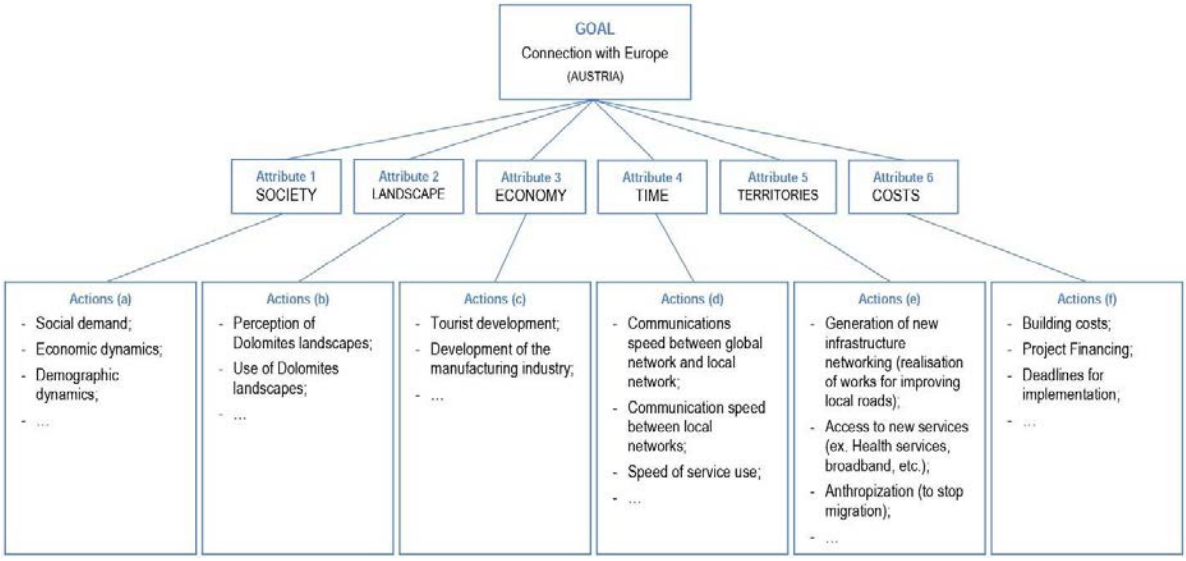

Fig. 2. Diagram of the evaluation method.

4. Conclusions

The need to avoid the migration from important Alpine areas as the Belluno province, which is a real geographical *cul-de-sac* between strong competitive areas, requires the realisation of important infrastructures, especially roads. However, the choice of the best project option must be made through the application of evaluation models able to compare the environmental performances of the different transport projects, and the AHP has proved to be effective for that.

It is important to remember that there are different evaluation models that can be applied to the above case, such as the Cost-Benefit Analysis (CBA), which is a "high" evaluation step, prodromal to the definition of future projects.

The different evaluation models are often placed on different levels, so it is possible to avoid costly competitions between them.

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