# APPLYING THE ANALYTICAL NETWORK PROCESS TO IDENTIFY NEW RETAIL SCENARIOS IN THE PROVINCE OF TRENTO (ITALY)

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## ABSTRACT

In the Italian Trentino area, the spatial planning institutional context is continuously evolving, especially in the field of retail planning tools. New emerging concepts and processes related to ex-ante evaluation of new retail settlements are highlighted in the regional decision process named Territorial integrated evaluation (Tie). This envisages a framework of criteria, strategies and action for the design of retail policies that can support the institutional innovation process of the Valley communities. Starting from this theoretical framework, this paper aims to illustrate a novel application of the Analytic Network Process (ANP) in the field of spatial planning with the purpose of investigating the interrelations between retail components and spatial development retail scenarios within the Province of Trento (Italy). Although the ANP model was tested on the main municipalities of the Trentino area (Trento, Rovereto, Riva del Garda, Pergine Valsugana and Arco), this study presents the Rovereto case study. The results obtained assist in the development of the operational evaluation system, that is easy to replicate to other spatial scenarios and that can support the policy makers in a participative process.

## 1. Introduction

Despite institutional innovations in Italian retail policy, the application of these innovations in most of the Italian Regions has only been half-heartedly pursued or completely disregarded until recently. Italian retail policies do not generally consider territorial aspects or the impacts of retail settlements on the landscape. Therefore, it is necessary to rethink this approach to the retail settlement processes' management (Brunetta and Caldarice, 2014).

This paper develops the theoretical framework for the experimentation of Territorial integrated evaluation (Tie) in the Italian Trentino area. In this region – the cradle of Italy's planning tradition – the institutional context is continuously evolving. For instance, in light of the indications of the recent Trentino District Plan, the newly formed Valley communities are now setting up retail planning tools. This exceptionally dynamic context has allowed experimentation with some emerging concepts in spatial planning such as multi-disciplinarity. Multi-disciplinarity is the connection between the territorial, environmental and economical dimensions of analysis and evaluation. The example of the Trentino area has allowed us to apply and redesign the Tie methodology with the aim of setting up local development scenarios which meet both the need for economic growth (in the retail and tourist sector) and the need for the conservation of exceptional landscape values. The outcomes of Tie – which have been converted into local legislation in conformity with recent European and Italian liberalization decrees – envisage a framework of criteria, strategies and action for the design of retail policies that can support the Valley communities in their institutional innovation process.

This paper reports a novel application of the Analytic Network Process (ANP) in the field of spatial planning with the aim of investigating the interrelations between retail components and spatial development retail scenarios. In particular, the paper focuses on the Rovereto municipality as a relevant case study with the purpose of identifying key spatial development themes related to sustainable land use and improving policies for the positioning of new retail areas within the Province of Trento.

The paper is structured as follows. After the introduction, the next section introduces the technical background and the role of Territorial integrated evaluation (Tie) to: (i) analyze territorial features, needs and requirements, (ii) define metrics to evaluate development scenarios and (iii) devise strategies for the localization of new retail areas. Section 3 illustrates the results of the Analytic Network Process application, which was conducted with the participation of a relevant number of Province of Trento's stakeholders. Finally, in Section 4 the outcomes are discussed and final conclusions reached.

## 2. The Territorial integrated evaluation (Tie): a background

Territorial integrated evaluation (Tie) is a technical method used for the *ex-ante* evaluation of the dynamics of new retail settlements in the regional decision process. Formally, Tie is the outcome of a research programme coordinated by the Politecnico di Torino from 2004 to 2007 for the Retail Department of the Piedmont Region. Tie does not intend to replace the assessment procedures which are compulsory by law (such as the environmental impact assessment and the strategic environmental assessment), but aims to be a voluntary evaluation tool to help in the decision-making processes and to design the territorial transformation and development. Therefore, the primary aim of Tie is to support the development of spatial programming scenarios (Brunetta, 2013) and to overcome the limitations of one-dimensional approaches to

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regional retail planning policies.

The Tie method necessarily requires a multidimensional and multidisciplinary approach in which territory (such as the land use and infrastructure system), landscape (such as the status and the evolution of the natural and cultural resources) and economic systems are integrated. This evaluation process has been closely linked to regional policy decision-making, and thus has been defined and proposed as the governance model for settlement of gross leasable areas (Brunetta, 2008).

It should be emphasised that Tie is both a 'voluntary' procedure and a 'holistic' technical process for institutional learning. More generally, Tie is configured as a consistent, logical and rational process with specific tools and techniques (themes, scales and indicators) of analysis and evaluation for the design of territorial development scenarios.

Because of these factors, the Tie methodological procedure was applied to regional policy in planning new retail settlements in the Trentino District. It was applied as cognitive support for the planning and design of new territorial development retail scenarios. Tie proposes an alternative approach to consolidated strategic evaluation procedures in regional planning and identifies a technical proposal for innovation in institutional decision-making planning. Finally, Tie is a systematic process and a rational and consistent evaluation action based on a holistic evaluation framework.

## 2.1. Themes, indicators and SWOT analysis

To organise the structure of the evaluation, Tie adopts and adapts some of the elements of the multi-criteria and SWOT analysis methods (strengths, weakness, opportunities, threats) while making a number of adjustments and changes. In accordance with the theoretical evaluation logic described above, the Tie operational dimension is characterised by both a descriptive and a normative nature (Brunetta, 2006; Guba and Lincoln, 1989; Miller and Patassini, 2005).

With this in mind, the structure of the Tie process relates to two interwoven scales of evaluation which correspond to two levels of territorial governance, both with their own precise mandate, purposes and resources. These two levels are as follows: (i) the macro-territorial level of evaluation, which is aimed at defining the programming scenario for Trentino's territories (Valley communities); and (ii) the micro-territorial level of evaluation, which is aimed at defining town planning guidelines (municipalities).

The Tie process model defines five strategic themes of evaluation, outlined for the construction of territorial scenarios. These themes are as follows: (i) territorial retail supply, that describes quantitative and qualitative aspects of spatial retail dynamics; (ii) tourism, that describes the socioeconomic impact of tourism; (iii) urban settlement, that describes the land use of the areas; (iv) landscape, that describes the values and risks of landscape; and (v) local initiatives, that describe the Valley communities' planning ability. Subsequently, the five strategic themes have been specified by using 34 indicators at the micro-territorial level and 36 indicators at the macro-territorial level (see Table 1).

Table 1
Strategic themes and indicators

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| STRATEGIC THEMES | MACRO-TERRITORIAL LEVEL (Valley communities) | MICRO-TERRITORIAL LEVEL (Municipalities) |
|---|---|---|
| Territorial retail supply | **A.01M** Retail consistency<br>**A.02M** Number of retail personnel<br>**A.03M** Number of retail personnel variation<br>**A.04M** Retail consistency variation<br>**A.05M** Retail density<br>**A.06M** Retail integration<br>**A.07M** Retail typology<br>**A.08M** Retail specialisation<br>**A.09M** Retail choice index<br>**A.10M** Retail evasion index | **A.01m** Retail consistency<br>**A.02m** Retail realisation index<br>**A.03m** Retail typology<br>**A.04m** Retail specialisation |
| Tourism | **B.01M** Tourism intensity<br>**B.02M** Tourism intensity (winter)<br>**B.03M** Tourism intensity (summer)<br>**B.04M** Tourist number variation<br>**B.05M** Tourist accommodation<br>**B.06M** Number of tourism personnel<br>**B.07M** Number of tourism personnel variation<br>**B.08M** Cycle path use | **B.01m** Arrival<br>**B.02m** Tourist number |
| Urban settlement | **C.01M** Population variation<br>**C.02M** Urbanised areas incidence<br>**C.03M** Retail areas incidence<br>**C.04M** Rural areas incidence<br>**C.05M** Grazing areas incidence<br>**C.06M** Infrastructural density | **C.01m** Retail spatial configuration<br>**C.02m** Increase of urbanised areas index<br>**C.03m** Agricultural areas incidence<br>**C.04m** Reuse of disused area index<br>**C.05m** Retail areas incidence<br>**C.06m** Retail spatial distribution<br>**C.07m** Retail spatial diversification |
| Landscape | **D.01M** Protected areas incidence<br>**D.02M** Agricultural areas incidence<br>**D.03M** Heritage incidence<br>**D.04M** Visual diversity consistency<br>**D.05M** Hydrogeological risk incidence<br>**D.06M** Hydrogeological danger incidence<br>**D.07M** Pollution<br>**D.08M** Air quality<br>**D.09M** Increase of urbanised areas index<br>**D.10M** Land consumption index | **D.01m** Protected areas incidence<br>**D.02m** Heritage incidence |
| Local initiatives | **E.01M** District financial helps for retail<br>**E.02M** Consortium financial helps for retail | **E.01m** Old town centre identification<br>**E.02m** Old shops identification<br>**E.03m** District financial helps for retail<br>**E.04m** Consortium financial helps for retail<br>**E.05m** Reuse of disused area projects<br>**E.06m** Events |

Once the indicators have been identified and analysed, the Tie methodology uses the SWOT analysis to specify and develop, at the macro-level, the sub-regional policy framework guidelines and, at the micro-level, the strengths and weaknesses (or benefits and costs) of the dynamics already underway at the local municipality level. This allows for implementation of the dominant and prospective scenarios while paying particular attention to retail settlement (Figure 1).
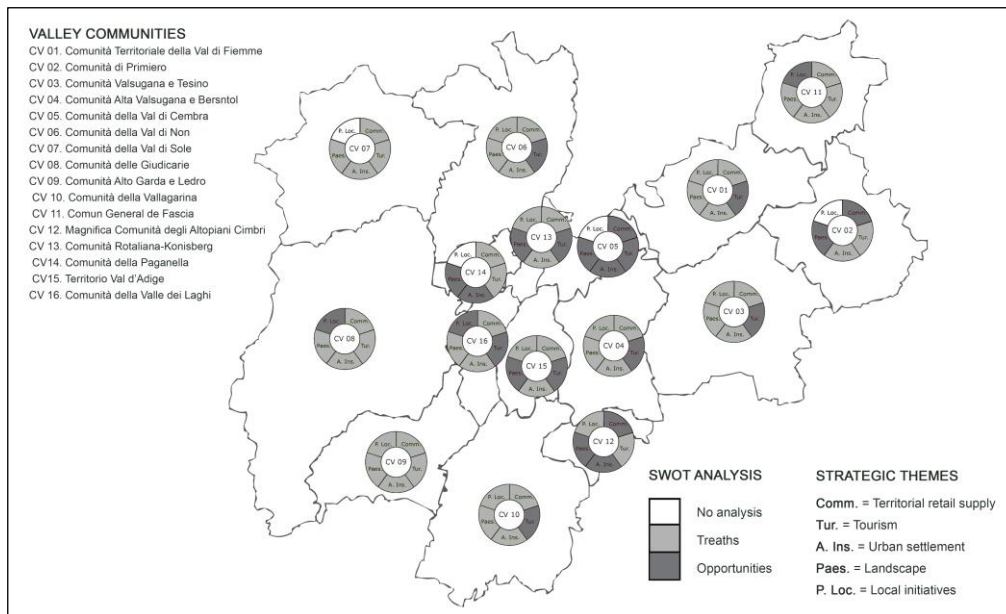
Figure 1. Opportunities and threats

The results have shown the different development scenarios in which retail – with the tourist industry and natural resources - plays a role which varies according to local revitalisation perspectives. Two scenarios – 'dominant' and 'prospective' – and key strategies, objectives and actions have been identified for each territorial context (micro and macro levels). In order to effectively implement the scenarios outlined by Tie, the research has identified a number of conditions and criteria that affect the territories in which the implementation of retail policies are related to the different scenarios.

## 3. Analytic Network Process support

The Tie methodology was reinforced and augmented using the Analytic Network Process (ANP) in order to model, cluster and begin evaluating possible spatial scenarios according to a 'what-if' framework. In the Tie procedure, the ANP method is developed at the micro-level (municipality level) comparing indicator priorities to the relative control criterion for a better definition of territorial scenarios (retail, marketing and cultural identity). In particular, the ANP method enables the most relevant indicators defining the territorial scenario to be selected. It represents an advanced version of the Analytic Hierarchy Process, theorised by Saaty (1980; 2008), which describes the interaction between elements belonging to heterogeneous clusters in a complex system.

The ANP allows interactions and feedback within and between clusters providing a process from which ratio scale priorities from elements can be derived (Saaty, 2005, 2013). This offers a more accurate and realistic representation for policy-making support (Bottero *et al*., 2008; Lombardi, 2007; Saaty and Vargas, 2006; Saaty and Ozdemir, 2008). Relations can be bidirectional (i.e. cause-effect) or mono-directional (i.e. simple influence without reciprocity).

The ANP exercise was supported by Super Decisions 1.6.0 Software[1], adopting a structured complex model (see Figures 2 and 3). The relationships between elements were identified by a focus group exercise organized in October of 2011 that involved

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[1] www.superdecisions.com

all the Politecnico research team members. Relation identification defined a sub-network for each control criteria previously set by SWOT analysis (see Section 2.1). A scenario and indicator priority was provided for each sub-network.

### 3.1. Application of the ANP model at the urban level: the Rovereto case study

Rovereto is a city of 38,244 inhabitants which is located in the Autonomous Province of Trento in the Vallagarina valley. The municipality is crossed by highway A22 and by state road SS12 fostering straightforward communications between Trento and the rest of the province. Accessibility is, therefore, one of the territory's main characteristics.

On the basis of prior spatial analysis (see Section 2), a decision-making model made up of a main and secondary network (or sub-network), was developed.
The methodological steps were as follows:

a.  **Structuring the decision-making model.** The aim is to choose the most appropriate scenario at the micro level (urban/municipality) in order to define local planning guidelines.

b.  **Setting up the main network.** The model is made up of a main network and a number of sub-networks. As outlined in Figure 2, the main network has been developed starting from a SWOT analysis where Strengths (i.e. Benefits) and Weaknesses (i.e. Costs) are conceived as control criteria for a complex network model. These criteria are weighted on the basis of two spatial *conditions*: *Accessibility* and *Spatial Integration*. This allows control criteria to be prioritized (or weighted) in relation to the strategic requirements previously identified by the Trentino District Plan.
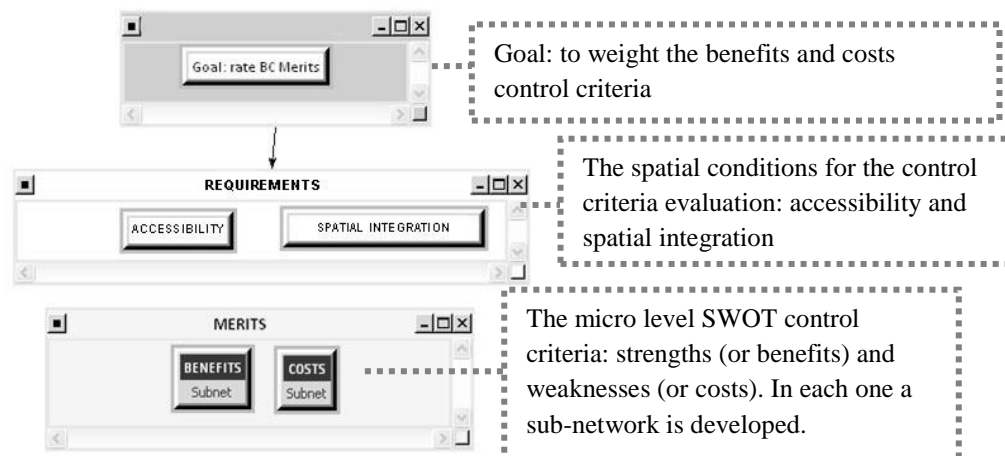


Figure 2. Main network at the spatial micro level

c.  **Defining the sub-network.** The development of the sub-networks requires identifying: (*i*) a cluster of alternatives (the three aforementioned territorial scenarios of retail, cultural identity and tourism); (ii) a variable number of indicators grouped in homogeneous clusters (in relation to the SWOT analysis) and filtered down using related control criteria; (*iii*) the relationships between the sub-network nodes leading to the relationships between clusters.
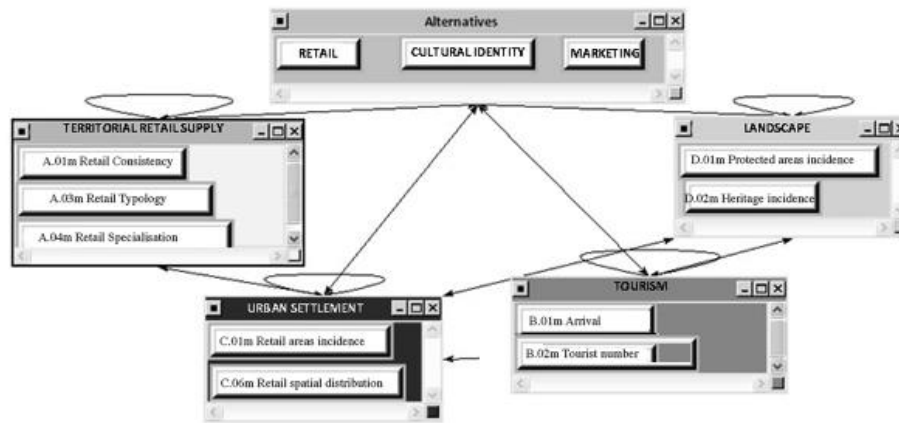
Figure 3. Costs sub-network

d. **Pairwise comparison questionnaires**. For each sub-network, using *Super Decisions* software, a number of pairwise comparisons were developed starting from the relations identified. The evaluation process required the participation of different stakeholders during a focus group. Each node (indicator) and cluster is compared to another referring to a specific goal which is another element of the network. Each network element could be a 'parent node' or a 'child node' in rotation.

A binary relation is established between two child nodes in relation to the parent node (or comparison criterion). The possible question could be: "How important is node A compared to node B considering C as a goal?". The evaluation process uses Saaty's Fundamental Scale (see Figure 4) to assess the priority of the elements. This is a nine-point scale in which 2, 4, 6 and 8 are used as intermediate values (compromise).

| Intensity of Importance | Definition | Explanation |
|---|---|---|
| 1 | Equal Importance | Two activities contribute equally to the objective |
| 2 | Weak or slight | |
| 3 | Moderate importance | Experience and judgement slightly favour one activity over another |
| 4 | Moderate plus | |
| 5 | Strong importance | Experience and judgement strongly favour one activity over another |
| 6 | Strong plus | |
| 7 | Very strong or demonstrated importance | An activity is favoured very strongly over another; its dominance demonstrated in practice |
| 8 | Very, very strong | |
| 9 | Extreme importance | The evidence favouring one activity over another is of the highest possible order of affirmation |

Figure 4. Saaty' fundamental scale (Saaty, 2008)

The vector of priorities is the principal eigenvector of the matrix as derived from a set of pairwise comparison matrices. This vector gives the relative priorities of the criteria measured on a ratio scale. If one ensures that they sum to one, they are then unique and belong to a scale of absolute numbers (Saaty, 2008).

e. **Defining priorities.** The expected results from the paired comparisons are an identification of:

- The importance (or weight) of the clusters (as Tie strategic themes) in relation to the relative control criterion;
- Indicator priorities (as actions) in relation to the relative control criterion;
- Alternatives or spatial scenarios sorted by priority (weight) at the sub-network level;
- The most relevant spatial scenario obtained through the following synthesis formula (Equation 1)

$$\$NormalNet(BENEFITS)*\$SmartAlt(BENEFITS)+\$NormalNet(COSTS)*\$SmartAlt(COSTS) \quad (1)$$

Where:
- $SmartAlt(node name) refers to the best alternative in relation to the current network;
- $NormalNet(node name) refers to the normalized value of the node in relation to the current network.

As recommended by Adams and Saaty (2003), influence was treated consistently - how the parent influences the children, or vice versa - but the flow direction was kept the same throughout the network and throughout the model. The Super Decisions software used for making comparisons and deriving priorities makes it possible to discover comparison coherence levels which are directly evaluated by the software. Finally, the overall priorities for the Rovereto municipality were derived (Table 2).

Table 2
Rovereto ANP overall priorities

| Subnet | Scenario | Actions | | Nor | Lim |
|---|---|---|---|---|---|
| CRITERIA | Accessibility = 0,75 | | Integration = 0,25 | | |
| WEIGHT | Benefits = 0,37 | | Costs = 0,63 | | |
| BENEFITS | RETAIL 0,53 MARKETING 0,27 IDENTITY 0,20 | A.01m | | 0,39 | 0,18 |
| | | B.01m | | 0,22 | 0,10 |
| | | E.06m | | 0,55 | 0,09 |
| | | A.06m | | 0,14 | 0,06 |
| | | A.02m | | 0,13 | 0,05 |
| COSTS | MARKETING 0,19 RETAIL 0,48 IDENTITY 0,33 | B.02m | | 0,90 | 0,25 |
| | | D.02m | | 1,00 | 0,23 |
| | | C.05m | | 0,77 | 0,09 |
| | | E.01m | | 0,22 | 0,03 |
| | | A.07m | | 0,09 | 0,02 |
| RESULT AGGREGATION | | RETAIL | +0,56 | | |
| | | MARKETING | +0,32 | | |
| | | IDENTITY | +0,12 | | |

Here, indicators are ordered starting from the most important ones, which are also the most interrelated, such as A.01m Retail consistency for the Benefit and B.02m Tourist number for the Cost. Furthermore, Table 2 shows the five indicators with the major priority in the model, both with regard to their weights on the clusters (see column 'Nor') and in regard to their weight on the whole model (see column 'Lim').

**3.2. Discussion of the results obtained**

In the costs sub-network, the *retail* scenario has relevant weight *(0.48)* because of the landscape value preservation and the efforts made in trade-tourism system integration investments. However, within the benefits sub-network, the *retail* scenario is more relevant *(0.53)* because of the high incidence of the indicators relating to the distributive structure of commercial supply (A.01m - A.06m). The *marketing (0.27)* and *cultural identity (0.20)* scenarios are definitely weaker in terms of benefits because in Rovereto tourism is characterized by a low stay length in relation to good historical-cultural supply/demand and good local planning (E.06m).

Analyzing the results aggregation, the *retail* scenario prevails (0.56), underlining local strength in terms of retail consistency, retail variety and retail specialization. The *marketing (0.32)* and *cultural identity (0.12)* scenarios assign high scenic and ecological value to the territories together with a necessary strategy of integration with cultural resources (i.e. the cultural pole of the MART museum) in order to increase not only tourist numbers but also length of stay.

Indicator prioritization supports Rovereto's commercial vocation. The retail demand indicator, indeed, overbears and its importance is equal to 0.18 of the average of the whole model values.

The impact of the spatial theme/analysis categories defined by the Tie (see Section 2) within the benefits sub-network is as follows:

  i.    Territorial retail supply, 47%
  ii.   Local initiatives, 21%
  iii.  Urban settlements, 14%
  iv.   Tourism, 13%
  v.    Landscape, 5%

The cost sub-network indicators highlight the unsuitability of tourist investments as compared to city characteristics. As a matter of fact, transforming Rovereto into a tourist destination does not appear the most suitable strategy. Promoting and incentivizing commercial diversification would be a better strategy for implementing development and business opportunities. Within this sub-network the most relevant (costly) spatial categories are *Tourism* (*40%*) and *Landscape* (*37%*); *Urban settlement* (*19%*), and *Local initiatives* (*4%*) have less affect than the other categories.

**3.3.  Testing the results using stakeholders participation**

A local workshop that involved a group of technical stakeholders of the Autonomous Province of Trento was organized in December 2011. The aim of this group was to test the Rovereto ANP model application and to compare the results obtained from the one developed by the Politecnico research team with a new one developed with the support of local actors.

The meeting was conducted as a focus group, and was composed of fifteen Province of Trento' technical stakeholders with Retail and Tourism management skills. Participants were asked to define priorities within the Rovereto ANP decision-making model by answering about 150 pairwise comparisons questions according to their knowledge of the case study. A comparison between the results obtained by the two ANP applications (the one developed by the Politecnico illustrated in Section 3.1 and the new one developed with the support of local stakeholders) denoted a net discord

both among the priorities of each sub network, and the synthesis priorities, as reported in Figure 5.
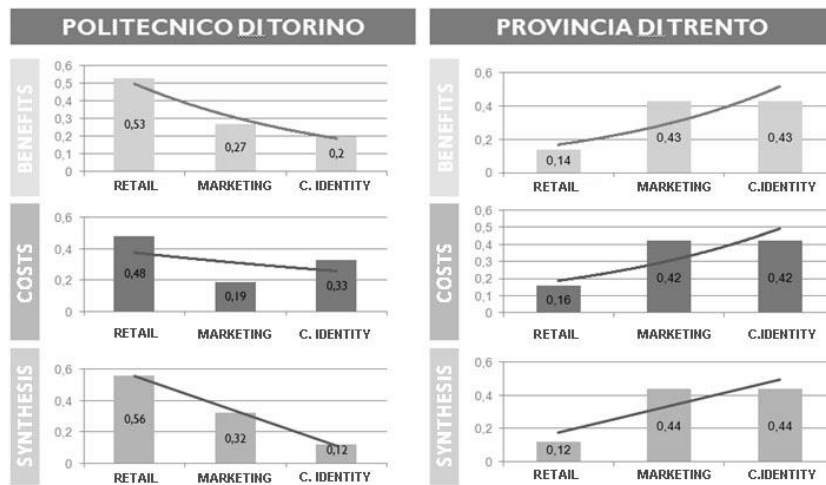


Figure 5. Comparison between the results obtained by the local actors focus group and those of the Politecnico research group.

The opposite trend highlighted in these results can be explained by the different approach adopted by the two groups in answering the pairwise comparisons. While the Politecnico research group used quantitative data for the calculation of each indicator, following an objective evaluation, the local stakeholders answered in a subjective way, without any guidance or support other than their own technical skills and local knowledge.

In the first application, the priority (0.56) attributed by the Politecnico group to the *commerce* scenario corresponds to the value of the retail demand for the municipality of Rovereto - 64% - and is considerably above the average of the other municipalities as shown in Figure 6.
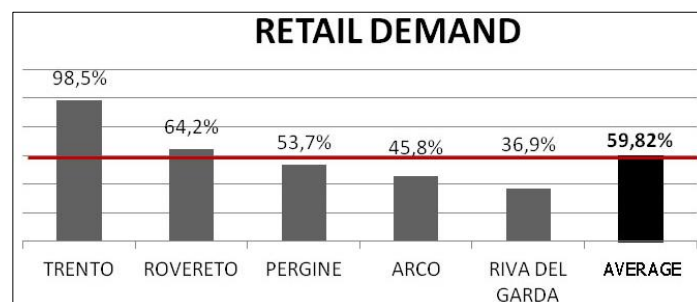


Figure 6. Territorial retail supply of the main municipalities of the PAT compared with the medium value.

The objectivity of these data does not allow us to further interpret how elements and spatial dynamics are perceived by local people and stakeholders or give us future trends and perspectives.

In the second application, retail implementation was perceived more as a problem than an opportunity. This is because of marked traffic congestion and parking issues that would worsen with further retail scenario development. Moreover, limited knowledge of Rovereto's territorial characteristics and spatial dynamics unbalanced

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the evaluation process in favour of landscape preservation (as stated in the regional plan of Vallagarina valley).

The only element of coherence and confirmation between the two evaluations was related to the tourist sector. In general, both groups viewed the 'arrivals' (B05) indicator positively and as beneficial to the local economy. Any attempt to lengthen tourist stay is perceived as an opportunity for both the municipality and the Vallagarina valley (Figure 7).
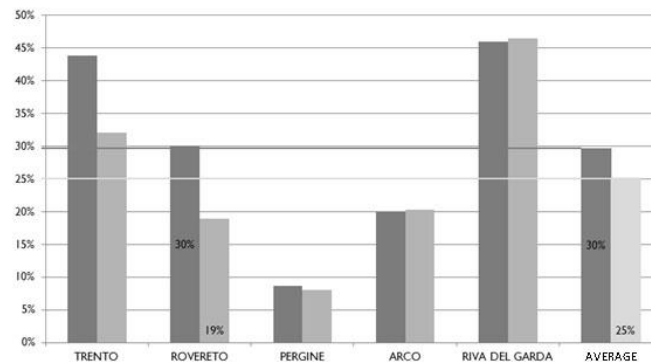


Figure 7. *Arrival* (dark grey*)* and *Tourist number* (light grey) compared to the medium value.

## 4. Conclusions

This paper illustrates an Analytical Network Process application in the field of Tie spatial planning and retail localization. Primarily, this Tie experimentation has provided the opportunity to discuss some general planning issues, as the link between theory and action in spatial planning. In this research this was realised through the scenario design of the sixteen Valley communities of the Trentino District. The spatial scenarios are not 'closed' visions, but are more similar to 'open routes' to territorial enhancement. These are linked to a set of shared criteria which act as the basis of the evaluation matrix as well as to a socially inclusive process of local planning action. Therefore, this study is relevant to the current debate on development considering the fundamental synergy between university and government institutions (Brandon and Lombardi, 2011; Lombardi *et al*., 2012). Finally, this paper has demonstrated the flexibility of the ANP approach in supporting different ways of reasoning and decision-making platforms in the field of land resource management. As already highlighted by the scientific literature (Saaty and Vargas, 2006; Lombardi, 2010; Ferretti, 2011), an application of ANP methodology can support:

- Strategy definition for land use planning and management increasing (i) territory value through land marketing policies and (ii) considering crucial requirements (such as, in the present case-study, accessibility, land availability, disused areas, and environmental constriction).
- Indicator priority definition for the integration and social and environmental sustainability of the design/planning proposals.

The test carried out on the municipality of Rovereto was useful as it allowed us to verify the solidity and internal coherence of the ANP decision-making model adopted in both the two applications. In addition, it confirmed the importance of involving

local stakeholders in multicriteria ANP evaluation related to public decision-making. Finally, it has been useful for highlighting the importance of the tourism issue in a strategy of local economy enhancement.

This ANP application has a further more crucial added value. It represents the first concrete successful attempt to include ANP modelling in a structured policy framework. From this perspective, it is relevant to highlight that the recent retail legislation of the Province of Trento (Law 1339/2013) has adopted a framework of criteria, strategies and actions for the design of retail policies based on this ANP model for supporting decision making in the Valley Communities institutional innovation process.

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