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Journal of
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This special issue collects a selection of peer-review papers presented at the 8th International Conference INPUT 2014 titled "Smart City: planning for energy, transportation and sustainability of urban systems", held on 4-6 June in Naples, Italy. The issue includes recent developments on the theme of relationship between innovation and city management and planning.

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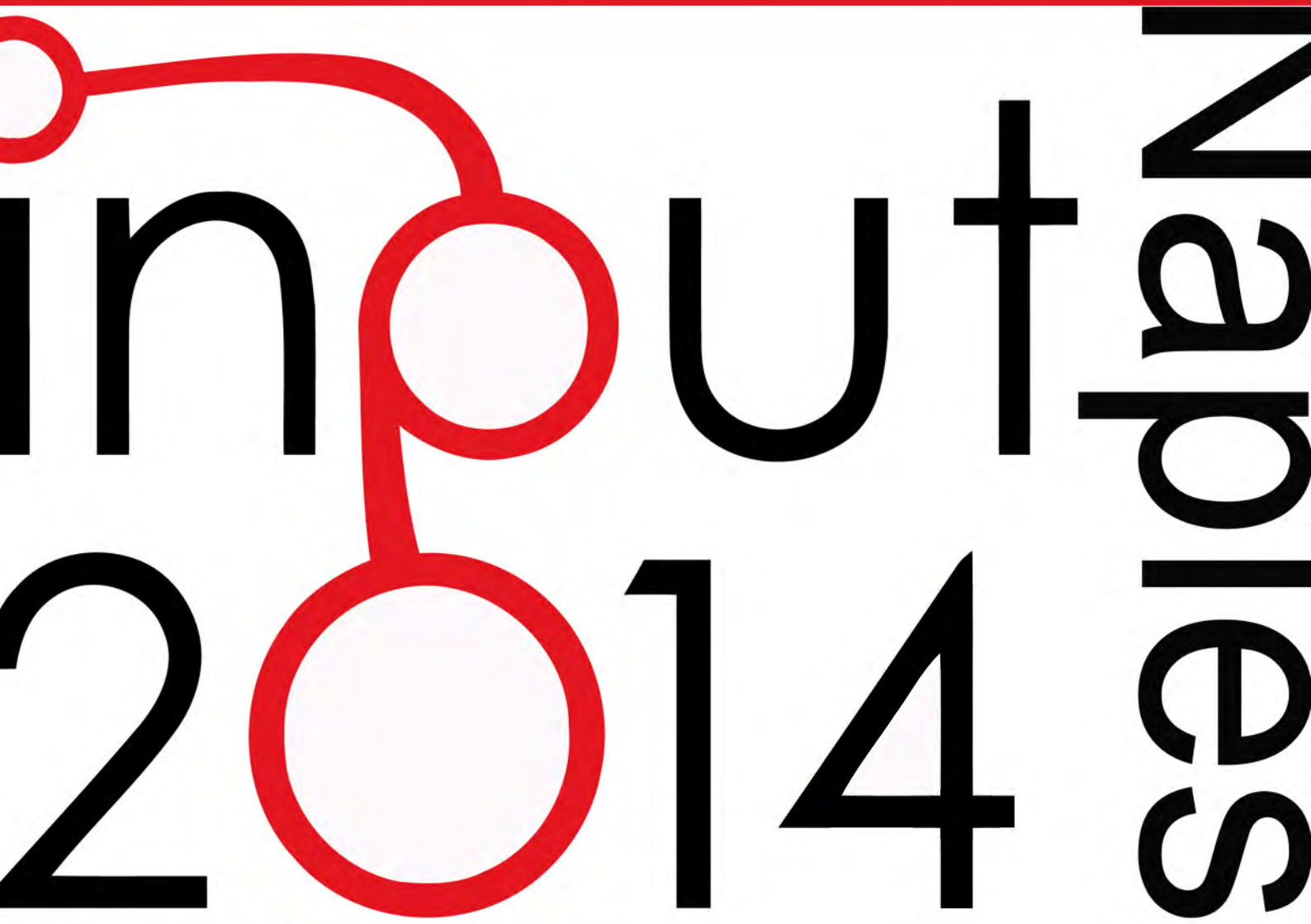

Smart City

planning for energy, transportation and sustainability of the urban system

Special issue, June 2014

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SMART CITY

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TeMA Journal of Land Use, Mobility and Environment

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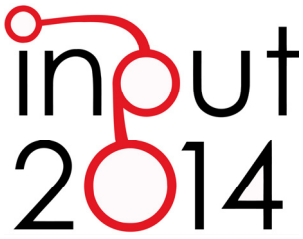
This special issue of TeMA collects the papers presented at the 8th International Conference INPUT 2014 which will take place in Naples from 4th to 6th June. The Conference focuses on one of the central topics within the urban studies debate and combines, in a new perspective, researches concerning the relationship between innovation and management of city changing.



TeMA Journal of Land Use, Mobility and Environment

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EIGHTH INTERNATIONAL CONFERENCE INPUT 2014

SMART CITY. PLANNING FOR ENERGY, TRANSPORTATION AND SUSTAINABILITY OF THE URBAN SYSTEM

This special issue of TeMA collects the papers presented at the Eighth International Conference INPUT, 2014, titled "Smart City. Planning for energy, transportation and sustainability of the urban system" that takes place in Naples from 4 to 6 of June 2014.

INPUT (Innovation in Urban Planning and Territorial) consists of an informal group/network of academic researchers Italians and foreigners working in several areas related to urban and territorial planning. Starting from the first conference, held in Venice in 1999, INPUT has represented an opportunity to reflect on the use of Information and Communication Technologies (ICTs) as key planning support tools. The theme of the eighth conference focuses on one of the most topical debate of urban studies that combines , in a new perspective, researches concerning the relationship between innovation (technological, methodological, of process etc..) and the management of the changes of the city. The Smart City is also currently the most investigated subject by TeMA that with this number is intended to provide a broad overview of the research activities currently in place in Italy and a number of European countries. Naples, with its tradition of studies in this particular research field, represents the best place to review progress on what is being done and try to identify some structural elements of a planning approach.

Furthermore the conference has represented the ideal space of mind comparison and ideas exchanging about a number of topics like: planning support systems, models to geo-design, qualitative cognitive models and formal ontologies, smart mobility and urban transport, Visualization and spatial perception in urban planning innovative processes for urban regeneration, smart city and smart citizen, the Smart Energy Master project, urban entropy and evaluation in urban planning, etc..

The conference INPUT Naples 2014 were sent 84 papers, through a computerized procedure using the website www.input2014.it . The papers were subjected to a series of monitoring and control operations. The first fundamental phase saw the submission of the papers to reviewers. To enable a blind procedure the papers have been checked in advance, in order to eliminate any reference to the authors. The review was carried out on a form set up by the local scientific committee. The review forms received were sent to the authors who have adapted the papers, in a more or less extensive way, on the base of the received comments. At this point (third stage), the new version of the paper was subjected to control for to standardize the content to the layout required for the publication within TeMA. In parallel, the Local Scientific Committee, along with the Editorial Board of the magazine, has provided to the technical operation on the site TeMA (insertion of data for the indexing and insertion of pdf version of the papers). In the light of the time's shortness and of the high number of contributions the Local Scientific Committee decided to publish the papers by applying some simplifies compared with the normal procedures used by TeMA. Specifically:

- Each paper was equipped with cover, TeMA Editorial Advisory Board, INPUT Scientific Committee, introductory page of INPUT 2014 and summary;
- Summary and sorting of the papers are in alphabetical order, based on the surname of the first author;
- Each paper is indexed with own DOI codex which can be found in the electronic version on TeMA website (www.tema.unina.it). The codex is not present on the pdf version of the papers.

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SPECIAL ISSUE

Eighth International Conference INPUT
Smart City - Planning for Energy, Transportation and Sustainability of the Urban System

Naples, 4-6 June 2014

ONTOLOGIES AND METHODS OF QUALITATIVE RESEARCH IN URBAN PLANNING

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ABSTRACT
Qualitative research can produce vast amounts of data and uses analytical categories to describe and explain social phenomena; several software packages are designed for qualitative data analysis and enable a complex organization of data. The study tests the capacity of new technology to build a formal ontology from qualitative data, in urban planning.

KEYWORDS
Formal ontology, Qualitative data, Urban planning.

1 INTRODUCTION

The last two decades have seen a notable growth in the use of qualitative methods to apply the planning rules because of the request in social fields to understand complex behaviors, needs and cultures.
From the 90s until now the concept of Planning Support System, PSS, has emerged in the scientific community. PSS studies the Information Technology and its impact on the urban planning referring to three main areas: the analytical methods and urban models to solve the complex problems at the base of the planning; the knowledge representation and the information management through the database to extrapolate specific information; the institutional aspects and the policy tools to improve the process of public participation (Rabino, Caglioni 2009a).
In this context qualitative data are a great amount. The qualitative data can be processed in many different ways (Rabino, Caglioni 2009b). The literature describes several tools that deal with the qualitative data as quantitative data to make it treatable, for instance the textual statics, the qualitative linear regression or the multi criteria analysis (HAMLET, TALTAC, LEXICO, ETC.). Also the visualization tools are suggested because they allow to represent the qualitative information using conceptual maps to show relationships between concepts graphically (IHMC Cmap Tools and its derivates). Besides these two types of instruments, recently have been proposed other software submitted as Qualitative Data Analysis Software, QDAS, for a more complex management of data using the procedures of archiving, coding and ex-ploration through queries (NVivo, ATLAS.ti, QDA Miner, Max QDA, Transana, etc.).
The aim of the paper is pointing out how this new type of technology seems to be actually tool to build formal ontology in terms of the conceptualization of the system. In fact QDA includes the two previous tools but increases the potential adding a social reflection about the data used, building formal ontologies of the qualitative objects, the PSS deals with.
In chapter 2 it is briefly illustrated the potential of the visualization, textual statistic and QDA. In chapter 3 are presented the ways in which QDAS create the formal ontology and how they include the other two previous tools. All this is put into practice in chapter 4 where, with reference to a specific case, it is shown how the ontological analysis enriches the results of textual analysis.

2 SHORT RECALL OF DIFFERENT METHODS FOR QUALITATIVE ANALYSIS

Qualitative data can be analyzed with different methods according to the specific case of work; below are exposed three of them.

- *Conceptual maps.* They are mainly graphic instruments composed by conceptual nodes (basic concepts) and logical links who connect them.

There are many software that create conceptual maps and allow the user to extrapolate, manually or using simple functions, the concepts by qualitative sources. Afterwards the user can create the conceptual map drawing the concepts and the link.
Conceptual maps are a strong method of visualization who can represent information and knowledge. The visualization of the issue is very useful because it clarifies the idea of the problem and allows a better understanding of the connection between the elements.
In addition, a conceptual map can be also used as a way of communication between different users, for example it could be adopted in a process of participation.

- *Text statistics.* They are quantitative instruments and use a statistic approach to explore the qualitative data. This method is used in text analysis and enable to find the frequency of the occurrences, the

presences of a word or a group of words, and the co-occurrences, the presences of two or more close occurrences.
The frequency can be expressed as the number of times that a word appears in the source and the number of occurrences can be chosen by user or automatically by a software.
To analyze the text's content, the user can individuate the most frequent occurrences and co-occurrences in order to know the principals topics used in the sources, their relation and connection between the text itself and other topics. Another way to explore the content is the use of technics of classification that categorize the objects of the text by their difference from an ideal-object, considered as the point of reference. There are different software that use the text search method; in addiction other algorithms or methods can be also used to analyze the data statistically, one of the most knew is the cluster analysis.

- *Qualitative Data Analyses.* These methods are directed to a complex management of qualitative data, using classification, coding and exploration procedures (Coppola, 2011).

The classification procedure is a manual operation that permit to define and build a database such as an empty meta-model that could be filled after. It is usually composed of this elements: sources classification that allows to define different types of documents and stores bibliographical information about them; folders classification which provides to identify folders with their own attributes where concepts can be recorded; links classification that simply defines the nature of the relationships between folders.
After this phase, the data are filed in this database through the coding procedure: every document is tagged as specific source with its bibliographical information and every concept found by user is tagged in one or more folders and for each of them the attributes are filled in.
In this way the tables of the database, that are not other than every type of source and every folder, are gradually completed, so it's possible to explore the whole set of data by queries. It's often possible to produce a graphic representation of these analyses through charts, graphs, tree maps or conceptual maps.

3 QDA AS FORMAL ONTOLOGIES

In the computer science community has emerged the formal ontology, another way for processing the data to analyze the structure of a given reality in formulating a rigorous and clear vocabulary.
The main aim of these approaches is the information definition of single concepts to disambiguate all the possible misunderstandings or doubts due to different translations or interpretations in the same context of analysis.
A formal ontology represents knowledge as a set of concepts within a specific domain, using a shared vocabulary to denote the types, properties and interrelationships of those concepts. In recent years, formal ontologies have been adopted as a way to share, reuse and process domain knowledge, so they are now central to many applications such as scientific knowledge portals, information management and integration systems, electronic commerce, and semantic web services.
Now there are many informatics languages to encode ontologies (e.g., UML, Cyc, OWL) and different software that implement sets of know-ledge-modeling structures and actions to support the creation and the manipulation of formal ontologies: in this field is situated NVivo, even if this role of this software is not clear to its producers and users, that consider it just a data handling tool. The main contribution of this paper is to reveal this role, as explained in the following of the chapter.
NVivo is a Qualitative Data Analysis (QDA) computer software package produced in 1997 by QSR International, a software developer based in Melbourne, Australia (Bazeley, Jackson 2013). NVivo provides a sophisticated workspace to easily organize, classify and analyze unstructured information. Specifically, in the

analysis of qualitative data NVivo helps the user to: manage the data organizing files from interviews, questionnaires and from other data formats such as audio files, videos, digital photos, Word, PDF and social media data; ask simple or complex questions of the data through different queries; show and display the concepts created and the relationships between them with a conceptual map or other visualization tools; report from the data.

Unlike quantitative software, NVivo doesn't have different types of model already incorporated as options but the researcher has to interpret the textual data and invent a model to explain the apparent relationships. In this way, the researcher's interpretations of the qualitative data are fundamental and irreplaceable.

An NVivo project is a single file that collects initial sources and nodes that are ideas or concepts linked to the data.

The nodes in NVivo enable you to extract some common themes from all the textual data stored in a specific project through the process called "coding": they can represent a specific idea/concept, a place where some interviewed live or are linked to, a single person, etc.

This process works in this way: the user catalogs the sources in nodes, each one is filled "tagging" the sentences or the words (information) from sources. The tag process not only copies the information in one or more nodes, but also connects them to their bibliographical information, the sources; it is evident that the node structure should be prepared in the researcher's mind already referring to the research questions. Accordingly, the user builds a database consisting of an empty matrix for each type of node and source and every typology has respective attributes that will be filled by the user.

This structure can be explored through different types of query, that can be based on the coding, text or attributes, and lets you examine the data using charts, models and other visualization techniques like tree map or cluster diagram to make sense of what is happening in the source materials.

It is clear, now, that NVivo includes the two main methods to analyze the qualitative data: textual statistics through queries and visualization tools through different techniques. About the textual statistics, it is possible to execute simple researches of words, sentences or concepts in all selected items, to find the most frequent words or sentences and to combine a textual research with a query based on the coding.

Regarding to the visualization tools, in NVivo there are specific functions that allow to create different diagrams to represent graphically the queries results, the similarity between concepts or directly the whole database structure like a conceptual map.

However the most important potentiality of this software is not an analysis method, but rather the previous process that try to define rigorously the treated system like a formal ontology. The codify in fact is first a conceptual process because it allows to define specific concepts whereby to provide a rigorous vocabulary that can be shared by the users. In addition, building the database, and so the tables of nodes, NVivo creates relationships between concepts through the attribute values in common.

It is evident, now, how NVivo is more complete than a simple textual statistic or visualization software because, if it is true that in NVivo the textual statistics and the visualization tools are not the main topic and have not an immense development, it is also true that a sufficient and basic smattering about them is present and that they are useful to support the user in the process of building of formal ontologies, searching hidden relationships between concepts.

4 CASE STUDY

The case study is an analysis made by Rabino and F. Scarlatti in 2006 (Rabino and Scarlatti 2006) about the "mental image" of a territory (namely Lecco and its province), obviously a highly qualitative and subjective

information. The aim of the study was the identification of the image of Lecco in people's mind. It was conducted proposing to some people with different features (age, gender, work, qualification and residence) one open questionnaire about the feelings that Lecco and its province arouse to them.

The chose method to analyze these interviews was the textual statistic, executed through Hamlet software, thanks to which it was possible to find the most frequent words and consequently to create a vocabulary of nineteen concepts: beauty, city, decay, highway, industries, lake, landscape, Milan, mountain, no_parking, Politecnico, pollution, problems, province, territory, The Betrothed (i.e. I promessi Sposi), traffic, tourism, work.

After a simple statistical analysis, the most frequent concepts in the questionnaires resulted mountain, lake, traffic and highway, instead the most recurrent co-occurrences were lake-mountain, lake-tourism, mountain-traffic and city-mountain.

Moreover, Hamlet allowed to apply the cluster analysis and the multidimensional scaling to the vocabulary, therefore it was deduced that the most related concepts were lake-mountain, traffic-pollution, traffic-lake, pollution-no_parking and traffic-no_parking.

It will be presented now the application of NVivo to this case study to compare and extend the Hamlet's results: it must be remembered that this analysis was realized on summaries of the questionnaires because they were no more available: it explains in part the little dissimilarities that will be found between the two studies.

First of all, the summaries of the questionnaires were loaded in NVivo and was created a node for each of them, composing the database to be queried: for every node it was defined the attributes gender, age, profession, instruction and residence of the interviewee.

Later were built nodes of occurrences submitted above and of the most frequent co-occurrences found in the analysis with Hamlet: lake- mountain, town – work, no_parking – traffic, pollution – traffic, lake – tourism, lake – Politechnic, town – mountain, pollution – lake, work – tourism, mountain – Politecnico, lake – traffic, lake – town , mountain – traffic, lake – highway,highway – traffic, mountain –highway, mountain – tourism, traffic – no parking.

In the occurrences research it was used the vocabulary implemented in Hamlet, in which the single concept was defined through its synonymies, instead for the co-occurrences were researched the two occurrences which were away maximum seven words between them.

If in the occurrences research the results are the same, in the co-occurrences one there are some differences probably due to the lack of the entire questionnaires and to the different implemented function for the textual statistic.

Accordingly, were analyzed the main concepts through cluster analysis to show the relations between them. In figure 1 is described the dendrogram of the occurrences showing the level of similarity of the different concepts: it proves the Hamlet's output, except for lake-traffic for which is not underlined the relation.

In the end it was interrogated the database through queries on the attributes values and the results were visualized with graphs. For example the figure 2 shows how the four most frequent co-occurrences are present in the questionnaires according to the values attribute provenience. It is clear that this software lets execute a more detailed and entire analysis regarding to the case study, providing a wider framework than a simple textual statistic.

The example of application exposed how implicitly NVivo, building nodes of occurrences and co-occurrences creates two formal ontologies; in fact, especially in the co-occurrences, the software forces the user to define rigorously what combination of words correspond to that co-occurrences. It is also clear now what is

the potentiality of the database that links different concepts and that the graphs and the textual statistics are tools to analyze better the system defined by the formal ontology.

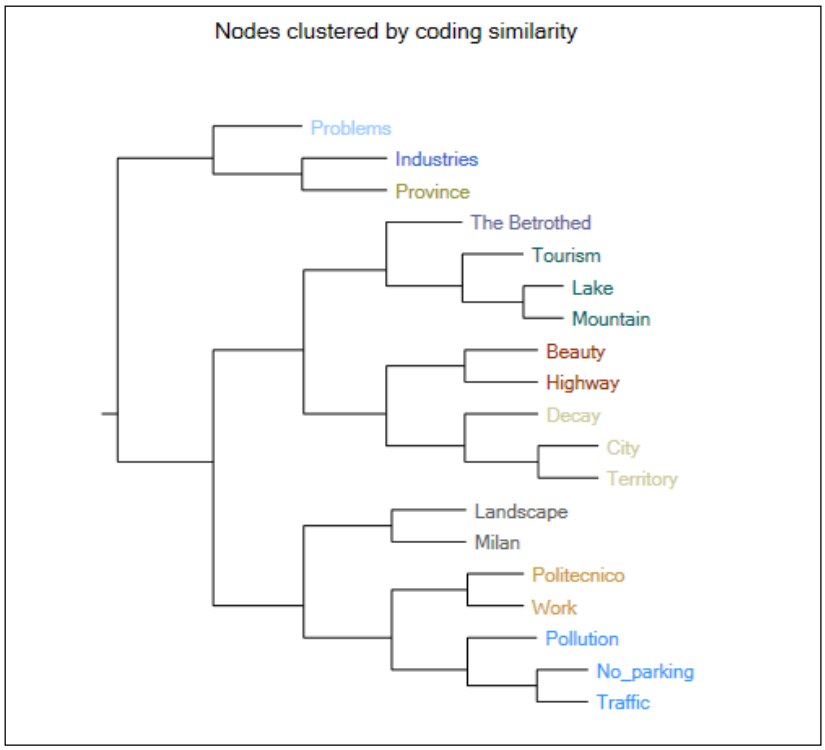

Fig. 1 The dendrogram of the occurrences

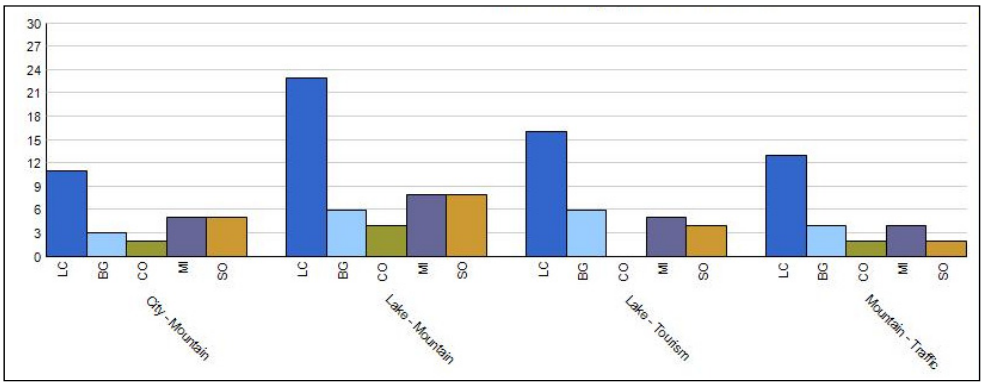

Fig. 2 Query that shows how the four most frequent co-occurrences are present in the questionnaires based on provenience

5 CONCLUSIONS AND FORESEEN DEVELOPMENTS

The discovery of intrinsically conceptualization implemented by QDA during the process of classification of data is of paramount importance. In fact, it allows to disambiguate doubts and different interpretations about concepts and to explore in great detail the information and their relationships, thanks to a comprehensive and structured storage of the material.

It would be useful making an entire application starting from the beginning, from the analysis of the sources. In this way it would be possible to confirm the thesis proposed in this paper, especially in a

decisional participative process where there are some non-quantifiable questions and problems (in environmental, urban, cultural field) that require to put together different points of view.

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IMAGES SOURCES

Fig. 1: Authors' image.

Fig. 2: Authors' image.

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He is professor of Urban Planning at the School of Architecture and Building Engineering of Polytechnic of Milan. He is an acknowledged expert in urban studies, especially applying system theories and methods. His main contributions concern operational urban models, evolutionary theory applied to geographical structures and, recently, web technologies supporting multi-agents planning.