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Proposal for a new COST Action on

"Urban Ontologies for an improved communication in urban civil engineering projects"

TOWNTOLOGY Project

A. Background

Guarino[1] defined an ontology as *"an engineering artefact, constituted by a specific vocabulary used to describe a certain reality, plus a set of explicit assumptions regarding the intended meaning of the vocabulary words.."* Ontologies are usually enshrined in computer programs. They determine what can be represented and what can be said about a given domain through the use of information techniques. Accordingly *"ontology designers have to make conscious and explicit choices of what they admit as referents in a particular system or language."*[2] The way to make these choices is an important subject of research given their practical implications over the long-term. In the context of Urban Civil Engineering, explication of the kind of entities that are to be admitted in a language is not an easy task as it will shape the communication between different systems.

Current ontologies for information systems are mostly static, emphasising objects with attributes and relationships over operations. They tend to minimise possible controversies about concepts, or ambiguities about their exact meaning. This may be because the roots of Geographical Information Systems are static, map-based models of the world and because of the emphasis in object-oriented methods on attributes and relationships rather than on operations. One of the greatest ironies of information technology is that once conceptual structures are represented in software systems they become remarkably difficult to change, despite the inherent volatility of electronic media. In part this is because software systems are complex and require sophisticated skills and expensive resources to maintain them.

On the positive side, prescription can bring useful stability, but on the negative side it either imposes outdated conceptual schemes on reluctant users, thus stifling innovation, or ensures obsolescence for information systems, which occurs when the discrepancies between what users want to say about a domain and what a system will allow them to say become too great. The history of computer applications offers many illustrations of this problem. The EC-funded COMBINE project[3], for example, tried to merge different definitions of building elements within a central data repository to support the informational needs of a range of computer applications designed to analyse the performance of buildings. Thus, different energy modelling programs would be able to access a single description of a building, the

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1 Guarino, N. (ed.) 1998: Formal Ontology in Information Systems, Amsterdam, Berlin, Oxford: IOS Press. Tokyo, Washington, DC: IOS Press (Frontiers in Artificial Intelligence and Applications).

2 Kuhn, W. 2001: Ontologies in Support of Activities in Geographic Space, *International Journal of Geographical Information Science*, 15(7): 613-631.

3 Augenbroe G. 1992: "Integrated Building Performance Evaluation in the Early Design Stages", *Building and Environment,* vol. 27, n°2, pp.149-161.

principal advantages being that users would only have to enter a building description once, and changes to a building design would always yield a consistent description, because there was only one. In practice, this proved impossible to achieve. Despite the fact that most of the computer programs were operating in the same general domain (energy modelling of buildings), the conceptual differences between them were too great to map with simple translations.

COMBINE sits within the ambitions of the STEP-AEC programme to provide comprehensive 'product models' of buildings, which can be instantiated by particular building designs, that will lead to greater interoperability between divergent computer systems in the construction industry. The lessons learned from the lack of success in this venture should inform the development of UCE ontologies.

The results of COMBINE suggest that a more dynamic approach is crucial, to support real innovation and local instantiation of the system. Any serious attempt to construct urban ontologies must accommodate the evolution of concepts among different actors. Yet it has to be recognized that any major urban civil engineering project also requires some stability to develop: stability of the terms of reference, applicable rules and expected results. This implies that an ontology could not be substantially revised until better definitions had been found to stabilize some of its components. The difficulties experienced in COMBINE and other similarly ambitious integration projects also reminds us that the problems faced are not purely technical, but reflect conceptual differences that have been shaped by social processes, within different cultural and social groups. This action will recognise the inherently sociotechincal character of ontologies in the methods it will use to understand meanings of concepts used by different groups. For instance, a street will be differently defined by different actors such as a cadastre officer, an engineering network responsible, a traffic officer. So, tools for managing urban ontologies will need to be capable of dealing with socially constructed meanings. Achieving this requires a close collaboration between different scientific fields and disciplines, including civil engineering, urban design and planning, spatial information techniques, artificial intelligence[4], sociology of science[5] and semiotics/language theory[6].

The extension of an ontology to other languages raises challenging questions as soon as one attempts to develop a multilingual index. The notion of “urban design” does not have any straightforward translation in French for instance. It is close to the notions of “projet urbain” and “composition urbaine” without being synonymous with any of these terms. The “projet urbain” (urban project) is indeed usually considered as a socio-political construct. Its definition rather insists on the public nature of the urban realm while the “composition urbaine” (urban composition) tends to be more heavily focused on the formal and geometrical properties of the space, in terms of vistas, alignments etc. As a consequence, we only can

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4 Gandon F. (2002), *"Distributed Artificial Intelligence And Knowledge Management: Ontologies And Multi-Agent Systems For A Corporate Semantic Web "*, scientific philosopher doctorate thesis in informatics INRIA and University of Nice - Sophia Antipolis — Doctoral School of Sciences and Technologies of Information and Communication (S.T.I.C.), 7/11/2002, 486 pages. Guarino N. and Welty C. (2000), *“Towards a methodology for ontology-based model engineering”*. In Proceedings of ECOOP-2000 Workshop on Model Engineering. Cannes, France

5 Kassel G., Abel M.-H., Barry C., Boulitreau P., Irastorza C., Perpette S. (2000), *“Construction et exploitation d'une ontologie pour la gestion des connaissances d'une équipe de recherche”*, Proceedings of IC'2000, Toulouse, 10-12 Mai 2000, available at http://www.irit.fr/IC2000/actes-enligne.html

6 Sowa J. (1995), *"Top-Level Ontological Categories"*, In *International Journal on Human-Computer Studies*, 1995, Vol. 43, N° 5/6, pp. 669-685.

assume the similarity of low level concepts, whereas we need to reorganise everything at top level through agreed high-level classes and proper hierarchical relationships.

Still the establishment of a multilingual ontology can not correspond to the juxtaposition of N monolingual ontologies. It relies on the construction of a common instrument where all languages have equal status. Accordingly it is necessary to establish as many relationships as possible between the different languages, while, at the same time, respecting the specificities off each culture (in the domain of legal systems for instance). The EuroWordNet project consisted of a multilingual database combining 8 different European languages[7]. An Inter-Lingual Index (ILI) was developed, based on prior experience of WordNet 1.5, which was further refined to accommodate supplementary sense-differentiations.

Experience gained from previous attempts to build a multi-lingual UCE glossaries[8] informs us of the necessity to adopt a strict methodology during the work. Existing ISO 2788 (Guidelines for establishment and development of monolingual thesauri) and ISO 5964 standard (Guidelines for establishment and development of multilingual thesauri) standards may be considered to frame the collaboration between partners.

B. Objectives and benefits of the proposed COST action

B.1 Objectives

The main objective of the Action is to increase the knowledge and promote the use of ontologies in the domain of Urban Civil Engineering projects, in the view of facilitating the communications between information systems, stakeholders and UCE specialists at a European level (Groupware).

Secondary objectives of the Action are:

- producing a taxonomy of ontologies in the UCE field, contrasting existing design methodologies, techniques, glossaries and production standards ;
- developing an urban civil engineering ontology both in textual and visual (graph) presentation and a visual editor to integrate and update concepts, definition, photos, etc. into the ontology (software tool) ;
- developing a set of guidelines for the construction of multi-lingual UCE ontologies, based on practical examples (cases) ;
- analysing the role of ontologies as a tool to foster an improved communication between UCE stakeholders.

B.2 Benefits

For the scientific community: The integration of information available in the UCE field is increasingly perceived as an important challenge by the scientific community. It is presently hindered by a number of difficulties. Ontologies are precisely a technical solution that facilitates communication between computer systems while guaranteeing their maximal flexibility over time. It has still to be tested in the specific domain of UCE, where language

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[7] Vossen, P., Peters, W. and Gonzalo, J. 1999: Towards a Universal Index of Meaning. In *Proceedings of the ACL-99 Siglex workshop*, University of Maryland.

[8] Dupagne, A., Long, A.E., Lahti P., Dunleavy, S.F., Hofman, F. 1996: *Glossaire-GCU, activité continue du Comité Technique COST-GCU*, Available from the authors, Liege.

and cultural barriers keep very important (due to legal discrepancies) as well as conflicts of interest between different stakeholders.

For municipal authorities and especially their information services: The results that are expected from this COST Action will be directed to cover the needs of municipalities, and their information services and consultants, key potential users of UCE ontologies. The objective is to facilitate the integration of data available at the local level and to allow easier connections with existing data from external sources (regional or statistical data).

For UCE industry and especially project managers: The results are intended to facilitate cross-national team building and collaborations by providing clearer definitions of concepts, relevant to most large infrastructure projects as well as by facilitating the exchange of information between different UCE expertise fields.

For other stakeholders: Analysis of the social and cultural implications of the definition of the meaning of controversial terms and concepts should lead to a better consideration of local specificities and possible divergence between stakeholder worldviews, while an improved transparency in the definition of technical terms presently in use in the UCE domain may facilitate the communication between technical and non-technical actors.

C. Scientific programme

To achieve the objectives established, the scientific programme starts with a review of the state-of-the-art that provides a basis for discussion, proceeds with brain-storming sessions directed to the three sub-objectives defined, and concludes with the elaboration of a report with the synthesis and recommendations, accompanied by various dissemination activities.

It is important to mention that at INSA-Lyon, during the academic year 2002-2003, a preliminary study was carried out by students in urban planning and computer science: only on street planning in French language, more than 800 concepts were identified and organised. This preliminary study will be considered as a feasibility experimentation for the proposed COST project.

The structure of the scientific programme includes:

1. ***State-of-the-art review:*** Current state-of-the-art and the COST members' know how on ontology building and glossaries in the domain of urban civil engineering projects (e.g. COMBINE project or previous experiences with UCE glossaries). This tasks includes the analysis and review of relevant glossaries (urban planning, architectural and technical dictionaries, and web based international thesauri developed in related expertise fields like, for instance, HEREIN[9]).
   The state-of-the art will review the applicability and relevance of existing production and industrial standards, like IFC/product model based standard or the results of the Finnish VERA research programme (http://cic.vtt.fi/vera/english.htm).
   This task will include the different way of storing ontologies, for instance by studying XML extensions devoted to ontologies, and editing them (especially giving emphasis to visual editors on ontologies).

[9] http://www.european-heritage.net/sdx/herein/thesaurus/introduction.xsp

2. ***Definition of main research needs on UCE ontologies:*** Definition of main research needs regarding UCE ontologies, based on the current state-of-the-art within these sectors of activity and on the COST members' know-how.

3. ***Methodologies for developing UCE ontologies***: Establishment of a working group (WG1) dedicated to the analysis of available ontology builders (KIF, IFF, Ontolingua, Loom, OIL etc.) and approaches (semantic networks, ontologies, topic maps[10]). The applicability of these techniques and approaches to the UCE domain is tested so as to provide guidance about their use. A very important methodological question we have to face is our to combine top-down (from high level concepts to urban objects) or bottom-up (from urban objects to high level concepts) approaches, since both can be used.

4. ***Construction of multi-lingual UCE ontologies:*** A second working group (WG2) is dedicated to the definition and comparison of some key urban processes, objects and actions throughout Europe, possibly based on a specific field of UCE and cross-national analysis of some common case studies. This task will build upon and develop the glossary of urban, regional and environmental planning terms established in 2004 by Calderon and Ventura.

5. ***Impact of ontologies upon communication between UCE actors***: A third working group (WG3) will concentrate on the social and cultural implications of using ontologies in the UCE context, in the view of developing a guidance for their best implementation in real-life contexts and their improved acceptance by different stakeholders.

6. ***Synthesis of the contributions***: Synthesis of the contributions collected from the three working groups and final definition of research priorities in the framework of the European Union.

7. ***Reporting, publication and dissemination***: Reporting, publication and dissemination of the results inside and outside Europe in order to promote future R&D activities that allow development of ideas arising from this COST Action.

This Action is expected to provide guidance about the use of ontologies in Urban Civil Engineering domains. Information gathered during the work will be synthesised in a report, disseminated via Internet.

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[10] Three modelling approaches are possible, semantic networks, ontologies and topic maps.

- **Semantic networks**: created by Sowa (1991), they allow the representation of reality by mean of a graph, in which the nodes are the entities (instances) of the real world, and the edges the relation between two nodes.
- **Ontologies**: essentially originated by Gruber (1993), they allow the representation of concepts; in other words, an ontology is a specification of a conceptualization; generally this representation is textual, and some XML extensions were proposed for storing ontologies.
- **Topic maps**: this tool allow the representation of both concepts and instances about the real world. See http://www.topicmaps.org/xtm/1.0/ for details.

In our case, ontologies will be used in order to clarify and organize concepts. But when we want to describe an existing cities (for instance Liverpool) with all objets/instances belonging to this city, topic maps will be an interesting tools. But none has the possibility to integrate the photo of an object, or a drawing explaining something.

D. Organisation

- Three working groups will be established:
  - WG 1 - Methodologies for developing UCE ontologies
  - WG 2 - Construction of multi-lingual UCE ontologies
  - WG 3 - Impact of ontologies upon organisational structures

The first two tasks (state-of-the art and definition of the requirements) as well as the last two ones (synthesis of the contributions and final reporting) are jointly organised by the three working groups and will be discussed during plenary meetings.

A website for the Action will be set up by the participants and will be maintained through the Action period. The website will be used for communication within the Action (e-mail discussion groups), to convey its aims and objectives to the scientific community and for disseminating its results.

This COST Action will actively trace and interact with related national and international research programmes, through exchange of information, meetings, joint seminars or any other means.

E. Time table

The timetable of the Action is presented in Figure 2. The Action is planned to last for **4 years**. The Final Report of the Action should be available at month 48 from kick-off.

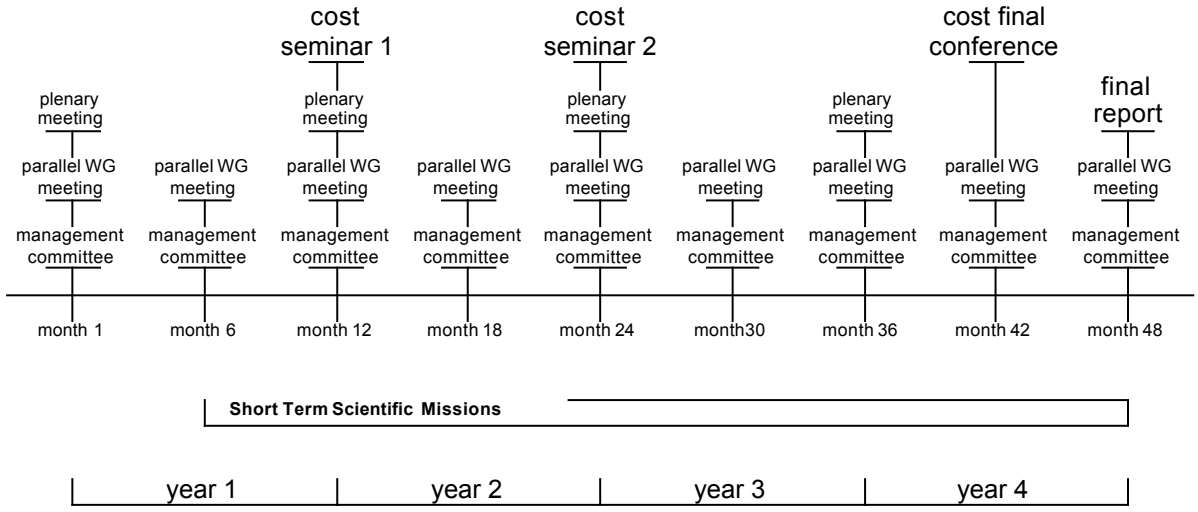

Figure 1. General timetable for the Action

Progress will be strongly linked to the main activity, which will be meetings and seminars. Figure 1 gives an overview of planned meetings and the topics to be handled. The kick-off plenary meeting would be held in Brussels and each of the following meetings in a different host country.

Several dissemination workshops/conferences are planned within the Action.

The first seminar is organised 12 months after the start of the project. It will consist of a brainstorming session aiming to feed with new ideas and guide the work of the whole Action, with particular emphasis on WG 1. The second seminar is organised 24 months after the start of the project. It will be aimed at evaluating the progress of the working groups and at focusing on common objectives for the remaining years. It second will have a special focus on the activities of WG2.

A conference open to the wider community will take place during the last year of the Action. Its purpose will be to publish the findings of the Action and to present these to local authorities, experts, city managers and teaching and training institutions. It is organised 42 months after the start of the project, 6 months before its completion.

Reports will be available from each seminar by the partners responsible for the meeting, and from the kick-off and final conferences, in co-ordination with the European Commission.

F. Economic dimension

On the basis of national estimates provided by the representatives of these countries, the economic dimension of the activities to be carried out under the Action has been estimated, in 2004 prices, at roughly Euro 4 million.

This estimate is valid under the assumption that all the countries mentioned above but no other countries will participate in the Action. Any departure from this will change the total cost accordingly.

The following COST countries have actively participated in the preparation of the Action or otherwise indicated their interest:

- Belgium (primary subscriber)
- France
- Italy
- Portugal
- Spain
- United Kingdom
- Sweden
- Switzerland

G. Dissemination plan

The target audience of this COST Action will be city managers of infrastructure (water supply, wastewater and solid waste, urban planners, traffic engineers, etc.), national regulatory bodies, research institutes, industry (represented by manufacturers and service providers), European-level policy makers, Government policy makers, regional planners and the general public.

Dissemination from this COST Action will be conducted by different means:

- posting of general information on a public Web-site;
- posting of working documents on a password-protected website;
- establishment of an e-mail network;
- publications: state-of-the-art reports, interim reports, case study reports, proceedings, guidelines, manuals, final reports;

- events: workshops, seminars and conferences organised by the MC, contributions to other national and international conferences and symposia;
- articles in scientific and technical journals;
- non-technical publications.

Deliverables will be:

- an ontology (even not exhaustive) in both in textual and visual (graph) presentation;
- a software tool, a visual editor in order to integrate and update concepts, definition, photos, etc. into the ontology.

H. Area of excellence of the participants

The participants have a network in their countries as well as internationally in their domain of expertise. As the proposed COST action address a European-wide ontology, international interdisciplinary co-operation will contribute to the whole network. A provisory list of likely participants to the network is provided hereafter.

	Organisation name and laboratory		**Key Persons**	**Area of excellence / Role in the consortium**
1	LEMA University of Liege	BE	Albert Dupagne Jacques Teller Véronica Cremasco	built heritage impact assessment EIA & SEA procedures urban governance benchmarking methods urban quality of life
2	LIRIS Institut National des Sciences Appliquées de Lyon	FR	Robert Laurini Catherine Roussey	Geographical Information Systems Urban ontologies Visual systems
3	ETSI Caminos University of Madrid	SP	Enrique Calderón	Urban and regional planning Urban Civil Engineering Urban sustainability indicators
4	University of Belfast, School of Architecture (QUB-ARCH)	UK	Chris Tweed, M. Sutherland	architecture and planning human environment interaction tool design for local authorities participation methods
5	EDU Institut National des Sciences Appliquées de Lyon	FR	Monique Zimmermann	Urban planning and design Urban sociology Social and political sciences Participation and negotiation
6	CIEC University of Coimbra	PT	António Antunes	Geotechnical Engineering, Road Management, Traffic Engineering, Transport Planning and Policy, Public Facility Planning, Urban Renewal
7	DUPT Università degli Studi di Firenze	IT	Paolo Ventura Carlo Carbone Pietro Giorgieri Scilla Cuccaro Damianos Damianakos Samuela Ristori	Regional planning Town planning and infrastructure project Urban safety management and traffic calming measures Historical town planning Urban maintenances Urban ontologies
8	Geocomputation Laboratory (Milano)	IT	Giovanni Rabino Francesco Scarlatti	Territorial Information Systems Modelling of land-use evolution Analysis of urban sprawl Spatial Ontologies Categorization of geographical objects
9	LISUT Basilicata University	IT	Giuseppe Las Casas Benjamino Murgante	Urban and environmental planning Methodologies Urban systems
10	Technical University of Tampere	SW	Anssi Joutsiniemi	Urban design and planning Configurational studies

11	LaSIG Ecole Polytechnique Fédérale de Lausanne	CH	François Golay	Geographical Information Systems Application of GIS to participatory design Human and organisational factors of GIS
12	University of Glagow	UK	Rolland Billen	3D urban GIS and 3D cadastre Spatial ontologies Augmented reality
13	University of Edinburgh	UK	John Lee	Language modelling Formal semantics Computational linguistics

LEMA is a research group attached to the Department of Architecture and Urban Configuration Studies at the University of Liège. It benefits from special capabilities in urban project management methodology and decision-making process applications. Its present involvement (since 1993) in practical urban historic-city-centre requalification projects (at several development stages) gives the group members a broader view of the whole process and a more accurate perception of actual urban decision makers' needs. Albert Dupagne participated in and led the COST UCE Action C4. LEMA is the coordinator of the **SUIT** FP5 RTD project, dedicated to the Sustainable development of Urban historical areas through active Integration within Towns. It also participates in the **PETUS** (Practical Evaluation Tools for Urban Sustainability) FP5 RTD project.

LIRIS (Lyon Research Center for Images and Information Systems) is a new laboratory created on January 1, 2003 from three existing computing laboratories in Lyon (LISI, LIGIM and FRV) and shared by CNRS, Claude Bernard University of Lyon (Lyon 1), Lumiere University of Lyon (Lyon II), and the Lyon National Institute for Applied Sciences (INSA-Lyon). Now it regroups around 150 researchers. Previously led by Prof. Robert Laurini, under the name of LISI, various research activities were made in GIS (spatial indexing, quality control, spatial reasoning, distributed GIS, etc.), and in visual systems. Now LIRIS carries out research in real time GIS, interoperability, urban ontologies, databases for continuous phenomena, etc.); see http://lisi.insa-lyon.fr/~laurini for more details. LISI was a member of the COST UCE action C4 project, and has organised a workshop on Groupware for Urban Planning in February 1998.

ETSI Caminos – University of Madrid. The Departamento de Ordenación del Territorio, Urbanismo y Medio Ambiente makes part of the Escuela Técnica Superior de Ingenieros de Caminos of the Universidad politécnica de Madrid. Its main responsibilities are teaching and research in the fields its name suggests, namely urban, regional and environmental planning and development. In these fields the Department is active undertaking research work with national and international administrations, and the private initiative. Regarding the European Union, the Department regularly cooperates with DG Regio, DG Environment and DG Research and also with the Dublin-based European Foundation for the Improvement of Living and Working conditions.

QUB. The School of Architecture at the Queen's University of Belfast (QUB) has developed expertise in the application of information and communications technologies (ICTs) to the built environment, particularly in CAD representation, decision support and argumentation capture, visualization, and virtual reality. Chris Tweed has represented the UK in two COST UCE Actions (C4 and C8), and has been involved in ESPRIT (ACORD P393), JOULE (COMBINE), and FP5 (SUIT, WINDS) projects, as well as nationally funded research in CAD and environmental modelling. Dr Tweed previously developed the MOLE system at

EdCAAD which pioneered object-oriented and logic modelling representations for buildings. Current research on dynamic urban information systems is being funded through the Virtual Engineering Centre at QUB, with a particular emphasis on mobile computing applications and dynamic building recognition.

EDU. The research laboratory « Equipe Développement Urbain » EDU is focussing on technical and spatial urban patterns, and especially objects, systems and public services) which are composing the city. In contemporary societies most design and construction actions do not include the participation of users. The gap between those who produce and those who use urban spaces leads to the problem of acceptation of urban design objects by citizens and especially the relationship between the technical design objects and the value of social use of those objects. The values of users, their practices and their expertise must be implemented in the design of technical and spatial patterns. The issues of this process kind of relation constitute the main research question of the EDU lab, i.e. how can technical design object achieve their special value of usage. Since several years the EDU lab is working on a new language for town planning for a better understanding of issues, problems and relations between different users and producers of urban spaces. Facing these topics, EDU will participate at the on going research project.

CIEC (Centro de Investigação em Engenharia Civil / Civil Engineering Research Center) is a research centre founded in 1992 by members of the Civil Engineering Department of the University of Coimbra. The main study areas covered by CIEC are Geotechnical Engineering, Road Management, Traffic Engineering, Transport Planning and Policy, Public Facility Planning, and Urban Renewal. The staff of the center comprises 30 researchers, of which 10 hold a PhD and the remaining 20 hold a MSc. CIEC is or was involved in four FP4 and FP5 RTD projects (HINT, MOMENTUM, MUSIC, and PORTAL) and three COST Actions (COST C7, C8, C15).

DUPT (Dipartimento di Urbanistica e Pianificazione del Territorio), which consists of about seventy teachers and researchers, makes part of the School of Architecture at the University of Florence. The action research group, which, coordinated by Paolo Ventura, consists of four teachers and two young researchers, is active in the following fields of research: regional planning (area-wide and environmental planning); town planning and urban outdoor design (particularly referred to roadway infrastructure and public or private services); theoretical models of new town and urban areas; town planning and Urban maintenances as a strategy of sustainability development; historical-city-centre planning. The team is currently involved in a national research, carried on by three different universities (Rome Engineering School, Rome Architecture School, Firenze Univ. School) about town design and traffic calming measures, and an international research about a town planning glossary (with ETSI Caminos).

Geocomputation Laboratory is the laboratory for geo-computation of the Department DiAP (Milan) devoted to connecting planning and policies issues and geographical data base management (GIS) with technological tools (Models, Statistical Methods, Communication and Visualization tools). Different researches are in progress. Giovanni Rabino and Lidia Diappi are the scientific responsibles.

LISUT (Laboratory for Urban Systems Engineering) belong to the Urban Planning Department of the Basilicata University. Its aims it to study urban and environmental systems giving special attention to methodologies. Led by Prof. Giuseppe Las Casas, LISUT will be in charge on urban risk management, and disaster preparedness in cities.

TUT. Anssi Joutsiniemi is working as a senior lecturer in the Department of Architecture, Institute of Urban Planning and Design of the Technical University of Tampere. His educational background is in architecture (M.Arch) and he is just about to finish his dissertation on configurational properties on urban street networks.

LaSIG (Laboratoire de Systèmes d'Information Géographique) is a laboratory of the EPFL (Ecole Polytechnique Fédérale de Lausanne), specialised in the development and application of Geographical Information Systems in municipalities and organisations. It has a long experience in analysis, design and operation of GIS through participatory approaches. François Golay is the directeur of LaSIG.

UniGlasgow. The Geomatics Research Group of the University of Glasgow is part of the Department of Geography and Geomatics, which has been founded in 1909 and is one of the ten largest departments in its field in Britain today. Initially more focussed on data acquisition techniques (photogrammetry, surveying), the group is currently active in 3D urban GIS, 3D spatial data structure, spatial ontologies and Augmented Reality. It has developed international collaborations in these fields, notably with the GIS technology group of TU Delft (3D urban GIS and 3D cadastre) and with the department of Electrical Engineering of the University of L'Aquila (Spatial relationships – spatial ontologies).

HCRC (the Human Communication Research Centre) at the University of Edinburgh is a leading centre for the study of communication from a cognitive point of view. Its 40 or so researchers have wide expertise in language, language modelling, formal semantics, psycholinguistics, computational linguistics and language technology. John Lee is deputy director of HCRC, on secondment from the Department of Architecture, where he has for many years researched on communication in design contexts, and in learning. A particular focus is the relations between language and other modalities (especailly drawing). He has been involved in many collaborative projects with national, European and US partners.

	Organisation name and laboratory		Key Persons	Email address
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