



**European Cooperation
in Science and Technology
- COST -**

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Secretariat

COST 4134/12

MEMORANDUM OF UNDERSTANDING

Subject : Memorandum of Understanding for the implementation of a European Concerted Research Action designated as COST Action IC1203: European Network Exploring Research into Geospatial Information Crowdsourcing: software and methodologies for harnessing geographic information from the crowd (ENERGIC)

Delegations will find attached the Memorandum of Understanding for COST Action as approved by the COST Committee of Senior Officials (CSO) at its 185th meeting on 6 June 2012.

MEMORANDUM OF UNDERSTANDING
For the implementation of a European Concerted Research Action designated as

COST Action IC1203
(EUROPEAN NETWORK EXPLORING RESEARCH INTO GEOSPATIAL
INFORMATION CROWDSOURCING: SOFTWARE AND METHODOLOGIES FOR
HARNESSING GEOGRAPHIC INFORMATION FROM THE CROWD (ENERGIC)

The Parties to this Memorandum of Understanding, declaring their common intention to participate in the concerted Action referred to above and described in the technical Annex to the Memorandum, have reached the following understanding:

1. The Action will be carried out in accordance with the provisions of document COST 4154/11 “Rules and Procedures for Implementing COST Actions”, or in any new document amending or replacing it, the contents of which the Parties are fully aware of.
2. The main objectives of the Action are: develop data mining software and methodologies to exploit a wide range of volunteered geographic information (VGI); define quality assessment criteria; establish an open and updatable repository of VGI analysis, integration tools, methods and case studies; develop VGI methods for understanding the local aspects of VGI datasets and their use.
3. The economic dimension of the activities carried out under the Action has been estimated, on the basis of information available during the planning of the Action, at EUR 56 million in 2012 prices.
4. The Memorandum of Understanding will take effect on being accepted by at least five Parties.
5. The Memorandum of Understanding will remain in force for a period of 4 years, calculated from the date of the first meeting of the Management Committee, unless the duration of the Action is modified according to the provisions of Chapter V of the document referred to in Point 1 above.

A. ABSTRACT AND KEYWORDS

New and unprecedented sources of geographic information have recently become available in the form of user-generated Web content. The integration and application of these sources, often termed volunteered geographic information (VGI), offers multidisciplinary scientists an unprecedented opportunity to conduct research on a variety of topics at multiple spatial and temporal scales. Since applications generating VGI are not often designed specifically for data production or analytical purposes, the Action aims at the following to fill this gap, recognizing the potential value of these sources to the EU in citizen-based decision-making by: 1) define VGI sources, share and develop data retrieval software, assess VGI quality, 2) define standardization criteria for interoperability with other datasets, 3) identify applications and transfer these applications to business implementation (market analysis, risk management, advertising, etc.). The Action targets fundamental scientific and technological advances by establishing a European network of excellence on GeoWeb technologies. The Action will focus on VGI and gather efforts carried out in an innovative and under-exploited field of Web research and knowledge production. VGI is particularly relevant as it provides information of citizens' preferences and concerns and is an alternative source of knowledge in a context where governments are putting fewer resources in data collection.

Keywords: User-generated geographic information, Geographic Crowdsourcing, Volunteered Geographic Information, data retrieval, semantic interoperability.

B. BACKGROUND

B.1 General background

The background of ENERGIIC is the growing production and availability of geographic information generated by non-professional users and supported by technologies generally known as Web 2.0 (O'Reilly, 2005; Goodchild, 2007). Many factors have led to this growth ranging from the technological to the socio-economic. Affordable computer power, the explosion of broadband internet, low cost equipment such as GPS (Global Positioning System) and other innovations demonstrate that VGI is however first and foremost related to evolution of technology (Perkins and Dodge, 2008). Web 2.0 applications that facilitate peer production of knowledge artefacts (e.g. Wikipedia, Flickr), combined with the growth both of online mapping tools and sophisticated smartphones capable of recording and georeferencing a variety of signals can transform citizens into potential empowered “sensors” that not only have the intellectual ability to process and interpret what they have observed (Goodchild, 2007) but also to locate the information and disseminate it globally over the Internet. Such user generated content, termed volunteered geographic information (VGI), differs from conventionally produced geographic information in several aspects: the source of the information, the technologies for acquiring it, the methods and techniques for working with it and the social processes that mediate its creation and impact (Graham and Zook 2010; Elwood 2008). Traditionally geographic information has been produced by experts and institutions (Harley, 2001; Budhathoki 2008; Graham 2010) so VGI represents a powerful shift in sources, contents, characteristics, modes of data production, mining, sharing, dissemination and use. There is a need for a method to integrate authoritative data and crowd sourced data. How can crowd sourced data and other data be combined and analysed to extent the scope of the authoritative data both spatially and semantically? High quality crowd sourced data is available and could be used to enhance authoritative data, therefore it is important to have a measure of the quality of crowd sourced data. The quality assessment of crowd sourced data is also important to determine if (‘free’) crowd sourced data could be used instead of (expensive) commercial datasets. The analysis of crowd sourced spatial data can lead to potentially commercially interesting applications. It could be valuable if spatial patterns can be detected and consequently used for modelling and prediction.

Since applications that generate VGI have introduced novel processes for producing geographic information exploitable with many different purposes (e.g. community mapping, crisis management, social networks, environmental monitoring, citizen science, market analysis, advertising, land administration and cadastre etc.), three steps need to be undertaken in order to maximize VGI exploitation. First, there is the need to understand what kind of information can be obtained from each specific source and the advantages and novelties introduced by VGI data over traditional sources; secondly appropriate data retrieval and storage software must be developed; these tools should also provide metadata and information about the quality of the retrieved data based on traditional measures (accuracy, lineage, coverage) and new ones more adapted to the VGI context (representativity, trust, credibility); finally the (semantic) integration of VGI sources with each other and with other spatial/non-spatial datasets, within current Spatial Data Infrastructures (SDI) such as INSPIRE (Infrastructure for Spatial Information in the European Community), will help to define the best areas of application per source.

The reasons for launching an Action are as follows: a) First and foremost: research and applications regarding VGI are still fragmented and are being performed in isolation, sometimes duplicating effort. Thus, there is a clear need to coordinate, consolidate and take advantage of Europe's vibrant and developing VGI research community. b) There is a need to develop shared/open software for mining, analysing and visualizing data, to identify required ontologies for semantic driven technologies and the governance of VGI; to test usability and assess quality of user-generated content and to develop methodologies for bridging the gap between VGI and traditional modes of geographic information production and dissemination. These can be achieved through only a multidisciplinary research network. c) The field of VGI offers a great potential for future interdisciplinary research activities and, partly because of its rapid development, it is largely practiced by early career researchers who will benefit from the Action's activities. Because of its nature, VGI data are culturally bounded by the perceptions, language and worldview of their producers. Europe is rich in cultural diversity and provides a natural laboratory for understanding both the universal and culturally specific aspects of VGI. However, the ability to analyse and understand these aspects require a network of experts with the required local knowledge and understanding.

Finally, as can be seen from the terminology that is being used to describe VGI, including crowdsourcing, user generated content, citizen science and many other terms, this area of research covers knowledge from geography, information science, computer science, geomatic engineering, sociology, ecology, anthropology, economics and potentially other disciplines. By establishing an open interdisciplinary network it will be possible to give researchers from different disciplines an opportunity to meet and overcome disciplinary boundaries.

COST is the most appropriate framework since it is an enabling mechanism to bring together a disparate scientific community, it aims at capacity building and enhancing synergies among knowledge resources and entrepreneurship's application. In fact network creation is the first step towards scientific consolidation and towards research-oriented project development (i.e. Framework Programme, etc.). The Action thus focuses on a core set of issues related to VGI, leaving room for later inclusion of further scientific challenges related to the usability of VGI data (like update procedures, definition of a viable economic model and of value assessment). In addition, COST will provide the ability to carry out a sustained series of activities in this area, unlike European Science Foundation exploratory workshops which are a single event or a specific research project with certain deliverables and outputs. The ability to share research and develop research ideas over time, with the participation of young and experienced researchers is likely to lead to concrete national and international research proposals.

The main benefit of the Action is to have substantial support to bring together experienced scholars in Europe and affiliated countries who are active in the area of VGI in order to provide solutions towards transforming information spontaneously and copiously generated by users into information that can be used for analytical and commercial purposes in different fields. This will modify the ways of knowledge in particular at the local level, so important in an enlarging Europe. Another benefit is in bringing together different disciplinary approaches involved in the VGI's revolution which are currently working separately: i.e. bringing *geocomputational sciences* which carry out data retrieval and mining together with *social and spatial sciences* which interpret the data and explore the cultural as well as social contents of VGI's creation.

Finally VGI implementations, as the Action's outcomes, will contribute to new professional skill building and innovative commercial enterprises which can develop applications based on VGI (territorial marketing, tourism, advertising, environmental monitoring, etc.). Additionally this type of information can be an alternative source of knowledge in a context where governments are putting less resources in data collection activities.

B.2 Current state of knowledge

User-generated content, and its subset, volunteered geographic information, covers a span of geographically-based initiatives and abilities, including such novel applications as Wikipedia, Wikimapia, Flickr, OpenStreetMap, and the overall concept of web mashups (overlying disparate data and existing maps to produce a new map). The recent explosion in the production and availability of geographic information generated by non professional users and supported by technologies generally known as Web 2.0 has brought about a resurgence in interest into the ways in which maps matter (Goodchild, 2007; Elwood 2008). As Goodchild (2008) states: "These are just a few examples of a phenomenon that has taken the world of geographic information by storm and has the potential to redefine the traditional roles of mapping agencies and companies."

Geographical data production includes defining a representation of the world (what features will be acquired, what properties, the resolution and so on) and acquiring data to feed databases structured adequately to this representation (thank to aerial or satellite image processing, to terrain operators, to sensors).

With respect to the design of such representations, a large amount of research has been carried out into the ways in which representation is enacted in traditional cartography (e.g. Pickles 2004 – A History of Spaces; Monmonier 2010, No Dig, No Fly, No Go; Monmonier 2004 Rhumb Lines and Map Wars; Livingstone and Withers 1999 – Geography and Enlightenment). This body of work has examined the aspects of place that are traditionally included or left out of maps, as well as the specific manners in which places have been represented. Above all, this work has shown that representation of place and the politics of geographic information (in terms of its collection, storage, publication and dissemination) matters. Or, in other words, that geographic data and maps have enormous social, economic and political implications (Budhathoki et al. 2010).

Within Europe, some scholars have looked at how geographic information is becoming a central part of the information economy and how the use of Internet and Web mapping is enabling to create, share and use geographic information (Haklay et al. 2008). Other scholars have outlined how this user generated information commonly known as volunteered geographic information (VGI), differs from conventionally produced forms of geographic information in several aspects: the content of the information, the technologies for acquiring it, the methods and techniques for working with it and the social processes that mediate its creation and impact (Graham and Zook 2010; Massiot et al. 2011). These studies highlight that traditionally geographic information has been produced by experts and institutions, so certain types of information have been privileged and other types ignored or marginalized (Harley, 2001; Graham 2010). Some scholars have focused their research on the investigation of the potential for integrating VGI techniques into the cadastre and land administration generally. The study is focused on the attempt to create draft cadastral maps using VGI methods, in an effort to minimize the costs, time and errors which rise when traditional procedures are used and in which land owners' participation is limited (Basiouka and Potsiou, 2011).

At the same time questions about privacy and anonymity are raised (Obermeyer, 2007; Kosta et al 2008; Krumm, 2009). VGI can be easily accessed via the Web, but to use it appropriately it requires subtle and adequate data retrieval and analysis methodologies, rigorous quality control (Bishr and Kuhn 2007; Haklay 2010) and an understanding of its strength and limitations. This also raises questions about credibility, reliability, the division of responsibilities and accountability among the stakeholders (Coleman 2010, Elwood 2008, Flanagan 2008). This theme also raises privacy issues regarding the content and use of personal information.

Another example of a domain where VGI has been demonstrated to have considerable potential is the identification and description of so-called vernacular place names – that is to say the often unofficial place names that people use in their everyday life, whose borders do not coincide with administrative regions. For example, Jones et al. (2008) investigated the use of web mining to identify place names associated with vernacular names and thus derive a “shared” idea of the definition of large vernacular regions such as Switzerland's Mittelland or the Midlands in the UK.

Hollenstein and Purves (2010) explored how place names were used in Flickr, in particular with respect to the naming of city centre neighbourhoods. Edwardes and Purves (2006) looked at the use of so-called basic levels, that is to say terms commonly used to describe place, in Geograph, a large collection of volunteered georeferenced images, and demonstrated that similar results could not be obtained from previous empirical studies, thus demonstrating that VGI has the potential to be used as an alternative means of gaining knowledge of shared concepts of space. This is important because it will help focus the contribution process on areas like vernacular geography or biodiversity where VGI probably is the best way to build databases .

Another important domain of VGI is citizen science, the scientific activities in which non-professional scientists volunteer to participate in data collection, analysis and dissemination of a scientific project (Cohn 2008; Silvertown 2009). Citizen science activities are common in many areas of research, such as archaeology, where it is common for enthusiasts to join excavations, or in natural science and ecology, where they collect and send samples and observations to national repositories. These activities include the Christmas Bird Watch that has been on-going since 1900 and the British Trust for Ornithology Survey, which has collected over 31 million records since its establishment in 1932 (Silvertown 2009). Astronomy is another area in which amateurs and volunteers have been on a par with professionals when observation of the night sky and the identification of galaxies, comets and asteroids are considered (BBC 2006).

Many of these activities yield geographic information, and because of the scientific framing issues of quality, coverage, veracity and trust are especially significant. Research in the area of citizen science has provided some indications on motivations, incentives, data quality and engagement. However, as recent review of the field demonstrated (Bonney et al. 2009), there is both the need and the scope to develop a better understanding of citizen science activities and their contribution to the development of scientific activities.

Related work has employed volunteered information without having a specific geographic focus. For instance, the Critical point of view Wikipedia research group has employed user-generated content in Wikipedia to ask a broad range of important questions about access, reach and participation. However, despite the recent interest in volunteering information and user-generated content, it remains that much existing work on user-generated content does not explicitly focus on the spatial aspect of the information. Moreover, a sustained effort is needed to bring researchers that focus on VGI into conversation with one another.

The production of VGI is also having significant impact on nationally significant data sets, where VGI has been used as a replacement for commercial or government data capture, Open Street Map being a prime example. Identifying marks of quality in VGI is a key issue, as it can be used as a source of cheap data by Institutions abdicating their responsibilities. However, in the context of national datasets, the use of VGI in the absence of other sources has been of great importance in third world disaster areas in Kashmir, Haiti and even Hurricane Katrina in New Orleans (Laituri and Kodrich 2008).

In conclusion, VGI represents a powerful shift in the content, characteristics, modes of data creation, sharing, dissemination and use, allowing people to become “sensors” of their own physical and social environment (Goodchild, 2007). The following quote on VGI clarifies the innovative aspect of the Action: "Like for GI Science in general, there are two roles for VGI in science: scientific questions posed by the phenomenon of VGI, and the use of VGI in doing science" (Kuhn 2007).

This Action is therefore ultimately important, not only because it brings together a necessary focus on VGI that is becoming increasingly embedded into much of contemporary life. It is also of key importance because by studying the ways in which VGI are produced and made visible, it may offer new and innovative approaches to old questions about the politics and practices of representation. It will also bring together people who use the data and people who contribute/diffuse. This is important because it will help focus the contribution process on areas like vernacular geography, disaster management, community mapping of environmental issues, updating and validating existing geospatial information or biodiversity where VGI probably is the best way to create databases .

The Action will also contribute to future research projects in the area of FP7 calls for environment where the emphasis is on engaging citizens in the collection of environmental information, and using them as sensors.

B.3 Reasons for the Action

There are several reasons for launching the Action.

First of all, as stated in B.1, research and applications regarding VGI are still fragmented and in need of coordination in order to consolidate and flourish. Secondly, there is a need to elaborate shared analytical tools, ontologies, and methodologies for bridging the gap between VGI and traditional modes of geographic information production and distribution such as Spatial Data Infrastructure (SDI) that can be achieved through a multidisciplinary research network; thirdly, the field of VGI offers a great potential for future research activities and it is largely practiced by early career researchers which will benefit from the activities promoted by the Action (STSM, training schools, workshops). Finally, the entrepreneurial exploitation of these data opens up to new professional skills and to innovative application in the field of marketing, environmental monitoring, crisis management, advertising, etc. The creation of a research network, that includes industrial partners, focused on VGI is tremendously important to enable industries to be close to the market and receive user feedback on tools and procedures. Additionally it would be important to identify trends in an early stage of development which would allow industrial partners and researchers to adapt their work to the user needs.

The Action mainly aims at scientific and technological advance since applications generating VGI are not often designed specifically for data production or analytical purposes, thus ENERGIC will gather methods and tools capable of exploiting VGI appropriately and correctly. However Geoweb technologies are also an enabling technology for the knowledge and benefit of society. VGI as compared to traditional geographic information sources offers new insights into spatial perception and behaviour of the general public at a scale that was not possible before. The creation and implementation of VGI by members of the public is also contributing to informal learning and to the increase in understanding of Geoweb technologies within the general population.

This is an important aspect, with a potential of enhancing the skills and knowledge of those who participate in these activities. The Action will provide a network for exchanging and disseminating experience in this area as well as opportunities for seeding applications on the part of small businesses. The creation of a research network that includes industrial partners, focused on VGI is an important action to enable industries to be close to the market and receive user feedback on tools and procedures. Additionally it would be important to identify trends in an early stage of development which would allow industrial partners and researchers to adapt their work to the user needs. It is useful to remember that The Seoul Ministerial declaration¹ on the Future of the Internet economy has politically acknowledged the importance of the Internet for our modern economies, our social life and our cultural and education frameworks. The declaration notably proposes "a vision that the Internet Economy, which covers the full range of our economic, social and cultural activities supported by the ICT, will strengthen our capacity to improve the quality of life for all our citizens..." (<http://www.oecd.org/dataoecd/49/28/40839436.pdf>).

To provide a framework for a better integration of European research on VGI is the immediate goal of this Action. It will be supplemented during its course by contributing to the scientific and technological advances in the area of Geoweb technologies. Expected practical outcomes of this Action will be a repository of VGI analysis tools and methods, expert publications, newsletters, Web 2.0 methods of online dissemination and collaboration such as wiki, workshops and events addressing the beneficiary target audiences, together with the training of Early Stage Researchers (ESRs) who will subsequently migrate to industry or academia and will leverage the Action results. Maximal productivity will be achieved by the participation of relevant stakeholders while setting up and running the Action's Working Groups. The scientific results will be made available through proper dissemination to both the research community and related industry and transferred to professionals using the coordination mechanisms of the Action. Other relevant technical and scientific outcomes will be indirectly transferred to industry representatives involved by the Action.

B.4 Complementarity with other research programmes

Since VGI needs scientific coordination and consolidation at European level COST is the most appropriate framework because it fosters the creation of an open and flexible scientific community, it aims at capacity building and enhances synergies among existing knowledge and research resources. The creation and coordination of a solid research network is the first step to develop common research agendas and more research-oriented projects, etc.; to launch business partnerships (EUREKA) or start a knowledge transfer (ESA). This Action is highly innovative in the topic and thus it has no direct link with current or planned European projects. Nevertheless complementarity and links with on-going projects will be provided by researchers interested in this Action, who are involved in other projects described in section E.3.

First of all the Action has a close link with the topic of spatial data infrastructures which have been developed by the directive INSPIRE (<http://inspire.jrc.ec.europa.eu/>) which aims at establishing an infrastructure for spatial information in Europe for the purposes of community environmental policies or activities which may have an impact on the environment. Links with INSPIRE regards mainly improving metadata of traditional data (user feedback to assess quality) and attaching metadata to VGI; overcoming current limitations of data producer view of the world; implementing interoperability (challenges of multilingual/multicultural world). VGI is an opportunity to facilitate the integration of user requirements in INSPIRE (in terms of formats, representation, required interactions), to facilitate data update, to enrich with new contents. But it is also relevant to think of the role of INSPIRE to support VGI (and not only to use it). INSPIRE SDIs could serve as reference for the “produsage” of georeferenced information and their integration. Other organizations to be considered are: AGILE (Association of Geographic Information Laboratories in Europe), the EuroSDR organization (European Spatial Data Research, developing ties to universities and National Mapping Agencies), the ICA commission on Neocartography (<http://neocartography.icaci.org/>); outside Europe links will be established with relevant institutions like NGCIA (National centre for geographic information analysis, <http://www.ncgia.ucsb.edu/>).

C. OBJECTIVES AND BENEFITS

C.1 Aim

The main objective of the Action is to build an open and flexible VGI European network of scholars, young researchers and industry representatives who will share their experiences in order to transform user generated information into exploitable data. The means foreseen will be: 1) develop common data mining software and methodologies that can exploit a wide range of VGI source (such as mapping efforts, photographs, social messaging, etc.) and can be applied in a variety of fields (environment, crisis management, advertising, tourism, etc.); 2) definition of quality assessment criteria (positioning, ontology, source identification, etc.); 3) establish an open and updatable repository of VGI analysis and integration tools and methods, literature and case studies 4) develop cultural and contextual analysis methods of VGI that will help researchers in understanding the local aspects of VGI datasets and their use. The means to achieve the objectives are: annual meetings, workshops, short term scholar mobility, annual training schools, focus groups for policy makers and entrepreneurs, and the creation of an online VGI gateway, blogging and microblogging. The main deliverables will be: reports of the Action's progress (annual working papers and reports); annual monitoring reports and final evaluation; publications of WGs' results in special issues of journals; publication of an open source repository online and updatable of technical tools to facilitate the use and exploitation of VGI; publication of a comprehensive final report including the main outcomes, policy recommendations and research agendas to be used also for future proposals; a VGI gateway; blogging and microblogging.

C.2 Objectives

As secondary objectives, the Action will continue to play a supporting role for:

- Research community implementation;
- Increase the international standing of European research in this area.
- Transfer knowledge to the scientific community and practitioners.
- Draw lessons from VGI's applications for policy recommendation;
- Identify future research agendas;
- Educational for graduate and doctoral students.

C.3 How networking within the Action will yield the objectives?

The Action aims at becoming the main reference point for European research in the field of VGI. This in turn would facilitate the launch of further collaborations and joint focused activities within the European community and with non-European entities working on the same field. The Action will become a think tank for researchers, and a hub for VGI and related activities in the area.

The means needed to achieve the Action's objectives regard: human resources, equipment and funding. Human resources are needed to undertake duties in the following areas: scientific (knowledge exchange, participating in workshops, developing and testing outputs); administrative (scientific secretary, webmaster, organization of meetings and exchanges, network management); editorial (analysis of results, drafting and distribution of recommendations).

In particular, the objectives of this Action will be achieved by a cooperative and interactive environment where scientists and researchers from academia, industry and research centres will be allowed to meet and exchange their ideas and experiences. This environment will involve:

- Scholars, who will dedicate manpower to the provision of lectures at Training Schools, and to attending the WG meetings; they will bring their experiences in VGI and select the activities within their research portfolios better tuned to the objectives of this Action;
- PhD students and early career researchers, who will bring new and disrupting ideas to discuss, spending part of their manpower in attending the WG meetings and preparing the Action's outputs where their research results will be harmonised to those of the other Action participants; moreover, they might contribute to shared visions by dedicating effort to the Action through the performance of STSMs;
- Representatives from industry, who will bring experienced contributions in the form of VGI applications for commercial transfer;
- Equipment at the institutions' premises that will be made available by participants (spatial database servers, analysis packages that are suitable for geographical and spatial information, computers, GPS enabled phones to test out VGI tools);
- Databases and software developed by the Action participants and made available to other researchers;

The Action will invest in training PhD students and ESRs, thus ensuring proper renewal of the participants' skills. Moreover, the Action will foster participation of scientists and researchers from new institutions and firms, by organising joint events with other projects and through the various dissemination activities mentioned in Section H.

The main skills required are in the field of: geocomputing, spatial analysis, geography, spatial data quality, spatial databases, image analysis, Web technologies, Web data formats, Web services, Web usability (HCI, human computer interaction), information retrieval, knowledge discovery and data mining, integration of unstructured spatial data.

Funding will also be needed to cover: scientific meetings and events; training schools, short visits and young researchers' participation; publications; invitations to international experts; large-scale dissemination of information.

C.4 Potential impact of the Action

The benefits of the Action will be achieved both from the scientific activities and from the networking activities.

The scientific benefits will derive from the innovation in an upcoming research area (VGI). In particular the innovative aspect of the Action relies on addressing the two roles of VGI in science: scientific questions posed by the phenomenon of VGI, and the use of VGI in doing science. Research needs to integrate the two, because VGI applications motivate and ground information science research, and better information theories improve applications. One of the benefits achieved by the Action is to highlight the main impact of VGI on how science and society work with geographic information: this evolution will profoundly affect a majority of natural, technical, and social sciences, not only geographical information science. Evidence is already provided by the knowledge (or cyber) infrastructures evolving in many fields, often with some spatial backbones (Kuhn 2007; GEON <http://www.geongrid.org/>; SEEK <http://seek.ecoinformatics.org/>).

In short, VGI deals with transient and fast-changing phenomena that are hard to quantify. It allows to record details that have never been mapped to any large extent because of the difficulty and high costs of fitting such information into existing schemas or capturing it in a timely way. This bottom-up process of creating geographic information through the contributions of citizens has great potential to be integrated with the traditional top-down process of collecting geographic data. As mentioned in the Economist (2007) these new sources of geographic information, as efficient local “micro GI generators”, could replace or implement national mapping agencies and other oligopolies of geographic information (GI); in fact the sensor-based GI and VGI do seem to go hand in hand and share many characteristics, such as the distribution of information sources and their dynamic and low production cost nature: “Eventually, today’s huge power stations and national transmission grids might be superseded by a system that relies on efficient local “micro power generators.”

This Action will bring valuable inputs to open data initiatives and more generally to the large reflexion on how to best organize and fund the equipment of European regions in geographical information usable for decision-making and for research. Lately, in some countries like France, large scale topographic data and most satellite imagery have become freely available for research and public sector.

The expected benefits of the Action will derive from the activities of the network which, as stated in section B, aim at the defragmentation and coordination of research and applications on VGI; the activities’ benefits will:

- contribute to the coordination and defragmentation of research efforts across Europe and to the strengthening of Europe’s scientific networking capacity;
- produce results of potential interest to important sectors such as private companies and industry and public authorities or policy institutions;
- produce added value from the coordination of national research efforts;
- permit inclusion, at the implementation stage of disciplinary perspective;
- encourage capacity building;
- encourage mobility of early career European researchers;
- spin off other funding schemes and projects funded by different countries.

C.5 Target groups/end users

The likely end users will be: young researchers and doctoral students that will improve their knowledge on the phenomenon and acquire professional skills; institutions which can benefit from the applications' results (e.g. participatory mapping for development-oriented interventions); citizens (user generated content is an enabling technology); teachers since VGI is a valuable teaching tool and source of information; Information technologies (IT) firms and public Institutions that make use of geographic information.

D. SCIENTIFIC PROGRAMME

D.1 Scientific focus

In order to achieve the objectives identified in the previous section, the main research tasks are:

Task 1: Identify VGI sources and conduct a comparative study of these sources to understand the commonalities and specific features of each source; develop a taxonomy of VGI sources to establish a solid research grounding of each category identified; examine the role of the semantic Web trust layer as a tool for quality assessment; explore the notions of reputation and credibility for VGI users.

Task 2: Development of automatic data retrieval software and strategies for each specific source; adoption of standard geodata formats compatible with OGC (Open Geospatial Consortium) /W3C (World Wide Web Consortium) recommendations, for harmonisation, interrogation and geo-visualisation of the different VGI sources classified in task 1; address the problem of legal/privacy and political dimensions of VGI

Task 3: Define requirements for the semantic interoperability of VGI sources with other datasets; developing formal vocabularies using semantic Web standards like RDF (Resource Description Framework) and URIs (Uniform Resource Identifier) to enable querying/reasoning and linking/mashing up different VGI sources to each other; tackle the optimisation problems due to processing very large amounts of VGI; identify how VGI sources will interface with Spatial Data Infrastructures mandated by the INSPIRE directive;

Task 4: Implement a repository of high quality applications and dataset in several fields(environmental, territorial marketing, crisis management and tourism) with the direct involvement of end users (firms, institutions, academia).

The innovative aspect of the Action relies on developing tools to transform user generated geographic information into knowledge that can be transferred for business and social applications (smartphone apps, social participation tools, etc.). Much of the recent growth of interest in websites that feature geographic information relies on the successful implementation of geocoding, georeferencing and interoperability services for converting informal references into formal ones that are the basis for digital geographic information.

D.2 Scientific work plan - methods and means

The scientific work plan will be organised in four phases: starting off; implementation, application; diffusion and consolidation.

Year 1: starting activities

Objectives: Start up of MC, MC and WGs and scheduling of the activities (meetings, workshops, etc.)

Activities:

1. Kick off meeting: getting started; partners' introduction; definition of MC and of Working Groups and their Chairs;
2. First Management Committee meeting devoted to scheduling of the activities (meetings, workshops, coordination with COST representatives, MC members' tasks, etc.)

3. Working Groups meetings: WG meet separately to define their detailed plan of the activities and report to the MC. In this phase WGs will build on contributions from the kick-off meeting and establish the following for each WG:
 - define application requirements relevant for the thematic area addressed by the WG
 - define interface and positioning with other WGs
 - define the Action's agenda
 - design showcases
 - start discussion about the rules for the attribution of intellectual property right. The MC will come to an IPR agreement shared among the Partners in Year 2 of the Action in order to avoid disputes during the Action and after the conclusion of the Action itself.
4. Open workshop at the end of year one: state of the art of VGI (external experts will be invited; early career researcher's participation will be encouraged and financially supported). This will be the occasion for the second annual meeting of the MC.
5. VGI gateway implementation and bimonthly website update
6. Bi-weekly blog update
7. Regular microblogging
8. STSMs (Short-term Scientific Mission)

Outputs:

Publication of working papers

Publication on VGI state of the Art in Europe

Annual evaluation and monitoring of the Activities planned and carried out (partners' participation; degree of countries involvement; new entries, access to Action's website and VGI gateway)

VGI gateway

Year 2: Implementation

Objectives: Implement WGs' tasks emerged in year one

Activities:

1. New year meeting: directions in VGI needs. MC, WGs will take part. A session of the meeting will be dedicated to the definition of IPR rules.
2. Working Groups meetings: WG meet separately to carry out their tasks and report to the MC. In this phase WGs will build on the results of the year one.
3. Open workshop at the end of year two: directions in VGI needs (external experts will be invited; early career researcher's participation will be encouraged and financially supported). This will be the occasion for the second annual meeting of the MC.
4. Bimonthly website update
5. Bi-weekly blog updates
6. Regular microblogging
7. STSMs (Short-term Scientific Mission)
8. Training School
9. Public event: First "European VGI day"

Outputs:

Publication of working papers

Publication on special issues of scientific journals

Set of rules regulating Intellectual Property Rights.

Annual evaluation and monitoring of the Activities planned and carried out (partners' participation; degree of countries involvement; new entries; access to Action's website and VGI gateway)

Year 3: application

Objectives: Production of a VGI analysis tool set and repository

Activities:

1. New year meeting: The VGI repository (contents, schedule, etc.). MC, WGs will take part
2. Working Groups meetings: WG meet separately to carry out their tasks and report to the MC. In this phase WGs will build on the results of the year two and will provide their contribution for the VGI toolbox and repository.
3. Open workshop at the end of year two: directions in VGI needs (external experts and entrepreneurs will be invited; early career researcher's participation will be encouraged and financially supported). This will be the occasion for the second annual meeting of the MC.
4. Bimonthly website update
5. STSM (Short-term Scientific Mission)
6. Public event : Second "European VGI day"

Outputs:

Publication of working paper

Publication of the handbook of the VGI toolbox and repository

Annual evaluation and monitoring of the Activities planned and carried out (partners' participation; degree of countries involvement; new entries, access to Action's website and VGI gateway)

Year 4: diffusion and consolidation

Objectives: diffuse and test the results obtained

Activities:

1. New year meeting: innovative applications and future research agendas. MC, WGs will take part.
2. Working Groups meetings: WG meet separately to carry out their tasks and report to the MC. In this phase WGs will build on the results of the year two.
3. Focus group with potential users and operators.
4. Second annual meeting of the MC dedicated to the preparation of the final conference and to the summing up of the Action's results.
5. Open Final Conference: Innovative applications for the VGI, data visualization and analysis. The conference will facilitate young researcher participation, based on lectures, discussions, poster, sessions, and round tables; (external experts will be invited; external early career researcher's participation will be encouraged and financially supported).
6. Bimonthly website update
7. Bi-weekly blog updates
8. Regular microblogging
9. STSMs (Short-term Scientific Mission)
10. Training School
11. Public event : Third " European VGI day"

Outputs:

Publication of working paper

Publication of research agenda: The future of VGI

Repository of innovative applications of VGI in several fields emerged during previous WGs' activities.

Final evaluation by external evaluators based on several indicators such as: participation of institutions from the industry segment, action participants, attendees to meetings (on average), number of technical presentation per meeting (on average), joint journal papers with acknowledgment to the Action per year, joint conference papers with acknowledgment to the Action per year, workshops organised per year, attendees to Training Schools, submission of other project proposals.

In particular from year 1 onwards STSMs will be organised (a least four per year) and two Training schools will be organised in year 2 and year 4. The Training Schools will be aimed at early-career researchers from the university, commercial, and government sectors. The goal will be to provide an inspiring and productive opportunity for peer-to-peer interaction with leading international experts in the field. Participants will:

- Learn the state of the art in the topic areas
- Understand and explore tomorrow's research and market challenges
- Be challenged to think laterally outside their daily work setting
- Present their own work and ideas to receive feedback and advice•Get one-on-one access to
- experts in a relaxed and productive setting
- Improve presentation and team work skills
- Strengthen and grow the network of VGI researchers (and allow it to transcend disciplinary boundaries).

The Training School format will be multi-faceted and will include:

- Topical presentations and group projects
- Analyses of case studies
- Discussions and critique of methodology
- Skill-development sessions
- Opportunities for working on joint publications in international journals, project proposals to funding agencies or management business plans.

E. ORGANISATION

E.1 Coordination and organisation

The Action will be coordinated and organised by the Management Committee and the Working Groups.

The MC will decentralise management activities and will set up small Task Forces with special tasks such as maintaining the website (Web task force), promoting the dissemination of results (public relation task force) and organizing and editing of publications (Editorial task force).

Working Groups

The Action will have four Working Groups (WG) according to the topics and objectives defined in section B and section C. This subdivision may be subject to adjustments due to the focus of research interests of additional participants. The Working Groups will be organized during the initial Management Committee meeting (Kick off meeting) and may be subject to additional changes after the experience of the first working period.

Each WG will elect a Chairperson, to coordinate the work within the group, and to ensure the exchange of information with the other WGs and with the MC. Special Interest Groups (SIGs) will be created, addressing specific topics that require expertise taken from the four separate WGs. SIGs will be created on demand, according to a bottom-up approach and could be permanent or temporary depending on the researchers and on technical development trends. Each SIG will elect a Chairperson who will interact and refer with the WG chairperson. Besides the delegates representing Signatories in the MC, it is expected that experts from each Signatory will attend the WG meetings, to present technical documents, and to participate in the technical discussions of the work.

Coordination with national research projects

The main occasions for presenting the results of the national research projects and the cooperation of the WGs will be the joint meetings (two per year) and the final conference (year 4). WGs will invite representatives from related international research programmes to attend their meetings. These relationships not only increase the visibility of the Action but also make it possible to bring knowledge from outside experts into the Action. Co-organisation with other Actions enables a better exchange of information within the COST framework, and fosters stronger links with researchers in areas adjacent to the ones of the Action.

Technical visits and STSM (Short-term Scientific Mission)

During the joint meetings, technical visits to host institutions equipment (laboratories, libraries, etc.) will be organised so that a better exchange of research methods and equipment can be obtained. Besides these, Short Term Scientific Missions will be organized, to encourage the exchange of researchers between institutions, particularly for early career researchers, leading to an improved comparison of methods and models, to an increased flow of information within the Action, and to the promotion of joint activities among researchers from Signatories.

Workshops, interim-meeting and final conference.

Each year the Action organizes an open workshop dedicated on reporting of the achieved results together with next year's perspectives; MC and WGs, supported early stage researchers and external experts will attend; an interim-meeting will be organised for MC and WGs for an evaluation of on-going and carried out work also to foster inter-WG interactions, in conjunction with the MC meeting. The final conference will be held at the end of the Action's running time: it will be dedicated to results achieved, to follow up activities and organised on a large participation base.

Website and virtual meetings

Between the meetings, scientific cooperation and planning of activities will be maintained by mailing lists and virtual conferences, blog. All participants will receive a regular electronic newsletter with information on activities and results of the Action and relevant developments in the field, to which all Working Groups will contribute. The Action website www.vgibox.eu will collect both the Action's activities and results and the initiatives in the field of VGI.

The Action's **milestones** will be:

- a repository of VGI sources (structured, unstructured) and tools
- the implementation of the VGI community through the Action's activities;
- the achievement of the required gender balance, early-career researcher participation, large geographical coverage;
- the publication of working papers, interim reports, final report and the VGI handbook;
- the creation of VGI website and its constant updating;
- the creation of a European VGI day
- new cooperation among partners and their national research programme;
- transfer of research to firms;
- the definition of best practices especially with respect to selection of models;
- build research agendas.

The management of the Action will be based on three strategic principles: adoption of an open source process approach, implementation of complementarity among the partners by a collaborative approach, decentralisation of the management activities by creating Task Forces.

The Action will actively identify and interact with related European or international research programmes as well as with European organizations, through the exchange of information, invited speakers, joint publications and workshops. In Europe, links with research organizations, governmental agencies and projects related to the COST Actions issues and stakes will be systematically sought and established, through formal contacts, delegations to common bodies, or through the participation of common experts in the COST Actions' MC or WGs.

E.2 Working Groups

The Action will have four Working Groups which will carry out tasks defined in the scientific programme. They will deal with:

- **WG1:** VGI taxonomy and data sources. To ensure the communication between the WGs, this WG will work on standardizing definitions in all areas of the VGI. This WG will also facilitate cross-WG activities.
- **WG2:** VGI producers and users; data quality and reliability. This WG will focus on the algorithmic as well as empirical (via user-studies) approaches to develop methods and criteria for studying data quality.
- **WG3:** Semantics and data analysis and modelling, data integration and visualization. This WG aims at the developing the integration of VGI sources with other geographic information to facilitate end users' exploitation and to perform analysis and dynamic queries on the data.
- **WG4:** VGI high quality multidisciplinary applications. This WG will focus on collection of VGI application from several fields to implement the VGI repository.

E.3 Liaison and interaction with other research programmes

The Action will establish links with other projects such as: COST Action such MOVE (<http://www.move-cost.info>) (COST Action IC0903) which aims at developing methods for knowledge extraction from massive amounts of data about moving objects (e.g. humans, vehicles, animals, and goods), as well as trajectories of abstract concepts (e.g. spreading diseases); MODAP (<http://www.modap.org>) which aims at creating a platform for technical as well as non-technical people who are interested in mobility data mining together with privacy issues; IST GeoPKDD (<http://www.geopkdd.eu/>) aiming at devising data warehousing and data mining methods for trajectories of moving objects; such methods will be designed to preserve the privacy of the source sensitive data; Marie-Curie ITN Geocrowd www.geocrowd.eu about management of user-generated geographic information; FIG (International Federation of Surveyors www.fig.net) and especially FIG Commission 3 WG; the ICA commission on Neocartography: <http://neocartography.icaci.org/>

E.4 Gender balance and involvement of early-stage researchers

This COST Action will respect an appropriate gender balance in all its activities and the Management Committee will place this as a standard item on all its MC agendas. The Action will also be committed to considerably involve early-stage researchers. This item will also be placed as a standard item on all MC agendas.

Since at present research related to VGI issues is mostly carried out by male researcher, both established and early career, but this COST Action is paying particular attention in involving as many female researcher as possible.

The participants in the Action will be encouraged to promote the involvement of female professionals in the different activities, and to adhere to gender equality when selecting and/or appointing new members. The Action wants to invite especially female professionals to take an active role at the different levels of management and decision of the Action in order to achieve gender balance.

Moreover, this COST Action plans to foster events that spread research that is gender sensitive in its topics, data collection and theoretical approaches.

The Action is committed to considerably involve early-stage researchers. 41% of the partners are early career research.

To further encourage the participation of early stage researches, this COST Action will organise two Training Schools for young researchers to build up expertise (see D.2).

F. TIMETABLE

The duration of the Action will be four years. The Activities and Outputs will be carried out as in the two following tables:

Activities/Time	Year 1	Year 2	Year 3	Year 4
Kick-Off Meeting	x			
First Management Committee meeting	x			
New Year Meeting (MC + WGs)		x	x	x
Working Groups Meeting	x	x	x	x
Open Workshop + Focus group with end-users 2 nd MC annual meeting	x	x	x	x
Website Update + Newsletter (Bimonthly)	x	x	x	x
Blog Update (Biweekly)	x	x	x	x
Open Final Conference				x
Public event : « European VGI day »		x	x	x
STSM	x	x	x	x
Training School		x		x

Output/Time	Year 1	Year 2	Year 3	Year 4
Working Papers	x	x	x	
State of the Art in Europe	x			
Special Issue		x	x	
Handbook of the VGI Toolbox			x	
The future of VGI				x
Annual Evaluation and Monitoring	x	x	x	x

G. ECONOMIC DIMENSION

The following COST countries have actively participated in the preparation of the Action or otherwise indicated their interest: AT, BE, CH, DE, EE, EL, FR, HR, IE, IT, MT, NL, PT, UK. On the basis of national estimates, the economic dimension of the activities to be carried out under the Action has been estimated at 56 Million € for the total duration of the Action. 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.

H. DISSEMINATION PLAN

H.1 Who?

The target audiences for the dissemination of the results will be:

- Young researchers and doctoral students;
- Academia;
- Institutions which can benefit from the applications' results (e.g. participatory mapping for development-oriented interventions);
- Citizens (user generated content is an enabling technology to exchange information with others);
- Teachers since VGI is a teaching tool and source of information;
- IT firms and public Institutions that, for different purposes, make use of geographic information;
- Web operators.

H.2 What?

The dissemination of the results of the Action aims at:

Providing Experts, European Commission Representatives and end users with reports, other traceable information and available material produced by the Action; improving visibility of the Action in the global scientific community.

The Action will apply the following dissemination methods.

Internal communication

For the participants a password protected area on the www.vgibox.eu website will be created, where interim results, working documents and draft papers will be posted. An e-mail forum and virtual conferences will be used for internal communication. There will be working papers, interim progress reports made by the MC, based on information given by the WGs' leaders.

At the end of each year, open workshops will be organised to discuss and evaluate the results. These meetings will also be used to discuss the planned activities in the next year. A focus group with potential users (entrepreneurs, public institutions) will be organised in year 3.

External dissemination

General information and outputs will be posted on a public website related to the dedicated fora as well as on the websites of the partners of the Action either as link to the periodical e-news letters on the progress and intermediary results of the Action. For the same reason, the Action will be represented at other meetings and workshops, such as GIScience (held every two years), AGILE (Association of Geographic Information Laboratories for Europe) (annual), ISPRS (International Society for Photogrammetry and Remote Sensing), ACM GIS (Advances in Geographic Information Systems) etc.; these events will be used for dissemination of results of the Action.

Final dissemination

At the end of the project various reports (VGI state of the art in Europe, etc.) and a VGI handbook will be published open source and articles will be submitted to scientific journals. Furthermore, the topic of this Action is expected to be researched in the context of some PhD theses. Short versions of the scientific reports and other outputs, Social media tools such as blogs, twitter, Facebook, etc. will be used to attract new stakeholders.

Global dissemination

A European VGI Day will be organised to involve scientists and citizens in general to practice with VGI data on one specific day (date to be fixed during the planning of the Action's activities) in each country member of the Action. The event will take place during the year 2, 3 and 4 of the project but could be organised after the Action's end. This event could involve designers and artists to produce VGI visualizations for different formats: large urban screens, mobile apps and many others.

A Facebook page will also be created.

H.3 How?

Creation of a European 2.0 website (www.vgibox.eu) including resources like reading lists, websites, working papers, PhD theses and MSc dissertations and other technical and scientific material, applications and manuals, a directory of scientists interested in the field, a calendar of events and news, etc. The website will also include a blog aimed at a general public audience, and will issue targeted press releases in a range of languages so as to share our work with a range of European media outlets.

Publication of a comprehensive final report including the main outcomes of the Working Groups.

Publication of four annual working papers and reports on the Action progress.

Publication of results of the WGs in special issues on journals in a range of disciplines like *New Media & Society*, *Economic and Society*, *Economic Geography*, *Gender Place and Culture*, *Global Networks*, *Cartography and GIS*, *Cartographica Informatica*, *GeoJournal*, *Transaction in GIS*, *Journal of Spatial Information Science*, *International Journal of Geographic Information Science*, *Transactions in GIS*, *Computers, Environment and Urban Systems* etc. on the specific topics debated within the network.

Publication of a Handbook of technical tools (VGI toolbox) to facilitate the use of the VGI repository developed by the Action.

Publication on policy recommendations and research agendas to be used also for future proposals. Cooperation and contacts with scientific institutions, with other research programmes (especially in the EU Framework programme).

Contacts with industry representatives and operators.

Organization of workshops and conference, participation in other workshops, conferences, mailing lists, etc.

Establishment of the European VGI day.

Social media tools (Facebook, twitter, wikis).
