

# **The AGILE Research Agenda**

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## **Abstract**

Since its establishment in 1998, the Association of Geographic Information Laboratories in Europe (AGILE) has worked on a research agenda. This agenda, in its first phase, was more an inventory of current GI research than a true agenda. A web-site allowed users to query information on research carried out by the AGILE members. The web-site has been undergoing several improvements with respect to contents and accessibility. In order to strengthen the ties between member laboratories and to promote cooperative research, so-called working groups were initiated. Working groups are expected to play an important role in the development of the research agenda, but an even more important role is the further development towards collaborative research initiatives. Recently, the AGILE Council decided to bring the discussion of the research agenda a step forward by inviting some key GI scientists to discuss a possible future strategy. The result of this discussion was a Green Paper on GI research for Europe. The Green Paper outlines the European policy context for the development of a research programme in the GI Sciences and puts forward five key research themes for discussion around which an active research programme can be developed, as well as discusses the next steps that should be undertaken.

## **1. Introduction**

In April 1998, during a special session at its first conference in Enschede, the Netherlands, the Association of Geographic Information Laboratories in Europe ([AGILE](#)) was established. At that point, some 50 so-called founder members already had indicated their interest in a body that intended to promote academic research and teaching on Geographic Information at the European level. The current membership stands at 70 laboratories from 21 European countries, as well as four vendors of GI software that have become affiliate members. AGILE has also signed memoranda of understanding (MOU) with peer organisations. The main activities of the Association are the organization of an annual conference, the development of the European GIS research agenda discussed here, the setting up of working groups, the exploration of several ways to communicate with members, the extension of its network, both in terms of ordinary members as well as by way of affiliated partners, the participation in (EU) projects, and the participation in the discussion on GIS related issues at the European level. Three years later, after four annual conferences, the AGILE organization has matured, has extended its activities and is more able to serve the European research community.

At the first conference of the Association of Geographic Information Laboratories in Europe (AGILE) in Enschede, April 1998, the members started a process to develop a European research agenda on Geographic Information Science. Rather than wishing something like a To Do list,

they were looking for synergy effects from increased collaboration facilitated through AGILE. The agenda was therefore tied to the members' actual research interests by starting with an inventory of their current research activities.

Information about ongoing research at member sites was collected and structured into themes derived from the research priorities of the University Consortium on Geographic Information Science ([UCGIS](#)) in the U.S. The result is the first and only comprehensive *directory of European research activities* on Geographic Information Science. It has been available to anybody through AGILE's homepage for two years now and underwent a thorough usability analysis and redesign in the second half of last year. The topics on which AGILE members are doing research can be accessed conveniently by research themes, member names, a map, and a search engine. The members are continually feeding updates on research activities into the inventory. This agenda, in its first phase, was therefore more an inventory of current GI research than a true agenda. This first phase will be described in section 2.

The second AGILE conference in Rome, April 1999, introduced the instrument of *Working Groups* to develop a research agenda for selected themes. The idea was to bring the agenda to life by building it up selectively in those areas where the members expressed the interest and willingness to contribute actively. So far, four working groups have been created and new proposals keep reaching the Council. At the Helsinki conference in May 2000, the working group on environmental modelling and planning started to develop a list of research issues specific to its area. It will produce a first version of its research agenda at the Brno conference in April 2001. Other working groups have begun a similar process. These working groups are described in more detail in section 3.

It is now time to extend this process toward a common plan for action to advance Geographic Information Science in Europe. While the European Commission is preparing the 6<sup>th</sup> Framework Programme and the U.S. has successfully launched the first international conference on Geographic Information Science – what is AGILE doing to establish a European research vision in this area? How can AGILE's research agenda be made more useful for networking European GI Laboratories and increasing collaboration and common initiatives within AGILE?

In the first half-year of 2001, these questions and the planning of the next steps in the process have been discussed. First a workshop has been held in Utrecht at the end of March. Participants included the AGILE council sub-committee for the research agenda as well as some eminent scientists contributing their vision on European research needs. The result of this workshop was a green paper on how to proceed. This green paper has been presented to and discussed with the AGILE members during the 4<sup>th</sup> AGILE conference in Brno, April 2001. The green paper describes five main priority areas for GI research, and indicates some conditions that should be met in order to successfully work on the priority areas. This Green Paper will be discussed in section 4.

## **[2. AGILE Research map](#)**

At the first AGILE conference in Enschede, the attending members decided to initiate a process for the development of a European research agenda. General motives for such an agenda were:

- that research is more effective if co-ordinated;
- the need for AGILE to have a “corporate identity”;
- the expectation that such a research agenda could lead to working groups that would focus on key research issues.



**Figure 1: Map to access information on AGILE members and their research activities**

It was agreed by the members that such a process should start with the current research activities of the members, and relate to existing research agenda's. For this reason, information on research by the member labs, as indicated on their subscription forms, was used to put together a research map. A next step was to ask individual members to check the information on their own laboratory, for the purpose of filling in the gaps and assuring that the information was correct. Also, members could propose up to three missing research themes and up to ten missing research topics. Finally, members could identify up to three priority themes or topics for AGILE working groups.

The result of these first activities has been presented in a research map, accessible via the AGILE website. After the first year of operation, the use of the research agenda and its functionality has been evaluated. As a result of this evaluation, the structure, lay out and functionality of the research web-site have been improved.

Currently the research agenda includes:

- Information about the members participating in AGILE
- Information about the members' current research topics and the research themes they belong to
- A map with all AGILE members including information about the laboratories
- A Search Engine for a full text search
- Information about working groups that have been formed by members of AGILE and mainly base themselves on current Research Themes
- Information about important **news** concerning AGILE's Research Agenda
- Information about the process of defining and maintaining the agenda

The information on research can be accessed in several ways. A map of Europe (figure 1) allows to pinpoint members and to get information for that member on research, as well as general information and, if available, Internet links to the homepage of the member or specific research web sites. Members can also be accessed by country. A "full-text" search engine allows to query the database and select laboratories based on the research themes and issues they are working on. An example of the result of such a query is given in figure 2.

**RESULTS for "interoperability":**

[\[Laboratories\]](#) [\[Themes and Topics\]](#) [\[other links\]](#)

Laboratories

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- 1.) [Department of Geoinformation](#)
- 2.) [Institute for Environmental Sciences\(ISA\)/ Geoinformatics Group](#)
- 3.) [Computer Graphics Lab](#)
- 4.) [Finnish Geodetic Institute, Department of Cartography and Geoinformatics](#)
- 5.) [Institute for Geoinformatics \(IFGI\)](#)
- 6.) [Laboratory on Geoinformatics and Cartography](#)
- 7.) [International Institute for Aerospace Survey & Earth Sciences \(ITC\)](#)
- 8.) [Institut für Geoinformation und Landentwicklung](#)
- 9.) [IAAA - Sistemas de Información Avanzados; Department of Computer Science and Systems Engineering](#)
- 10.) [Chair of Hydraulic Engineering](#)

Themes and Topics

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- 11.) [Themes and Topics : Model - GIS Interoperability](#)
- 12.) [alle topics](#)
- 13.) [Untitled](#)

Other links

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- 14.) [Working Group](#)
- 15.) [Working Group](#)
- 16.) [AGILE's Working Groups](#)

**Figure 2: Result of an example query on *interoperability***

It should be made clear that the research agenda is:

- an evolving structure (not a single snapshot);
- being actively pursued;
- an organising principle for AGILE conference sessions;
- a common effort of all AGILE members;
- for public use and comment.

### **3. Working Groups**

The primary function of AGILE is to facilitate the networking activities of its members and from them to create a single European voice on GI research and teaching. Working groups are important in this context because they both allow members to co-operate on specific themes in their own interest as well as provide a stable work base for the whole organisation.

A working group can come into being either by a Council decision or as a result of a proposal from a number of AGILE members. In some cases, working groups will be set up to carry out specific tasks and will cease to exist once these tasks have been carried out. To set up a working group, a proposal should be prepared which outlines the primary objectives of the working group and describes the deliverables anticipated from the work of the group. The proposal should have the active support of at least five groups from at least three different countries. Although working groups are primarily an AGILE activity, non-members are allowed to join a working group as well.

AGILE working groups will be expected to play an important role in AGILE conferences, for example by organising special sessions within the overall programme. Also, publications could result from their activities. It is the intention to publish each year a selection of conference papers in (special issues of) GI-journals. While responding the questionnaire related to the research map, members suggested also themes for possible working groups. Such themes were: interoperability; data quality and data usability; GI infrastructures; participatory GIS; GIS foundations (core theories); environmental modelling; GI education; risk management; and temporal GIS.

At this moment four working groups has been established:

- Environmental modelling;
- GI education;
- Interoperability;
- Data policy.

It is expected that during this year, working groups will be established on Planning and Data usability. More on the AGILE working groups is found at the AGILE website: [www.agile-online.org](http://www.agile-online.org).

## 4. AGILE Research vision: The Green Paper

### 4.1. Introduction

The AGILE manifesto entitled “*Green Paper for an Action-Oriented Research Agenda in the Geographic Information Sciences*” was drafted in April 2001 with the intention to:

- stimulate a broad based discussion within and outside AGILE on how best to inject some additional pace into the activities of the association,
- develop a more coherent image of AGILE research priorities, and
- exploit new opportunities and align the research agenda to the current and future needs of society.

The green paper is deliberately a high-level summary document, and is divided into five short sections. Following this brief Introduction, Section 4.2 outlines the European policy context for the development of a research programme in the GI Sciences, Section 4.3 undertakes a brief SWOT analysis of AGILE, and Section 4.4 puts forward five key research themes for discussion around which an active research programme can be developed. The final Section, 4.5, outlines the next stages of the process.

### 4.2. Policy Context

This section addresses two main issues: the increasing recognition of the **spatial dimension of national and EU policies**, and the **emergence of a European Research Area**

#### *4.2.1. The Spatial Dimension of EU policies*

There has been a significant shift in policy at national and EU level during the 1990s away from sectoral approaches and top-down regulatory mechanisms which were manifestly unable to address the increasing complexity and interaction of environmental, economic, and social issues. What has emerged, particularly in the light of increasing environmental concerns, is a more integrated approach to policy where the interactions and cumulative impacts of different policies and actions are assessed ex-ante to increase their effectiveness. This shift to a more integrated approach is evident in all areas of policy but particularly in relation to agriculture, environment, transport, regional policy, and urban policy.

Directly flowing from the point above is the emergence of spatial planning at the regional scale as a powerful framework for analysis, co-ordination of intervention, and evaluation of impacts. The formulation of the European Spatial Development Perspective is the clearest embodiment of this approach, but its principles are also present in the other areas of policy identified above. These include for example the revision of the Common Agricultural Policy with greater emphasis on the achievement of environmental objectives and the requirement to formulate integrated rural development plans, the Water Directive (2000/60/EC) requiring the preparation of river basin plans, and the new requirements for integrated plans for coastal zone management.

The regional approach to planning, the increasing recognition of the importance of local issues and local stakeholders, and a tightening of the requirements for monitoring and evaluation, have

also increased the importance of more focused interventions, and hence the importance of geographic information to assess needs, target intervention, and monitor effectiveness. The increasing requirement to **adopt Geographic Information Systems for policy monitoring and evaluation** in fields such as agriculture, and water management are examples of this increasing importance.

A further cross-cutting theme is the increasing recognition that not only better information is necessary to inform policy, but better access and dissemination of information to the public is required to involve stakeholders, enhance participation in the democratic process, and help achieve key objectives such as environmental ones that require changes in behaviour and consumption patterns. The revised Directive on Access to Environmental Information (EC 2000) is a major step in this direction, but all policy areas signal the importance of this issue.

Within these “mega trends”, geographic information is crucial in two respects:

1. We are likely to see a significant increase of detailed geographic information across the Union as a result of the policy requirements identified above. This thematic information needs to be managed, analysed, and facilitated to government agencies, the private sector and the general public.
2. The need to integrate policy means that information also needs to be integrated across policy domains, and areas of intervention. Geographic information is increasingly important therefore not just for its thematic attribute content but also as the framework to integrate data from these different domains, and areas.

From a policy perspective, a range of requirements emerge from this:

- There is a need to increase the flow of disaggregated data from the local level, for example city neighbourhood, to the European level in all the policy domains.
- There is a need to develop new datasets and indicators for new policy domains such as eEurope, e.g. Internet access, e-business turnover, etc.
- There is a need to share knowledge of who has what data, and how it can be accessed, i.e. develop and implement a GI policy in the Union.
- There is a need for increased data comparability and interoperability, including for web-based visualization, data exploration, integration, and modelling from different sources e.g. remotely sensed and administrative data, types, e.g. quantitative and qualitative indicators, and disciplinary domains, e.g. environmental and social.
- There is need for agreed methodologies to characterize and analyse fuzzy territorial units such as landscapes, and aggregate data to different flexible geographies, such as river basins, coastal zone management areas, and nature protection areas.
- There is a need to develop methodologies to add intelligence to information –via accepted metadata and other standards-- collected for one purpose so that it can also be used as proxy in another policy area, and develop dynamic monitoring systems.

#### *4.2.2. The European Research Area*

The starting point for this initiative by the EU Member States and the EC is the recognition that European research receives less funding from both government and the private sector than is the case in the US and Japan. Moreover, most research in Europe is funded at the national level

resulting in fragmentation, overlap, and lack of synergy. With this in mind the EC Communications to the Council and Parliament COM(2000)6 and 612 envisage the development of a more integrated European Research Area based in particular on:

- Networking of existing centres of excellence, and the creation of virtual centres,
- A more coherent implementation of national and European research activities,
- The establishment of a common system of scientific and technical reference for the implementation of policies,
- Greater mobility of researchers.

Among the **research priorities** areas identified, the following are of particular **interest to the GI research community**:

- Research to develop the information society, particularly in conjunction with the eEurope initiative,
- Research in support of Community policies needed to implement a sustainable development model, and areas characterized by the presence of strong uncertainties and risk,
- Research related to the needs of society, and in particular economic and social issues.

#### 4.3. AGILE SWOT Analysis

How is AGILE currently positioned to address these priority research areas? Here we present a SWOT analysis, a standard management tool used to identify internal and external factors surrounding the operation or affecting the success of an entity (company, government agency or programme). The explicit Strengths, Weaknesses, Opportunities and Threats (SWOT) for AGILE are as follow.

##### *Strengths:*

- The association brings together over 70 member laboratories in 21 countries dedicated to GI research and teaching
- It encompasses both environmental and social sciences, with a strong underpinning in technology-focused research, hence displaying a strong multidisciplinary character
- It builds on over 10 year experience of collaboration in GI research at the European level starting from the EGIS conference series (1990-95) and the GISDATA programme of the European Science Foundation (1993-97).
- The number and quality of the research presented at its annual conference is growing year after year, and its working groups provide a flexible structure for collaborative research in the GI sciences.

##### *Weaknesses*

- The current research agenda is a useful identification of the research interests of the members, but it needs to be extended by a strategic agenda.
- The association needs to develop further its research priorities and identify the funding and operational mechanisms to pursue them,
- The profile of the association as the European network of excellence in GI research needs to substantiate with tangible branded outputs, rather than through the efforts of individual members.

### *Opportunities*

- Increasing recognition of the strategic importance of spatial information and GIS for policy formulation, analysis, monitoring, and evaluation at both national and European levels,
- Increasing emphasis on integrated and sustainable approaches to policy encompassing environmental, economic, and social objectives, analysis and modeling
- Emerging recognition of the importance of investing in Europe-wide network of excellence to address common research issues and achieve synergy, and as a platform for the mobility of researchers.

### *Threats*

- The main threat to the association is not to seize this favourable junction of emerging opportunities to establish itself as the recognized European point of reference for GI research. Without a significant gearshift in clarity of purpose, resources, and outputs of high scientific quality and policy relevance, the risk is that the association will be unable to sustain the momentum reached.

## 4.4. Towards an Action-oriented Research Agenda

In this section, five priorities for the development of the research agenda are presented. Next, some typical application areas for geographic information are described, and lastly, some necessary conditions for EU research programmes that have to be met are indicated.

### *4.4.1. Research priorities*

Three basic principles underpin the development of the AGILE research agenda:

1. AGILE is a largely academic research organisation and should therefore focus on addressing key fundamental research questions rather than the needs of any particular agency at any given time,
2. Research must advance science *and* be relevant to society,
3. An action-oriented programme must be *focused*, and therefore cannot address all possible research topics.

With these considerations in mind, the following **five challenges** are put forward as priorities to develop a research programme:

#### ***I. GI Policy and Society***

The exploitation of digital information poses challenges and opportunities as yet not fully understood or tested. Hence this stream will focus on the economics of digital information, and GI in particular; the role of government in the information society, including issues of access to information and information infrastructures; the spatial impacts of such agency on economic and social development; the transfer of innovation and organisational change.

#### ***II. Theory of spatio-temporal information systems:***

The construction of databases for spatio-temporal information requires nontrivial extension to current database theory. The questions posed are directly linked to the structuring of spatio-

temporal information, the methods to describe and manipulate it and also to present it. It seems possible today, to construct a comprehensive theory of spatio-temporal information management and presentation.

### ***III. Dynamic Modelling of environmental and social processes:***

The construction of explanatory models and the use of models for the assessment of the outcome of different policies is a large area of connected research questions. We must proceed from single resolution, rasterized (gridded) space or economic-ecologic non-spatial models to integrated dynamic spatial and temporal models, where the influences at different resolution levels integrate socio-economic and natural science contributions.

### ***IV. Semantic interoperability of spatial data and services:***

The use of the existing large data collections for many applications, many novel, is a crucial step in promoting economic and social development in the information age. Space related information systems are in a unique position, in that the meaning of their terminology can be connected to physical objects and operations on them (so called 'semantic grounding') and become therefore independent of national natural languages. This is the stepping-stone to build metadata, which not only supports data discovery, but can be accessed by applications and visualization tools ('intelligent' data know when they are relevant and how to 'behave' when being accessed by particular spatial services).

### ***V. Integration of social and physical sciences in their contribution to space:***

Methodological approaches and ontological assumptions for the physical and social sciences and the humanities are very different. For example legal procedures, engineering and planning are vastly different in their thinking – but all affect geographic space. Bridging the conceptual gaps of how space and time are viewed from different disciplines is crucial for the eventual integration of their results, and for the interoperability of models across domains.

#### *4.4.2. Examples of application areas exploiting Geographic Information*

<b>Common Agricultural Policies:</b>
Modeling socio-economic units (villages) and their viability with respect to different agricultural policies can show how different policies affect the different rural regions of Europe differently.
<b>Foot and Mouth disease:</b>
Spatial simulation of effects of changing the market parameters for animals on the volumes and routes of animal transportation and connect this to the possible spread of contagious diseases.
<b>Management of Coastal Zones</b>
The conflicts between the demands for economic development of coastal areas, the pressure from tourism in particular and the need to protect the unique ecological systems pose complex policy question. Rational backing for solutions can only be provided by dynamic models of ecology and economy in its distribution in space.
<b>Watershed management</b>
Some of the necessary policies to avoid the (regular) natural disasters have serious effects on the economic well-being of the region's inhabitants and are strongly opposed. The simulation of the interaction of policies on land-use, engineering measures and economy may show combination of

measures, which are beneficial to all.

**Transportation in Cities:**

Public transportation is the only possible solution for the massive demand for mobility in the highly populated areas of Europe. Transportation companies do not yet face the difficult problem of informing its customers systematically about the transport offerings they make and how they can be used – in consequence, individuals use cars for lack of information of public transport; less information is necessary to travel by car than using public means.

**Mobility technologies:**

The information society (eEurope) has profound effects on mobility and quality of life beyond vehicular transportation. It also provides key location-based information services to the tourism industry, asset management and maintenance, and emergency services including rescue and crime prevention and reduction strategies.

#### 4.4.3 EU research programmes

All these application areas require the construction of large collections of data with respect to geographic space that document past change and link it to causes of changes; most of these data are available, but must be integrated from different sources, bridging semantic gaps. The necessary models link ecology and economy with other social theories (e.g. the law). Advances in the research themes identified above will benefit any of these examples.

The EU research agenda should concentrate on practical case studies of direct value to Europe and its citizens (such as those listed above). The research agenda should – and this is different to today's Calls – require that the lessons learned from the particular research is generalized and integrated into a scientific framework; funds must be made available for the advanced training of scientists in the base sciences, including support for mobility, base funding for scientific centres of excellence where tools for use across many applications can be developed and maintained (e.g. dynamic spatial models emerged at University of Utrecht after 15 years of sustained effort). It must become clear that building a European scientific infrastructure requires:

- **People**, who can be supported with 2 to 5 year grants for PhD. and advanced qualifications and with mobility grants.
- Support for scientific **research with direct impact** to the European policy questions (as listed above), which can be organized around 3 to 5 year projects centred on concrete cases and involving 3 to 10 research units in collaboration.
- Long term support for **centres of excellence** where in the 5 to 15 year timeframe advances in the big challenges are achieved and the results from individual research is integrated, refined, and tools for subsequent research and applications produced.
- **Flexible framework** and lean management, to be able to respond quickly to new challenges and hot topics.

#### 4.5. The Next Steps

This Green Paper was discussed at the AGILE conference in Brno in April 2001, providing an opportunity for all participants to contribute and to contribute to the suggested research streams. Following on Brno, consultation within the wider research community is now sought, and

comments are to be incorporated into a White Paper that will become the basis of a fully articulated research programme for which funding opportunities will be sought. Please send comments to the fourth author (AGILE secretariat).

Finally, AGILE considers both the research map and research programmes to be fundamental initiatives for the Associations existence and hopes to be able to contribute, via its members, to the reinforcement of GI research policy in Europe and internationally.

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