From Local Heroes towards Global Communicators: The experiences of the UNIGIS network in educating GIS professionals worldwide

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1. Introduction

With eleven years of experience in successful international academic distance learning in spatial information management and geoinformatics, UNIGIS is one of the oldest distance learning initiatives. This is a valuable experience, with successes and mistakes that are typical of innovative initiatives.
This article presents an analysis of an international effort of seventeen universities worldwide in providing a common program in Geographical Information Systems (GIS), against a background of changes in the international landscape of tertiary education. These changes have to do with the tendency in Europe and the rest of the world to uniform the system of higher education and also with more general tendencies resulting from developments in Information and Communication Technology (ICT).
In this article, the following questions are considered:

- What is UNIGIS?
- How does the UNIGIS network grow within the context of changing landscapes?
- What are the different phases in the sustainable growth of the network, and what are the success factors in each of these phases? An example of the establishment of UNIGIS India is presented to demonstrate the process of expansion of the network.
- Which lessons can be derived from the experiences of the UNIGIS Network and what does the future hold in store?

The analysis is mainly based on the experiences of the UNIGIS office at the Vrije Universiteit Amsterdam (VU), one of the founding members of the network.

2. International Network

UNIGIS is an international network of universities co-operating in the design and delivery of part-time distance learning in spatial information management and technology (see also: www.unigis.net). The program was founded in 1990 and the network has since expanded into a worldwide group of seventeen universities that offer UNIGIS courses on a franchise basis. At present, per year over 1500 professionals from more than 40 different countries worldwide subscribed to one of the universities of the network to participate in the UNIGIS program. Another 500 are belonging by now to the UNIGIS alumni group.

The course is offered in a variety of forms including a one year postgraduate certificate, a two year diploma, or a three year MSc. Common to all these programs is the

basic structure of UNIGIS, which is based on a series of distance learning modules delivered via the World Wide Web (WWW), including course notes, computer exercises, WWW links, discussion platforms and reading materials. Member institutions of the UNIGIS network are relatively free to adapt and translate course resources and supplement them with additional materials to support the needs of local students.

UNIGIS students are professionals working in GIS for a wide range of organizations, including central and local government, utilities, consultancy, business, GIS vendors, research and education. They are people who link GIS theory to a whole range of practical applications, such as the monitoring of the movements of elephants in African national parks with the aid of GPS, the development of geographic profiles of rapists for the police, and the functionality of water quality monitoring systems. Although the GIS theory is largely the same in each case, the practical aspects vary enormously for each application.

The students are interested in acquiring a broad academic foundation to underpin their knowledge, in the course of which conceptual, technical and organizational aspects of GIS come under discussion. Because of their work and responsibilities they cannot attend conventional courses. Therefore they need flexible education that can be followed part-time, at times that are convenient for them. This means that the education must be as free as possible from limitations of time and place.

3. Rationale

Geographical Information Systems (GIS) are finding increasing application in a broad range of organizations, from utilities companies to environmental consultancies. Specialized undergraduate provision is still in its infancy, resulting in a large number of mid-career professionals being asked to take on GIS responsibilities but whose backgrounds do not include any GIS experience. For many, taking a career break in order to obtain a GIS qualification is simply not possible. On the other hand vendor training in GIS software is considered too superficial, unbalanced and related too much to certain products, and not scientific in nature.

In the second half of the nineteen eighties, an international group of GIS researchers and educators came together to discuss this vacuum in the educational market and possible pedagogical ways to address this specific target group. The original idea for the UNIGIS distance-learning program was developed at the University of Salford in the United Kingdom and its first phase of development was funded by a grant from the University Funding Council. At an early stage, however, it was realized that collaboration with other institutions would be necessary. The skills and knowledge needed to develop a comprehensive GIS course and optimally support students required resources from more than one university. GIS specialists in each institution are too few to support independently the administrative and academic inputs to a complete course, but together they represent a strong team with wide-ranging and complementary skills.

Notwithstanding the fact that initial market research from the Dutch Ministry of Education (1994) concluded that an educational program in GIS for professionals would not be viable, ‘stubborn’ scientists from the UK, Austria and the Netherlands started setting up the UNIGIS program[1]. The purpose was to provide the breadth of experience and knowledge necessary to run a course with a complete and logical structure. The focus was on a part-time distance-

[1] It is an interesting fact that the initial feasibility study indicated that UNIGIS would not be viable. Reality however has proven these findings to be incorrect. The student numbers demonstrate that the UNIGIS program meets demands.

learning route to postgraduate qualifications in the GIS field, suitable for those using GIS in the workplace.
Nowadays the network has expanded into an international group of seventeen universities in fourteen countries. Each UNIGIS Office at the associated universities works independently, but strong collaboration exists in the development of course materials and student support. The network also provides opportunities for organizing international summer and winter schools, making agreements with software vendors, obtaining European accreditation, etc.

The next important milestone of the network took place in June 28, 2002 when the UNIGIS International Association was officially established, which created a legal framework for the activities of the network. The aim of the Association is to promote education and interest in GIS at the highest level, both in national and international context, and to represent in the broadest sense of the word the interests of its members in that area.

Figure 1: UNIGIS International Network 2005

Within the Vrije Universiteit, the UNIGIS program was at first just tolerated. The concept of delivering international distance education for professionals was in the early nineties considered too distant from the core business of the university and besides, very risky. Moreover, the infrastructure of the university was insufficient to support this type of learning. For example, the fact that the UNIGIS office needed their own fax machine, was difficult to solve, because university policy only permitted each Department to have one fax machine. By now, these infrastructural problems have long been overcome. More important, the landscape of Dutch academic policies has changed dramatically. The impact of these changes on the UNIGIS program will be discussed in the next section.

4. UNIGIS within the changing academic landscape

There are several tendencies causing changes in the academic landscape, which directly influence the set-up of UNIGIS. One tendency is to uniform European higher education, resulting from the Bologna Declaration (June 1999). As a result, the Vrije Universiteit has put expansion and differentiation of the education supply high on the agenda. Three different effects can be mentioned:

- demand driven education plays an increasingly important role;

- post graduate education for new target groups, for instance professionals;
- the scope of the educational market has explicitly an international focus.

These effects have thus changed the university policy enormously in favor of UNIGIS-like educational programs: programs targeted at professionals, with new methods in education delivery (part-time, web-based distance learning), with a strong international flavor.
From a more pragmatic point of view, the change towards the Bachelor-Master structure in Europe and in the Netherlands offered an important opportunity for UNIGIS at the VU. The Netherlands used to have it's own national system and terminology of academic titles. For the UNIGIS program at the VU, this Dutch system was not compatible with the Bachelor and Master system used by the other UNIGIS members. More precisely, it meant that students of UNIGIS Amsterdam could only receive their Master of Science in GIS title through one of the English universities offering the UNIGIS program. The change towards the general Bachelor-Master system made it possible for UNIGIS to provide Master of Science Diploma in GIS from the VU directly.

A second tendency causing changes in the academic landscape results from developments in the information and communication technology (ICT). These developments caused powerful changes in the way education is delivered, the way students learn, the way lecturers teach, the way researchers work together, the way international collaboration takes place and the way the marketing of the courses can take place. We will discuss these consequences for UNIGIS:

- digital communication among students; among staff members; between students and staff; and between the institutions of the network;
- content delivery (the web as the new digital learning environment);
- marketing of the UNIGIS network (targeted both to students and industrial partners).

Email facilities, in combination with the fax machine and telephone, have been used right from the start of the UNIGIS program in 1992, as a general communication tool between UNIGIS students from all over the world and more specifically between the students and their tutors. The use of email has increased substantially since the start, and soon only students having email could participate in the program. Email (and the email archive) and digital forums improve the possibilities for students to discuss course material, to answer questions of other students and to improve the contact between staff and students. The only drawback that must be observed, is the dominance of native speaking English students on the general email forum; non-native speaking students seem to be more hesitant to participate.

In 1997, UNIGIS at the VU changed from a paper-based program to a digital learning environment. On a protected internet site, students can access their personal study center, in which they can find their study status and records, their personalized course materials, and contact information of other students and staff.
The intranet site also contains a special area for the UNIGIS staff. Since several staff members are working on a part-time basis for the program, and others are traveling quite a lot, all members can access the information they require through the internet. Via the web, they can consult which assignments have to be reviewed, and they can look up student records. The administration is also done via the intranet. This includes keeping track of grades awarded, submission of student assignments, the tutors' evaluation of them, monitoring study progress and the access students have to their course materials.

The international UNIGIS network has benefited substantially from the opportunities the internet offers to support online distance collaboration and for marketing and promotion purposes. By hiring a virtual office place on the internet (see figure 2), neither hardware and

software installation nor maintenance required, all members of the network have access to all the documents of the Association. Without distinctions, every UNIGIS node can publish new information on the intranet site for other members to see, and have at their disposal all up-to-date information regarding the network. This is an important step forward, as members from all countries have equal access to the network, wherever they physically are. The secure intranet site, only accessible by passwords, contains announcements on GIS Summers Schools, on newsletters published by UNIGIS nodes, on interesting conferences, magazines and software developments. On a calendar, one can see what workshops or other activities are going on at the UNIGIS offices of the different universities. More important is the "documents" section on the intranet, which contains all information regarding access to the shared learning materials (the course modules), official documents on the UNIGIS International Association, contracts with Industry and Institutional partners, information on shared educational and research projects, and materials for marketing and promotion. The intranet site is also useful for more practical purposes like having all contact information of all members at hand, and being able to set up 'polls' within the network.
There is also a database of all UNIGIS students worldwide (respecting the rules of privacy of course), which is extremely helpful in negotiating favorable contracts with Industry. Being able to come up with impressive student numbers, seduces Industry to supply the students with free or almost free software, in the expectation that these professionals will also use their commercial software within their professional work environment after finishing the program.

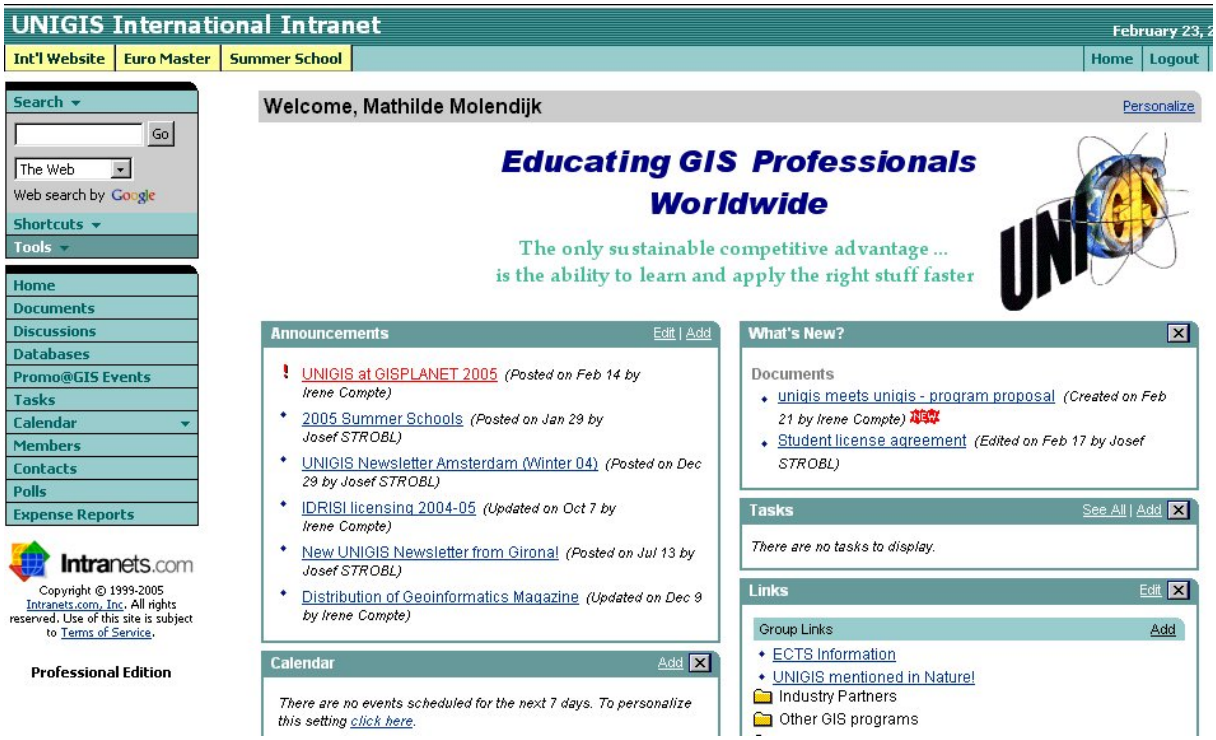

Figure 2: UNIGIS International Association **Intranet** site

From a marketing perspective, the UNIGIS International public website is very useful for the acquisition of students and for promoting the publicity of the UNIGIS brand (see figure 3). Although most of the students still find their way to the UNIGIS program by mouth-to-mouth advertisements from fellow students and alumni, the UNIGIS web pages are to an increasing degree important to draw students to the program[2].

[2] See also www.unigis.net**,** and www.feweb.vu.nl/unigis.

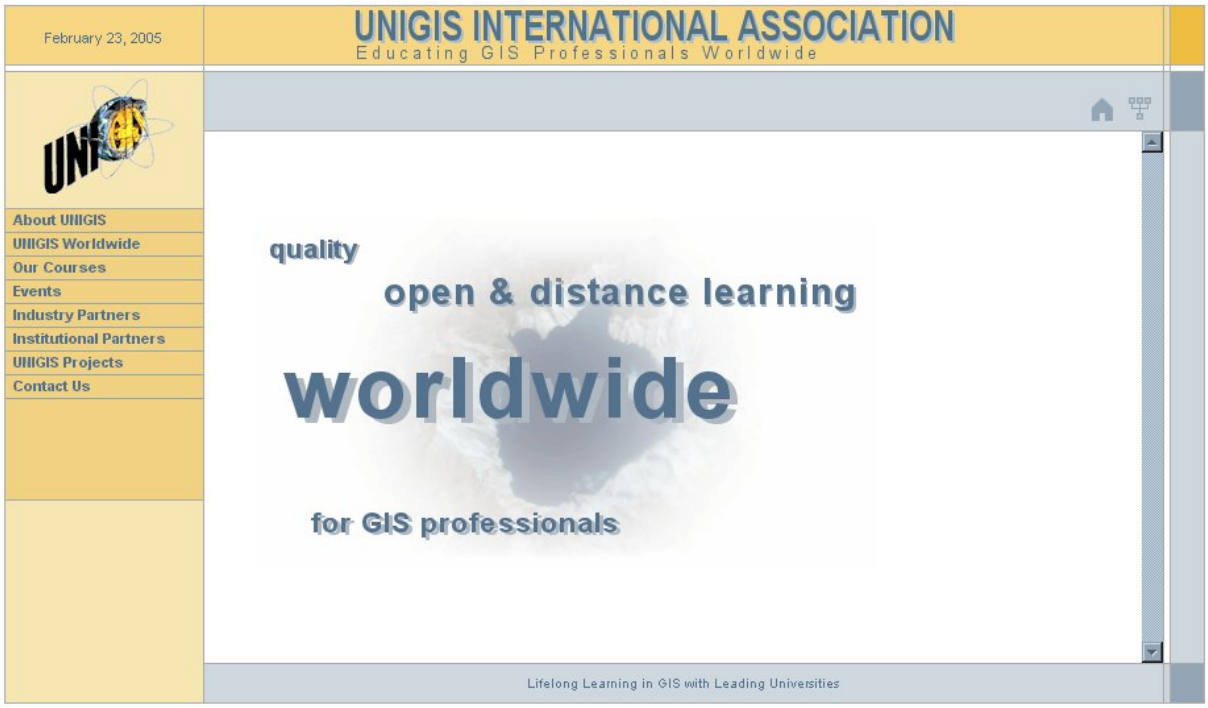

Figure 3: UNIGIS International public website

In sum, the two tendencies discussed in this paragraph played a substantial role in explaining the growth of the UNIGIS network. The changing policies facilitated explicitly the positioning of UNIGIS within the existing academic structures; this innovative program could no longer be considered as an odd, maverick program, but was now put forward within the university as an example for desirable future developments in education. The tremendous developments in the field of ICT have made it possible to strengthen considerably the virtual network. Besides attracting more students to its program, the internet offers the UNIGIS International Association a new way of communication, which makes the organization transparent and democratic, with equal access for every member. Above all however, it is the extraordinary progress in communication between students themselves and between students and staff, together with the impressive content available on the web, that the web is causing revolutionary changes in education and which has made the UNIGIS network a sustainable network.

5. Description of the growth of the UNIGIS network

In the area of information systems science, the model of Nolan (Nolan and Gibson 1974) is often used to describe the development and growth of a new information system within an existing organisation. The stages that Nolan distinguishes in this context are: initiation (first tests of a new system by a limited number of 'pioneers' within an organisation), growth (expansion of pilots of the new system within the organisation), control (the new system conquers a clear place within the administration of the organisation) and integration (the new system is integrated in the organisation). In parallel to this model, we can distinguish the following comparable stages in the establishment of the international UNIGIS network (see also figure 4):

The initiation phase (phase 1, 1990 – 1995)

This stage results from the efforts of a limited number of enthusiast academics having a clear vision and ideas on GIS tertiary education for professionals. These 'champions' were prepared to introduce new methods in their education, in a very innovative way and without paying too much attention to university structures. This phase is characterized by:

- a great deal of energy the champions put into their new educational methods;
- an unstructured way of implementing this education within the university;
- a limited amount of students ('guinea pigs');
- a limited number of universities involved (namely the five founding members of the network, from the U.K., Austria and the Netherlands);
- and starting with the education without being certified properly.

The pilot is carried out outside the official university structure and the technology being used is still limited (fax machines and computer network). From the perspective of the students it is also an initiation. They accept that not all components are of high quality. In return they do get a lot of attention, and their critical remarks are appreciated and seriously used. Financially it is an investment, possible by funding from projects.

The growth phase (phase 2, 1995 – 2000)

This phase is characterised by the following developments:

- the network starts to take up the question of 'branding', to protect its ideas by using formal contracts;
- the network starts to put the issue of 'quality assurance' on its agenda;
- the network becomes multi lingual - the use of just the English language is becoming too limited to fulfil the ambitions;
- the number of institutes associated with the network, as well as student numbers per institute, starts to grow;
- some champions of the initial group drop out: they look for innovations in other directions or they cannot cope with the newly emerging structures. Some institutes simply do not manage to get along;
- rapid and fundamental developments in technology (esp. the genesis of the World Wide Web);
- strong support from Industrial partners;
- for the students the courses are highly structured with detailed planning.

The control phase (phase 3, 2000 – 2005)

The subsequent processes typify the control phase:

- the network undergoes further regularization, most noteworthy is the formal establishment of the UNIGIS International Association (UIA);
- the UNIGIS program is now available is several languages (English, German, Spanish, Hungarian, Portuguese and Czech), and the modules are enriched by local contents from several universities offering the UNIGIS program;
- the quality of the modules increases;
- the contents of the program are being enhanced and fine-tuned. Students enter now a more flexible program with several specialization pathways;
- the education is being enriched and further differentiated by the incorporation of international GIS Summer Schools in the curriculum;
- the amount of students and of partner institutes increases further;
- contacts with the students become less intensive;
- contacts with the Industrial partners become contracts;
- growing mobility of students and staff within the network;

- spin-off activities such as working on joint research projects and the joint development of new course modules;
- special relationships with GIS organisations originate. These organizations start to commit themselves to training their employees through the UNIGIS program (e.g. certain Departments of the Dutch Ministry of Water Management, or the Ministry of Agriculture).

The final growth phase (phase 4, 2005 – 2010)

For the final growth stage we envision:

- further globalisation trends. Life long learning will be accepted and UNIGIS is the global, virtual & multilingual university for GIScience.
- UNIGIS at each university site will be incorporated within the existing university structures, and the universities are adapted to these kinds of collaborative educational networks.
- Further standardisation of the ICT will take place (e.g. blackboard as the ict working environment)

However, it would be a mistake to have the impression that this is really the final stage. Immediately it is also the start of a new life cycle. A couple of issues which do ask for a new start will make this clear. Information Technology will get a new position within universities, e.g. at the VU the discussion has started to have a Multi Media Centre. The application of our discipline in other science directions takes place (e.g. Health Sciences, Marketing). This kind of new forms of cooperation will have strong influences on the way the courses have been organised till now. The step from distance learning to regular ('indoor') education is a big one. One of the lessons learned is the way we have organised the contacts with the students. From very intensive it became a real 'distance' course. We came to the conclusion that we have to intensify the contacts again: these are valuable for both students and staff members, and it is a privilege to work with professionals.

The growth of the network never reaches its final point in phase four. Every new institution joining the network asks for specific measurements and actions that are related to phase one, two, and three. The big difference is that we are now able to look back, and based on the experiences we are able to guide them in a more structural way through the pitfalls of the different phases. Later on, we will give an example of this by describing the establishment of UNIGIS India.

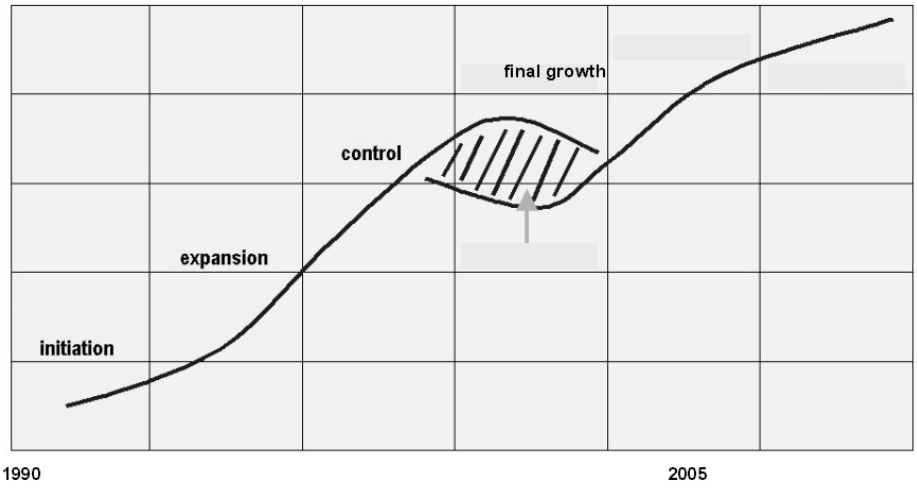

Figure 4: Adaptation of Nolan's model to visualise the growth of the UNIGIS International Network.

6. The strategy of the network explained

If we try to explain the growth and sustainability of the network, apart from the developments described before concerning ICT and the educational policies changing the academic landscape, it makes sense to use the literature of the economists. A well-known book in trying to explain the strategy behind networks is the one from Shapiro and Varian, Information Rules (1999). The next paragraph will use several of their concepts to explain the sustainable growth of UNIGIS from an economic perspective.

Economics of networks

A fundamental economic characteristic is the fact that the value of connecting to a network depends on the number of people already connected to it. This basic rule can be interpreted in a variety of ways. It becomes more interesting for institutes to take part in a network if the right number of renowned institutions are already collaborating. This is not surprising because it then becomes easier to achieve success in your own country. The reasons for this may include the quality of the material used, the opportunities for undertaking joint activities, utilising the expertise of senior researchers and teaching staff, as well as exploiting the brand and the other marketing resources that have already been created by others. Experiences from other countries in getting the study programme certified are highly valuable for countries where this has not happened.

Similar arguments apply for students too. They have trust in the network because many of their peers have gone before them – with success – and the material offered is impressive. What is important is a brand name that is recognized, i.e. the certification of diplomas and titles by the universities. But the international aspect is also important. Students are aware of globalization in their field. The cooperation between international institutes instils confidence. Being able to work together with international colleagues and students is an impressive

experience. Student recognition is managed through enrolment at universities. Students are enrolled locally, and the enrolments are then shared centrally to provide students with benefits of the network (discounts or free copies of the 'Friends of UNIGIS', see below).
In addition, there are of course many simple benefits of the network: it is a lot easier to get work done if people can share their energy, experiences and wisdom.

This explains an important strategy of UNIGIS: growth. This growth should be achieved in two ways: from a network node, on the one hand. A node must ensure that it has a sufficient – and preferably growing – number of students. On the other hand, the network must also achieve growth through the addition of new institutes in the network. A logical conclusion of the first line is that the density of the network should not be increased such that the institutes then have to compete with each other.

More about growth
There are a number of factors involved in the strategy to increase student numbers. Firstly, there is the quality factor and the monitoring thereof. Every institute has to ensure that the programme is certified in the respective country. If this does not happen, efforts are made to have the certification done in another country at one of the other institutes. Students then graduate from the partner institute. For almost seven years, the Dutch students had to graduate from an institute in the UK. However, the programme has now been certified in the Netherlands.
The quality must also be reflected in the materials and in the way the materials are offered and the learning process supported. It is especially important that the materials are continually updated and that they include localized information.

An equally important strategy is the differentiation of the materials. We have made a conscious choice to differentiate the material given to the students. Preferably, this would take the form of a personalized version of the material, but in our case we have opted for five specialization variants. This gives students a large degree of freedom to choose material that fits in with their own wishes and work experiences.

Localizing the material also plays a prominent role in the growth of the network. Firstly, it is important to bring about a geographical spread and coverage of the network. This strategy is complemented by differentiation of the material. The first strand of this differentiation is language. UNIGIS material is currently available in Czech, English, German, Hungarian, Portuguese, and Spanish. Consideration is currently being given to expanding the offering to Greek and Italian too. This means that as well as studying in their own language, students can also choose one or more other languages. One of the aims of the European MSc is to encourage students to study in several languages. Apart from the question of language, specific local aspects relating to the use of GIS are also a factor in further developing the material. This is because the key geographic institutes in the world (land registries, national survey, etc.) are organized in totally different ways. Furthermore, coordination of this discipline varies the world over. The learning material takes account of these local variations.

Intellectual property rights
The goal should be to choose the terms and conditions that maximize the value of the intellectual property rights rather than maximize the protection of the material. This rule sounds straightforward, yet especially in the academic environment, the matter is not that easy. Learning materials do not have the same significance as articles or books, but they still have authors who have compiled and developed them. A lot of energy goes into finding

formulas so that institutes who have produced materials retain the intellectual property rights therein, but that there is still sufficient freedom to ensure that the material can be distributed, used and modified. This subject remains an area of attention. The network does not therefore have intellectual property rights, but does have the brand and brand support materials.

Organization of the network

The network is organized along the lines set out above. It is essentially decentralized, but with a small centralized overhead[3]. The network's governing body is responsible for its growth and its general quality, but is dependent on the relationship with and between the partners in the network. A meeting is held annually between the directors of all institutes to evaluate the strategy and to adopt a strategy for the forthcoming year.

As well as the academic institutes, the network also includes the 'Friends of UNIGIS'. Throughout the years, relationships have developed with the key commercial players in the field. in particular with software developers. They add value to the network in several ways, for example, through their name, by offering discounts on their software (or free copies), and by providing financial support to students through scholarships or training places. They are also able to share their experiences and offer help with the marketing of UNIGIS. One software supplier, for example, gave all the institutes more than 100 books describing the state of the art in applications and the use of their software.

We endeavour to achieve market leadership. Not through pricing, but through early presence in the market combined with a vision of how to stay in the front position, based on the rules of network economy with the knowledge and developments in our discipline.

7. Expansion of the network, a case study of UNIGIS India

An example of the expansion of the UNIGIS network, based on the growth theory, forms the recent establishment of UNIGIS India. Before launching a new UNIGIS site in Asia, a two-year research project was formulated together with UNIGIS partners in Europe and interested potential partners in Asia. This project, known under the name InterGIS[4], is considered as a first necessary step to get to know the new partners in Asia. In this case the knowledge and skills of the academic GIS staff of these potential new partners had to be updated, and measures had to be taken to improve the technical infrastructure at the Asian universities necessary for the delivery of the UNIGIS courses. The content of the UNIGIS curriculum had to be adapted to the Asian circumstances. Furthermore it is crucial to establish good contacts with a local team of enthusiast personal, as well as to get insight into the internal policies of these universities that should favour the UNIGIS way of educating professionals. On the other hand, this acquaintance with the research and education in the field of GIS and Remote Sensing in Asia is a valuable contribution to the UNIGIS network.

The InterGIS project proposal was submitted to the Asia-Link Program of the European Union. The Asia-Link Program was launched at the beginning of 2002 to foster regional and multilateral networking between higher education institutions in European Union Member States and South Asia, Southeast and China. The InterGIS project aimed at enhancing educational, scientific and technological interaction between Europe and South Asia in the rapidly growing field of Geographic Information Science. The two main objectives of the

[3] The UIA applies a two tiered contribution system, in which each member university pays according to its own financial means. Apart from this, the UNIGIS offices pay for the use of modules from other UNIGIS universities, and a small "concept fee" also has to be paid. Each UNIGIS office at the associated universities is financially independent and is largely funded by student contributions.

[4] See also www.gis-learning.net

project – curriculum and human resource development - are achieved through various activities including:

- review of existing curricula in Europe and Asia (including the partner institutions);
- identification and prioritization of GIS educational needs of the GIS community;
- developing a common GIS curriculum;
- assessing the educational and job market potential;
- training selected teachers and students through international GIS Summer Schools and workshops according to the needs of the target groups and consistent with the standardized curriculum.

By now the two main objectives of the project have been reached (see figure 5):

- the existing UNIGIS curriculum has been modified based of the curriculum review, and the identified specific educational needs, taking into account the developments in the job market.
- teachers and post-graduate students from the partner universities are selected and trained ensuring adoption, implementation and dissemination of the curriculum.

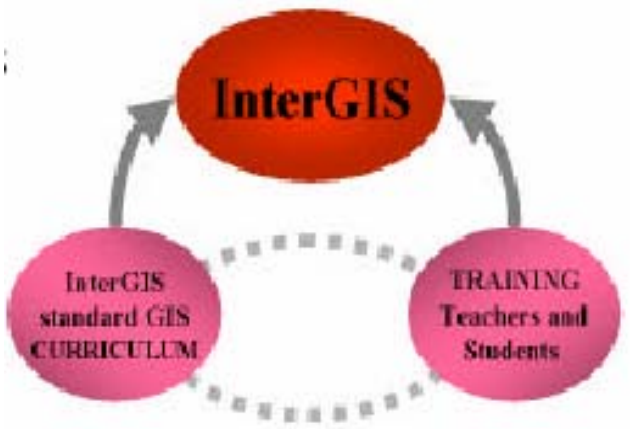

Figure 5: Main objectives if the InterGIS project

Under the umbrella of UNIGIS Salzburg (Austria), the University of Goa is now the youngest node within the UNIGIS network. Salzburg helps in this initial phase with the marketing of the programme in India, as well as with the further training of staff. Salzburg assists in the organization of workshops and Summer Schools at the University of Goa and at other linked universities in India. Apart from meeting the objectives of the projects, the spin-off in terms of getting to know the staff well over the past two years and knowing the differences in pedagogy between the universities and countries, serves substantial to the mutual understanding and eventually the success of the expansion of the network into Asia.

Figure 6: UNIGIS India in-the-make

8. Lessons Learned

Several lessons can be drawn from the case study of the UNIGIS network. Lessons regarding the international collaboration, and lessons resulting from the use of ICT, and in particular the World Wide Web.

Lessons Learned from International Collaboration

It is important to establish a lively network through virtual communication (via the intranet site, or resulting from mutual projects) and face-to-face contacts through staff and student exchange, international Summer Schools or annual network meetings. It is also important that each university within such a network is largely independent, although in the initial phases of setting up a new site, twining with an 'older' network member is recommended. Some practical tips and lessons:

- Promote student and staff exchange between the associated universities; promote mobility and enlarge the horizon of students and staff through the organization of Summer Schools or other international events.
- Balance globalisation trends and local needs. The UNIGIS courses are in continuous development and are offered in several languages. The curriculum, the modules and the communication with the students are adjusted according to the local needs and demands. In Spain and Portugal for instance, web meetings with students form an integrated part of the program. In Amsterdam participation in the yearly workshops at the Vrije Universiteit is obligatory.
- Also entry requirements for students vary considerably from university to university, as well as the course fees and even the diploma's awarded (the diploma's are issued from the different universities). To solve this latest issue, a European Union project (EMGISc[5]) was set up, aiming amongst others the certification of a common European master degree in GIS.
- Each participating university has a considerable degree of independence. The UNIGIS International Association looks after the mutual interests of the network.
- International collaboration is extremely positive for augmenting the quality of the course materials. Not only are the materials evaluated on a yearly basis by students

[5] see www.euromastergi.org

from all over the world, the modules itself are developed by the network members according to each speciality.

- International collaboration, and having a large international student community, is very favourable for negotiating beneficial contracts with Industry and institutional partners. The network has agreements with the main software players in the GIS field. Although UNIGIS does not favour one particular GIS software package in its' education, each UNIGIS office decides for itself which GIS software packages are supported. Since it is impossible for the staff to support all GIS software packages, students are informed beforehand what to expect regarding the technical support from the staff.
- The International network facilitates the collaboration within research and educational projects, as demonstrated for instance with the InterGIS project on curriculum development and capacity building.
- Be careful with the selection of partners for the network. The vision behind the network should be that all partners contribute to the strengthening of the network. Screening of the partners beforehand on mutual aims and interests according to fixed procedures is recommendable.
- Also keep in mind that the interest to participate should be of an academic nature, and not so much of a commercial nature. The network can function financially independently, but great financial benefits should not be expected from it. Joining the network is not about getting high quality educational materials for a bargain.
- Do not spend too much time on working out detailed plans for collaboration with international partners. To a great extend, these networks, the accompanying synergism and ambitions grow from practice.

Lessons learned from web-based learning

It is noted that ICT offers many interesting technological possibilities for distance learning such as easy access to course material, student support, international knowledge exchange through discussions, as well as possibilities for course organization and administration. On the other hand, the push from technological possibilities like chat rooms, SMS text messaging, video rooms, gaming places, etc. has sometimes overshadowed the didactic applications. Exploiting all these opportunities and creating a living learning community demands most of all dedication and commitment from both students and tutors.

Experience teaches that distance learning, certainly when combined with the flexible structure of the course, threatens to be a very individual pursuit, and it demands a large measure of self-discipline from the students. Compared with traditional education, students slip more easily into a spiral of study delays. From student evaluations it appears that a stricter guidance from tutors is needed to keep students motivated and to avoid delays. Discussions via the internet do not arise spontaneously. Tutors must stimulate active discussion, which demands a considerable investment of time by the staff, which is handled quite successfully for instance at the UNIGIS offices at the universities in Portugal, Spain and Austria. As mentioned before, language also forms an obstacle for participation in an international forum like the UNIGIS discussion list, where the working language is English.

The introduction of web-based learning leads irrevocably to changes in the course organization to accommodate the new way of working. The maintenance of the course website at each of the universities[6] requires a considerable investment of time and money. The website must be kept up-to-date with new items to keep the site interesting for students

[6] Each associated university is responsible for it's own technological infrastructure.

and others. Further, the course material must be regularly reviewed and links to web resources must be continually checked.
From the student side, having fast access to the internet is a requirement to enable study of a web-based course. This is not possible in every country. In South Africa, for instance, the course is much less web-oriented because otherwise the number of potential students would be too limited.

In sum, the ICT has improved the program in terms of efficiency and quality, and offers at the same time more flexibility for the students. For the students, the use of the ICT offers almost unlimited flexibility in their choice of modules, specialization pathways, study pace, communication etc. They have access to the program from all over the world, all the time. At the same time, they form part of an international study community of professionals working with spatial information, which envisions the growing need for life long learning. The students consider this as a very valuable element of the program.
The developments in ICT, together with the changes in European educational policies (as described in paragraph four), and the economic strategies underlying network growth (described and explained in paragraph 5 and 6), explain the success of UNIGIS at a more theoretical level.

In conclusion, starting up the UNIGIS network was an adventure. The expedition has brought new horizons, excuses to travel around the world, but above all, a reason to be not any longer the local hero, but a global communicator, accepting the knowledge and wisdom of both students and colleagues around the globe.