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## 24

# UNIGIS – networked learning over a distance

#### Josef Strobl

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## 24.1 Introduction

One area in which GIS&T educators have innovated is in distance learning using a variety of delivery methods and approaches and often in collaborative ventures. As they have discovered, it is one thing to develop materials in a collaborative venture, but quite another to deliver them into differing educational systems. In this, the UNIGIS experience is particularly interesting. In the early 1990s, universities from the UK, Netherlands and Austria joined forces to offer distance learning programmes in what back then was simply termed 'Geographic Information Systems'. Although UNIGIS started using a hardcopy correspondence format, the emerging internet immediately was used for all communications, and later served as a base for content management and integrated learning platforms. Today the UNIGIS network of universities (www.unigis.net) includes partners on all continents, ranging from the original Manchester-Amsterdam-Salzburg cluster in Europe, to the Americas, Southern Africa (Breetzke, 2007), an emerging presence in Australia, and to a rapidly growing network in Asia. These partner universities are now complemented by study centres in many additional locations. These are operated by an academic (or other) institution in a defined region and are under the academic and organizational responsibility of one of the UNIGIS partner institutions. Students tutored at local study centres are registered at the host (partner) institution which awards the final qualifications. Such has been the development of the network that it is now possible to register for a UNIGIS programme in at least twenty-five institutions worldwide and its programmes admit close to 1000 new students each year.

This idea of online distance learning in GIS&T was of course not unique to the UNIGIS consortium, but was also taken up by a range of academic institutions and by some publishing houses. Few succeeded in the longer term, with exceptions being professional courses in the Penn State's *World Campus*, *GIScOnline* from Birkbeck, University of London, and a long history of successful programmes hosted from Kingston University, also in London.

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Other initiatives, like the *Virtual Geography Department* (Solem, 2000) or the *Swiss Virtual Campus* (see Chapter 26) contributed numerous lessons-to-be-learned.

This chapter is not intended as a how-to set of guidelines, and certainly not as a record and assessment of all developments in nearly two decades of work. Rather, it is presented as a case study that illustrates some of the more important considerations that have emerged from both successes and failures in the UNIGIS network. Although we review issues related to the development of the network, the character of our students, our approach to the curriculum and so on, of particular interest is likely what we have to say about the organizational framework itself and the way that it supports a variety of business models.

## 24.2 Networks

UNIGIS has a very wide geographical spread of partner institutions, and this is only made possible by a single core principle. Although standards, quality and expertise provided by UNIGIS qualification are expected to be 'global', access, assistance and communications (including language of instruction) are localized as much as possible. This 'local studies for global qualifications' approach requires a well organized network of independent institutions and could not be replicated by the strictly centralized approach adopted by other distance learning providers in the field.

The sustainability of UNIGIS as a widely distributed 'federated' and highly flexible approach to GIS&T education in very different locations is clearly linked to its character as a network of partners. Such a network has high resilience and can adjust better to local variations in things such as curriculum, legal idiosyncrasies and fee levels (lower fees in one market have to be supported by lower cost through localization of resources). At the same time such a network can take advantage of common ground while retaining independence when it is needed. In UNIGIS, central management is vested in the *UNIGIS International Association* (UIA), which is a foundation incorporated in the Netherlands with participating academic institutions as members. It is governed by the association board with an annual general assembly at one of the member sites. However, under what is actually a very thin layer of network coordination by UIA, there is a growing body of bilateral and multilateral agreements and cooperative action.

## 24.3 Target audience

Distance learning actually is not only characterized by its mode of delivery, but most importantly it is also defined by the particular target student audience (see Strobl, 2008). Most UNIGIS students are currently active as GIS&T practitioners, and a majority hold previous degrees and has substantial professional experience. All think that GIS&T is an expanding area offering increasing future professional opportunities and want either to establish themselves fully in this field, or to improve their career options by means of a formal qualification and acquisition of a more structured knowledge base. Interestingly, this target group of ambitious, upwardly mobile and highly motivated professionals turns out to be quite similar in many different countries, societies and environments. 'Average' UNIGIS students are in their thirties, have collected professional experience after a first undergraduate cycle of studies, are starting their families and thus are 'settling down'. At

#### 24.3 TARGET AUDIENCE

the same time they are recognizing the value of a geospatial approach in their professions, looking at stabilizing and enhancing their careers and wanting to make sure they stay at the 'top of their game' in the coming years.

In the current age of 'Lifelong Learning', this kind of continuing education increasingly tends to be the rule rather then the exception. As the speed of many (technological and other) developments seems to accelerate, 'updating and enhancing' one's qualifications is frequently required, and professional careers as well as personal lives cannot always be put on hold to 'go back to school'. In-service continuing education when holding down a job and tending to family and other social obligations implies not only temporal constraints, but also geographical limitations. Distance learning offers the requisite flexibility in scheduling and place of learning. This is illustrated by the fact that in German speaking regions the geographical distribution of students does not exhibit a significant distance decay from Salzburg, but rather is determined by clusters in the general population.

Even though GIS&T is an ICT-oriented discipline, a broad majority of students do not consider themselves to be ICT professionals. First, they regard themselves as belonging to some original domain or discipline such as Planning, Resource Management or Ecology and, typically, in any intake of students no one discipline will have a share of higher than 15 per cent. For them, GIS&T is essentially an enabling technology, a methodology that allows them to do a better job in these domains. This clearly demonstrates the position of GIS&T as a *transversal* discipline, offering geospatial concepts, thinking (National Research Council, 2006), methods, and spatially explicit communication methods (like 'mapping') to many different disciplines. In short, recognizing the value of GIS&T from personal experience, 'having a problem and looking for a solution' distinguishes the typical UNIGIS student from undergraduates obtaining a qualification and then starting to look for an application domain.

Although UNIGIS was originally conceived as a postgraduate programme aiming at masters (MSc) qualification, it became clear early on that a significant subset of candidates were not aiming at an(other) academic degree, but rather at a recognized qualification in geospatial methodology and technologies that could be obtained in a shorter timeframe than a traditional Masters. Such a 'professional diploma/certificate', branded as 'UNIGIS

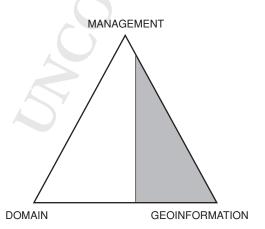


Figure 24.1 Qualification emphasis offered by UNIGIS with major weight on geospatial concepts and methods, a management perspective, and building upon (application) domain knowledge

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professional', is offered in some regions either as a first step towards an MSc (e.g. in the UK), or as a separate, parallel study programme (e.g. in the German language programme). In the latter case admission requirements are somewhat lower than for the MSc option, although in practice most applicants already hold academic degrees and are looking for an add-on qualification in GIS&T.

While the above mentioned target groups are surprisingly similar across most UNIGIS partner institutions worldwide, a somewhat different type of student is emerging in some Asian countries with a focus on select partners in UNIGIS India. Typical applicants there have completed a first degree and immediately afterwards try to enhance their employability and career prospects with an additional, postgraduate qualification. This in turn means that these students study full-time, and distance learning does not individualize their learning contexts in the same ways. Indeed, sometimes classroom settings are used to facilitate online access and tutoring.

Given these additional target audiences, it is not a trivial task to translate these needs into common curricula and academic delivery frameworks and it is to these that attention now expands. Although practitioners from various application domains continue to pursue GIS&T add-on qualifications, student numbers from technical (or integrative – like Geography) disciplines looking towards GI to start their careers are increasing.

## 24.4 Curricula

In any field curricula serve several important and partially overlapping purposes, such as defining objectives and outcomes, communicating the focus of study programmes, defining expected qualifications for both students and employers, and facilitating the comparison of alternative study options. In a new discipline like GIS&T it is at the same time both harder and easier to define curricula when compared to well-established disciplines. It is harder, because work has to start from a beginning in which the range of options and potential contents can seem overwhelming. It is easier because there is less 'baggage' in the form of traditions and 'always-have-been-important' topics and it is possible to have a more forward-looking focus on outcomes and less on the identity of a discipline. Starting with the NCGIA Core Curriculum and more recently culminating in the UCGIS Body of Knowledge (DiBiase et al., 2006), the GIS&T community has worked hard to build its identity through a common understanding of what graduates are expected to understand and able to do. In each of these (and many other) curriculum development initiatives some fundamental questions have been explored:

- Are the required ICT qualifications included, or considered prerequisites? Some curricula
  and textbooks continue to start from the very old fashioned 'bits-or-bytes' discussion
  (Toppen, 1992).
- Should we have to teach students in some user-discipline context? Particularly in continuing education, students know quite well *what* they intend to do with their GIS&T, they want to learn *how* to do it and to do it well!
- How should we incorporate still rapidly evolving areas of spatial technologies, such
  as data acquisition through imaging, LiDAR, GNSS, SensorWebs, UWB and other indoor positioning and tracking technologies? Are these constantly updated parts of a

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- curriculum, or rather instantiations of generic concepts related to how we measure the 'what-where-when' of phenomena?
- With what emphasis do we include indispensable topics that can legitimately be considered independent disciplines? Examples of this, from a very long list, include remote sensing, surveying and cartography.

It follows that, as in many applied, technology-oriented curricula, there is a 'demand conflict' between concerns of immediately employability and longer term conceptual and generic knowledge transcending technology generations.

The specific challenge to postgraduate, continuing education curricula like UNIGIS arises from the fact of a very diverse prior exposure to explicit spatial thinking, geospatial concepts and, for example, 'mapping practice' in the target audience. As an admission criterion we keep considering the idea of 'spatial disciplines', that is, disciplines with a mapping tradition such as Forestry, Planning, Transportation, Geography and Geology, whose graduates are more likely intuitively to relate to approaches to spatial analysis as compared to, for example, a Computer Science graduate, who will bring different strengths. In one attempt to balance starting positions, UNIGIS Salzburg developed two 'propaedeutical' learning modules, *ICT for Novices* and *Geography for non-Geographers*, teaching basics of ICT and spatial thinking and concepts respectively. Experimentally, these modules were prescribed for 'borderline' admission candidates and helped with final admission decisions, motivating some candidates to retract their applications, and providing others with a smoother start.

Essentially, the key issue of prerequisites is by and large neglected in most GIS&T curriculum development efforts. This issue is of course more critical the later in life a curriculum is aiming, and is obviously most relevant when students join from very different experiential backgrounds, academic disciplines, cultures, and application domains. Most likely this variety cannot be dealt with adequately through strict prerequisites and remedial learning, but rather flexible implementation of curricula with supportive tutoring and instruction as discussed in the next section of this chapter.

Another closely related issue is giving credit for prior learning. Candidates with a variety of backgrounds bring with them formal qualifications and academic credit invariably overlapping with at least some of the curriculum requirements. Curricula focusing less on the process and more on outcomes and what-students-can-do can deal with requests for such credit for prior learning more easily by telling the students to 'just do the assignments and demonstrate your competences'!

UNIGIS maintains a *Common Core Curriculum* to cross-reference programmes at various member institutions and to serve as a common guideline. Beyond this core, partners are free to define and offer elective subjects allowing students to emphasize themes and objectives of particular interest. Maintaining a balance between compulsory core subjects and electives is an interesting issue, but currently is around 50% core, 25% electives and 25% thesis.

In several academic institutions, curricula for geoinformatics programmes as well as the qualification of suitable teachers, development of materials and distance learning *per se* were entirely new, even though highly qualified academic departments already existed. In this, European Union (EU)-supported curriculum development initiatives under the *Tempus* framework also turned out to be helpful in Poland, Croatia and Central Asia while at the same time offering participating UNIGIS sites from other countries the chance to reflect on their practice, often initiating substantial change in all institutions participating in the project.

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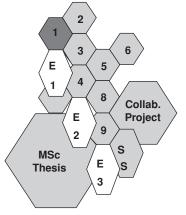


Figure 24.2 UNIGIS (University of Salzburg) Curriculum Schema with compulsory modules (1-9), electives (E1-3), summer school (SS), collaborative projects and Master's thesis

One example for a recent curriculum debate was centered on the applications/ geoinformatics issue: are graduates expected to be primarily competent application developers, or should they first understand methodology application logics in their domains? Parts of the industry are clearly demanding 'computer scientists with a spatial touch', while the broad range of application domains requires some development skills, but more of a focus on 'what to do' instead of 'how to implement'. These divergent demands can hardly be covered in any single programme, so UNIGIS is experimenting with blocks of electives focused on application development, spatial database design, or related qualifications to respond to the demand for advanced ICT skills without changing course away from an applied programme supporting the full spectrum of application disciplines.

In Europe, curricula are expected to be 'Bologna-conformant', based on the European Credit Transfer System (ECTS) measuring student effort to achieve defined outcomes. Twenty-five to 30 hours are rated as 1 ECTS, and a full Masters programme typically requires 120 ECTS over four semesters. ECTS, though, is not well defined for continuing education, part-time studies, overlap with professional practice and competence-oriented qualifications. Implementing curricula usually follows national or institutional regulations governing the academic institutions awarding a qualification, therefore necessarily leading to differences in frameworks. This is particularly noticeable in interdisciplinary and international cooperative programmes like UNIGIS, where a strong common denominator and divergent local constraints have to be balanced.

#### Organizational framework 24.5

The academic norm is to take an agreed curriculum and implement it in a traditional environment of classes and classrooms, lectures and laboratories followed by examinations over a number of semesters. All universities have a clearly defined modus operandi of how successfully to make this happen, but when UNIGIS was launched, none of the departments involved had any experience of how to manage and organize an academic programme not tied to classrooms, not timetabled by hour and semester, and not involving regular

face-to-face contacts between students and instructors. Today a *modus operandi* has evolved across different UNIGIS partner sites that groups admitted students into cohorts or *intakes*, synchronizes their progress through obligatory *modules* (= classes), with materials provided through online learning management systems, and with written assignments uploaded and then graded by instructors.

It is interesting to note that in virtually all partner universities successful participation in the UNIGIS network was a bottom-up initiative led by GIS&T faculty and that the infrastructural and organizational role of the university apparatus varies widely. Although some functions, such as learning management systems, student databases and quality management, are run by the university, in a majority of instances a parallel infrastructure is run by the UNIGIS unit itself (and sometimes shared across partner sites) to take care of all the specific requirements that arise from distance learning in a continuing education context.

## 24.6 Business models

The overall business model is the most decisive factor for successfully organizing quality postgraduate programs by distance learning, but once again in practice the key factors are quite similar across the UNIGIS partners. In them, the development and running of a new distance learning study programme represented a very substantial investment, but neither the initial investment nor the subsequent operation are fully incorporated into the overall university financial structure. Even though national fee systems vary widely, UNIGIS typically is implemented as a separate financial operation in each university with a mandate for full cost recovery including institutional overheads. A number of scale effects (cf. DiBiase and Rademacher, 2005) mean that, to keep study fees at an acceptable level, development and other costs have to be shared and spread over multiple institutions.

This latter point was a key incentive for UNIGIS to develop into an international network. The effort of development and delivery, the breadth and depth of required faculty expertise across many fields (Foote, 1999) and infrastructures for learning would have required impossibly high student numbers to be financially viable. Such large numbers immediately run counter to important objectives like personalized student contact through tutoring and supervision and building of knowledge in tightly connected student communities. Moreover, in many instances the market area of a single institution as defined by language, region and target group(s) would not have supported such high student numbers on a sustained basis. The development of a network of institutions, where cost, expertise and ideas are shared means that new partners now, roughly 20 years after the original inception of UNIGIS, face a very low startup barrier, and can offer a programme they most likely otherwise would not be able to sustain on their own.

That said, organizational and business models at partner universities differ widely. In some cases operations are tightly integrated into the university structures, reflected as one cost/revenue cycle operating completely within the institution's business systems. In more cases, though, UNIGIS is run more like a project within the academic rules of the institution, but all or most faculty are employed or contracted directly as UNIGIS staff and all expenses have to be borne directly from revenues.

Overall, distance learning requires new lines of organizational thinking, reaching across and beyond the traditional boundaries of institutions. As proposed in the Networked Organization of Distance Education (NODE) concept and illustrated in Figure 24.3, online, or

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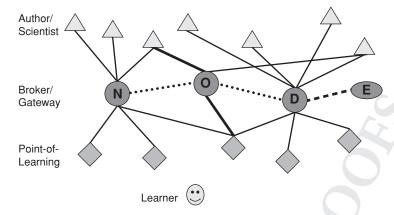


Figure 24.3 NODE - Networked Organization of Distance Education

physical points-of-learning provide student access to institutional (university?) frameworks that in turn connects learners with authors and facilitators of knowledge. In order for it to be sustainable each step in such an educational value chain needs to be properly reflected in the business model.

As outlined above, the scaling and sharing of efforts between and among UNIGIS sites on average by far exceeds the within-university resourcing, resulting frequently in more of an intra-UNIGIS dependency than individual university integration. Therefore it is not surprising that UNIGIS partner sites now consider themselves a *Virtual University of Geographic Information Science* reaching across many 'real' universities.

## 24.7 Online learning didactics

Initially, none of the founders and early actors in UNIGIS had any serious experience in distance learning. Starting out with a correspondence course certainly does not provide much experience relevant to today's online environments. While many strategies and operational steps had to be developed from experience, the guiding principle actually did not change, and it is tightly coupled to the particular target group at the core of the UNIGIS initiative.

Although the UNIGIS originators knew nothing of it, the network developed at the same time as the ideas of *Situated Learning* and *Communities of Practice* (COP) (Lave and Wenger, 1991). A COP is loosely defined as a '... group of people who share an interest, a craft, and/or a profession ... and then proceed towards ... through the process of sharing information and experiences with the group that the members learn from each other, and have an opportunity to develop themselves personally and professionally'. Due to the characteristics of a mature target audience and the UNIGIS focus on continuing education, students went from being a group of practitioners through a community of learners to a community of practice. The latter is manifested in the *Club UNIGIS* alumni association that some graduates consider the most important of the outcomes from their studies, as it offers an effective professional network that some alumni use as a key foundation for their professional activities. As so often in advanced continuing education, academics need to recognize that our role is less and less that of teacher, but more and more that of facilitator

and moderator. Even in a new intake of UNIGIS students, most of them are already GIS&T professionals, and can share a treasure trove of skills, experience and domain expertise by far exceeding what the academic faculty can offer.

A common language of concepts and an environment conducive to learning are important first steps towards facilitating students learning from each other and with each other. The concept of the network, which at the beginning of this chapter was focused on institutions, actually might be even more important for the learning process among mature, motivated students. This is why UNIGIS courses start with face-to-face workshops, designed to entice students to establish small learning groups. Even though follow-up communication will be mostly by electronic means, this initial learning in study groups might at first sound counter-intuitive in an online distance learning course, but it actually is what keeps individuals motivated, secures high completion rates and already well thought-out questions to instructors. These workshops are the first step towards the development of communities of practicing professionals within *Club UNIGIS*.

Obviously, acknowledging learning as a social activity is the foundation when developing practical guidelines for online didactics. The use of social web technologies facilitating group interaction in a learning environment has already been discussed in Strobl (2007). Since then, a variety of new technologies have offered themselves for consideration. Emphasizing peer interaction as a foundation for learning certainly does not take away responsibilities from teachers. Working with a given number of students in an online rather than a residential class turns out to be more work for the instructor, not less — a factor which by now is widely recognized and, for example, discussed in Beaudoin (1990) from the perspective of the resulting lower teacher-to-student rations. The need for a full time tutor who is a first point of contact for students has been established from experience and positive feedback over many years. Instructors at sites with less domain expertise receive second-level backstopping by module authors and recognized experts.

Some of the key lessons we have learned about on line distance education are:

- Active learning starts from a constructivist position, but in addition offers the advantage of providing feedback to students, an insight into 'what I can do'.
- Providing feedback may well be the most important factor in sustaining motivation. Whether through quizzes, a successful result from an analysis, or from personal interaction, learners need regular and frequent feedback on their work.
- A need for quick turn around help, particularly when working with sometimes obstinate and idiosyncratic technologies (We are of course not talking about GIS&T software here!). Learners can get quickly frustrated with very minor glitches.
  - Providing a clear sense of purpose through examples, case studies and applications from real world domains.
  - Establishing the link to professional practice through the use of professional software, which enables students immediately to see the mutual benefit and overlap between what they are learning and their professional job.
  - Collaborative projects/assignments offer a break from individualized work, focus on teamwork as an important facet of professional practice, strengthen a learning community, and often lead to impressive results.

This list of lessons learned could be extended, but should make one well-known conclusion very clear: an academic programme is much more than textbook content and an

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exam. The overall social environment, the process of learning in all its variants, and the consideration of each student as an individual – all have to be taken into account in a more explicit and conscious way for distance learning programmes.

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#### 24.8 **Quality assurance**

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Quality assurance and management (QA) are acknowledged to be indispensable and critical elements for successfully sustaining academic programmes. In the context of a distributed, multi-partner distance learning arrangement there are some factors to be considered beyond the standard institutional and external accreditation and quality monitoring procedures. Overall, the entire network 'benefited greatly from the initial QA process and practices based on the mature UK system' (Petch, 2010, see http://www.qaa.ac.uk/) but with the expansion of the network to cover new regions, themes, contents and actors, QA cannot now be considered fully satisfactory. In fact, distance learning poses several particular challenges peculiar to itself. Some, such as assuring the identity of a student actually having submitted an assignment, are relatively easily resolved, but others, such as rating the professional relevance of a learning outcome in a local market, are not so simple and some, such as ensuring the direct compatibility of level of graduates in opposite parts of the globe, are virtually impossible. QA is one of the core tasks for UIA and network management. While institutions will and mostly do take responsibility for assuring the quality of their own qualification awards, securing the integrity of the brand and level of UNIGIS qualifications worldwide is as difficult as it is essential.

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As Jim Petch (personal communication, 2010), one of the UNIGIS originators, has commented: 'Distance learning and e-learning are but first steps in the intelligent industrialization of education. Still there are lots of lessons to learn. But this is where the main frontier for education lies. And QA is what will enable it to be intelligent and not just a haphazard by product of technology.' He goes on: 'End-to-end QA for e-learning is crucial for using e-learning as agent of change - and a key issue for enabling next generation teaching and learning. A sine qua non for sustained development of distance education!'

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Practical measures for quality assurance in UNIGIS vary greatly, but for the most part rely on established methods whose overall aim is to produce an ongoing, high level QA culture across a diverse and heterogeneous network:

joint curriculum development;

- benchmarking of curricula against standard industry curricula;
- cross-site training workshops for UNIGIS faculty;
- mutual/peer review of learning materials;
- sample review of student assessments, a process that is not always trivial considering the multitude of languages involved;
- sample co-review of theses;
- masters thesis competition, and submitting theses to external competitions which provides an incentive for high performance;
- publication of papers under external review.

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Again, this list can be extended but it serves as an illustration of the many practical steps required to establish a thorough QA environment; this is of course a process that by definition will never be finished.

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## 24.9 Conclusions: successes and challenges

Why has the UNIGIS distance learning programme in GIS&T proved to be so successful for over two decades (see Strobl and Car, 2009)? In retrospect it is possible to identify factors that have enabled the establishment of the programme globally and that have very little to do either with the technology used for delivery of the courses or, for that matter, the detail of the curricula on offer. Possibly the most important has been the development of trusting relationships among partner sites, between students and instructors, and among fellow students. UNIGIS would never have emerged if some of the key actors had not successfully worked together before. In turn this reflects a shared set of aspirations and objectives (Molendijk and Scholten, 2005) and a focus on the social contexts of learning. The flexibility and adaptability of a bottom up approach and an extensive network has enabled the sharing of resources and innovations, and co-operation with the GIS&T industry has enabled the programme to stay close to both market needs and student expectations.

This is not to say that there are no remaining challenges associated with sustaining the growth of the network and the evolution of the technology. As UNIGIS has grown, so it has become more diverse, leading to greater possible differentiation in institutional and individual agendas and making the maintenance of an appropriate quality assurance regime increasingly difficult. At the same time there is an increasing need for curriculum maintenance and reinvention to respond to increasingly rapid changes in the technological environment in which we are situated.

## Acknowledgement

James Petch has contributed significantly to the content of this chapter both as the founder of UNIGIS, and by sharing specific thoughts and comments on some of the themes and issues discussed. Thanks are also due to university leaderships for 'letting this happen' in the early stages and trusting an unproven concept.

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