Creating a Geodesign syllabus for Landscape Architecture in Denmark

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Abstract

Geodesign provides a conceptual framework through which to understand relationships between geoscience and design. This paper takes its point of departure from the merger of the Departments of Geography and Geology and Forest, Landscape and Planning at the University of Copenhagen, and the subsequent approach taken to Geodesign as a means to realise potentials within the new academic structure. The aim is to address specifically how an on-going process of transforming the Landscape Architecture program has begun to integrate GIScience in a new way that fosters integration within and between disciplines. The approach to Geodesign will therefore be discussed in terms of cross-disciplinary dialogue and curriculum development. Emphasis will be placed on the results of the Geodesign Conference held at UCPH in November 2014 at which practitioners and academics came together to present extensive experiences and understandings of Geodesign. The conference was also the forum for discussion of the challenges and opportunities offered by Geodesign in the context of teaching.

1. INTRODUCTION

During the European Geodesign Summit 2014 at TU Delft it became clear that, while the number of Geodesign oriented programmes and courses is increasing in the U.S.A, use of the term Geodesign at European universities was only just beginning. In this context the work of the University of Copenhagen (UCPH) with Geodesign must be seen as somewhat pioneering and exploratory. This chapter presents the first concrete initiatives of the newly formed Department of Geosciences and Natural Resource Management (IGN) aimed at harnessing the potential of Geodesign. These initiatives include the Geodesign Conference in Copenhagen 2014 (Geodesign Conference, 2014) and the current transformation of the BSc program in Landscape Architecture at UCPH.

This paper explores the background and profile of the BSc program in Landscape Architecture at the UCPH, and the development of GIS education in Denmark generally. The unusual coupling of academic disciplines at IGN is explained with the significant potential that it offers for interdisciplinary work. The field of Landscape Architecture education is ever evolving as the nature of landscape problems and opportunities change over time. The means by which we teach, learn and do landscape architecture are equally evolutionary and the pace of that evolution is ever quickening. The means to tackle complexity through the use of IT, for example, have multiplied remarkably in recent years. The consequences of these rapid developments can be hard for even experienced teachers and practitioners to comprehend, and frameworks within which to understand these changes are essential. Geodesign is one such framework, offering a conceptual model that can cross disciplines, but it aims consistently at facilitating and understanding spatial change.

Geodesign brings into focus a range of methods and tools that many Landscape Architecture educational programs are already using, but significantly Geodesign makes communication with other disciplines, and practices possible in new ways. Importantly, Tom Fisher (2010, 2014) identifies a key strength of Geodesign as that of critically addressing the consequences and impacts of proposals. He states that traditional design thinking focuses too much on the current and immediate needs of the clients and communities. By addressing the impact of design and planning decisions practitioners are forced to adopt a descriptive stance before returning to a reformulation of their otherwise prescriptive work. The tools and methods necessary for this shift give a common platform of understanding with scientific disciplines where the prescriptive nature of planning and design is often viewed with scepticism.

As a relatively new and evolving term Geodesign is still at an early, formative stage, and questions of how to organize and structure Geodesign education, its curriculum, scope and workflows are being explored by an increasing

number of academic institutions that are adopting Geodesign within existing programs, or establishing new majors with Geodesign at their core (Paradis, Treml, & Manone, 2013). The relationship of Geodesign to well established disciplines such as Landscape Architecture and Geography remains a focus for a number of academic papers, and almost all summits and conferences organized to date.

Carl Steinitz (2013) in his speech given at the Geodesign Summit 2013 in Redlands, CA, presented options for organizing educational institutions and programs based fully or partially on Geodesign. Steinitz shared his opinion that a design profession school should combine several design oriented disciplines, e.g. architecture, landscape architecture, urban planning. Similarly to Fisher (2014), Steinitz argues that 'even the school of design […] does not have all the things that influence it and it influences'. To his mind a favourable situation (also with great Geodesign potential) is when such design school is coupled with geographical sciences. At UCPH the ambition of combining Landscape Architecture, Planning and Geosciences presents itself as achievable due to the unique disciplinary organisation of the university.

2. BACKGROUND

2.1 Organizational change at the University of Copenhagen

The Department of Geosciences and Natural Resource Management (IGN) at the UCPH was formed in 2013 after a series of mergers, and reorganisation of research and university institutions.

Starting in 1991 a Department of Economy and Natural Resources (ENR) was formed at the Royal Veterinary and Agricultural University of Denmark (KVL) by the merger of the small institutes of Landscape Architecture, Urban and Rural Planning plus Forestry, and Applied Economics. In 1992 a number of Danish technical and applied research organizations in forestry and landscape engineering were merged to form the Danish Forest & Landscape Research Institute (DFLRI) under the Ministry of Environment. Later in 1996 physical and urban planning, as well as GIS were added to the institute's research profile. In the late 90's most ministerial research institutions in Denmark were transferred to universities. Therefore, DFLRI was merged with ENR to form a new department of Forestry, Landscape and Planning at KVL. In 2007, KVL was merged with the UCPH. However, the organisation of KVL remained intact as a Faculty of Life Sciences (LIFE). In 2013 a new faculty of Science was formed merging parts of LIFE with the UCPH Faculty of Natural Science. From the latter the Institute of Geography and Geology was merged with the largest part of Forestry, Landscape and Planning to form the IGN. It is now a rather large university department with approximately 450 FTEs (including 160 enrolled PhD students) and 2000 students.

A result of these mergers has been the creation of a significant concen-

tration of GIS expertise in both teaching and research at the department. This expertise is found across all five sections of IGN: Forest, Nature and Biomass; Geography; Geology; Landscape Architecture and Planning; and the Forestry College. With a range of theoretical and methodological traditions these sections are all engaged in understanding, predicting, planning and managing the spatial domain of human environmental interaction.

According to the IGN departmental strategy, formulated in the spring of 2013, the merger of diverse departments resulted in "an increasing need for internal cross-program collaboration. In the fields of geography, nature management and landscape architecture, new possibilities should be identified, assessed and pursued, both to ensure efficient use of resources and to develop new potential" (IGN, 2013).

In this context, Geodesign has been seen as a promising framework within which to conceptualize key activities at IGN. Geodesign would also appear to offer significant opportunities to promote integration and cross-disciplinary collaboration between the scientific domains already present at IGN, in particular between the sections of Geography and Landscape Architecture and Planning, but also other fields working with Hydrology, Forestry, Climate Adaptation, Recreational Planning, Urban Livelihood and Mobility, and Nature Management. Therefore, IGN has chosen to foster Geodesign both in terms of research and teaching.

2.2 Landscape Architecture at the University of Copenhagen

The current BSc and MSc educations in Landscape Architecture at the UCPH have developed from Garden Architecture teaching at the then KVL in the 1930's. Later in the 1960's a specific Landscape Construction education gave rise to what has become Denmark's largest Landscape Architecture education. By 2000, a strong research tradition was developing in connection with the education and in 2002 a new research and teaching department was formed named Forest, Landscape and Planning. In 2006, the landscape architecture BSc increased student uptake and since then, has offered a specialization in Physical Planning, now at both BSc and MSc level. In the same period, teaching of all masters programs switched to teaching in English and the number of non-Danish students and staff increased rapidly. Specifically, Urban Forestry as a subject area fed an interest in Urban Greenspace Planning and Management, and now the MSc offers specialisations in Landscape Design, Urban Planning, and Greenspace Management. The growth of Landscape Architecture as an academic endeavour is reflected in a burgeoning PhD cohort, and a steady increase in professorships.

Teaching within Landscape Architecture at UCPH is science-based with the clear sense of design and planning as the interplay of art and science. On the BSc level students are schooled in natural processes in parallel with

the development of an aesthetic sensibility fostered through creativity. Plant, soil science, and water management are, for example, taught through 'learning by drawing' techniques, and early design projects address challenges that have clearly defined scientific and aesthetic aspects.

The history and current practice of Danish landscape architecture, architecture and planning is drawn on extensively in teaching. This, and the students' a priori awareness of the Danish design tradition, contributes to a generally significant aesthetic sensibility amongst students. The vibrant educational environments associated with other Danish design and architecture schools in Copenhagen also feed into this. In this context, the aim is to negotiate means for engagement with aesthetics, through design, in relation to natural science and human processes. Since the expansion of the Landscape Architecture programs into urban planning, the role of design and aesthetics within the discipline has presented new challenges. Not least, because many colleagues from beyond the design disciplines are engaged in teaching on the programs. At the same time a growing number of designers have joined the existing staff, and research in design processes at UCPH has been fruitful in recent years. This has been reflected in the teaching in relation to design process and in particular the use of IT. However, the latter has been somewhat fragmented and has had a limited reach amongst teaching staff. Within the Department the research group for Landscape Architecture and Urbanism has taught the BSc course Design Method and IT tools (AutoCAD and Adobe), and the MSc course Terrain and Technology in Landscape Architecture (Civil3D). GIS has been taught from outside this group and has been only weakly integrated into the BSc and MSc programs.

2.3   GIS practice and education in Denmark

GIS is well embedded within various educational programs in Denmark and a thriving GIS-user community exists both amongst academics and practitioners. Computer based mapping and handling geographic information emerged in Denmark in the 70's and 80's with projects relating to utilities (Jacobi, 2006), agricultural land-use mapping (Platou, 1984) and geological mapping (Jørgensen, Hermansen, & Jensen, 1993). Early development of in-house systems failed to reach a level of maturity, but served to establish the professional discipline and highlighted the need for development, research and education.

In the early 90's a range of universities and other educational institutions, mainly in disciplines relating to architecture, engineering, and geography, became active within the field. In particular Aalborg University, the Institute of Geography of the UCPH and the Institute of Landscape at KVL. In 1991 UGIS, a consortium of academics from various universities, was formed (Balstrøm, 1992). The intention was to coordinate teaching and research, and

to exchange experiences and knowledge within the fairly modest number of researchers interested in GIS at the time. UGIS resulted in an enhanced national network and a range of book- and inter-university teaching activities (e.g. Balstrøm, Jacobi, & Sørensen, 1992, 1999). Despite its obvious need, the organization did not sustain. The main reason was that universities due to politically motivated reforms were encouraged to compete regarding fund and students.

At present GIS is taught at several Danish universities. At Aalborg University, Roskilde University, and the UCPH undergraduate education is provided, whereas numerous courses aiming more or less explicitly at geoinformatics are provided by Aarhus University, the University of Southern Denmark, and the Danish Technical University.

In a Global context explicit considerations regarding application of GIS and other geo-focused technologies to planning range back to the mid-90's (e.g. Batty, 1995). Planning Support Systems (PSS) and Spatial Decision Support Systems (SDSS) have developed to be common terms for "models and methods that inform the planning process though analysis, prediction and prescription [and] provides the driving force for modelling and design" (Geertman & Stillwell, 2009). Traditionally these approaches have been particularly aimed at registration and ex-ante description of the present, and the processes leading to it. Geodesign is in addition concerned with ideas and suggestions of what the future could be to cater for observed or foreseen problems or to afford future needs and wishes. Accordingly, Geodesign adds informed creativity, means/tools for developing/expressing proposals, and ex-post evaluation of potential effects and functionality of proposed designs to assessments of the past/present made by GIS (and SDSS).

In May 2009 national law was enforced as an implementation of the EU's INSPIRE directive (Denmark, 2014; INSPIRE, 2014). The law states that a range of geodata, services and metadata repositories, including data produced by municipal and state authorities, must be made publicly available (Danish Geodata Agency, 2014a). Among the many very good things about such open access is that teaching and education relating to geodata can take place on the same data as applied in real-world by private and public organizations.

2.4 The formation of the GIScience & Geodesign research group

With the creation of IGN in 2013 the newly formed Section for Landscape Architecture and Planning restructured its research groups. A new GIScience & Geodesign group was formed, aiming to bring together researchers and teachers within the section, and across IGN, working with GIS in interface with other software. The group offers the benefits of coordinating the teaching of computer based spatial analysis and design, but it also requires a broader perspective, one that is not bound to the use of specific software.

According to Steven Ervin it is probable in the future of Geodesign that "we will no longer need to distinguish between building and landscape, or CAD, or GIS, or BIM [Building Information Modelling], or LIM [Landscape Information Modelling]" (Ervin, 2012). This understanding of the evolutionary nature of IT processes is seen as essential within the group. The group is engaged in comprehending and problematizing the application of IT to spatial problems, requiring dialogue and a broad understanding of the possibilities for analysis, planning, and design processes across IGN.

3.   AN APPROACH TO GEODESIGN

Geodesign is seen as a set of tools and methods founded in iterative, explorative and creative design processes. These processes are under constant development as they are challenged, expanded and transformed by the increasing availability, and expanding functionality, of geo-spatial technologies and data management systems. At UCPH unique opportunities for collaboration across Geo-disciplines create a strong platform from which the aim is to help drive these developments.
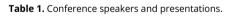
The task of bridging science and design involves the development of methodologies that harness the power of analysis offered by digital data as a means to open up and expand the possibilities for speculative and exploratory planning and design. For geo-scientists the challenge is to understand the open-ended nature of design processes, while for designers the challenge is to understand the depth and significance of geo-data and geo-data processing.

The first phase of this interdisciplinary approach has brought Geographers, GIS professionals, Landscape Architects and Designers together to begin teaching Geodesign on the Landscape Architecture program. Now the potential to broaden the scope of Geodesign teaching to engage multidisciplinary student groups, in and beyond the Landscape Architecture curriculum, is seen as an all-important next challenge.

3.1   The Geodesign Conference in Copenhagen 2014

To kick-off the venture into Geodesign at UCPH it was decided to arrange a one-day conference with invited international speakers at the forefront of Geodesign teaching and practice. The Geodesign Conference in Copenhagen was held on November 11th 2014 with around 110 attendees (Geodesign Conference, 2014). These ranged from practitioners from private and public sectors, bachelor, master and PhD students, and faculty and management from the department. The morning session of the conference was devoted to mapping the concept of Geodesign with the focus on background and technologies. The afternoon session focused on curriculum development and establishing Geodesign education and training.

In connection with the conference IGN hosted what we believed to be the first Geodesign PhD course in Europe. For attendees of the course, their first day involved attending Geodesign conference, helping to frame the concept and put it in perspective. The following days were dedicated to presentations by selected invitees and PhD students' own projects. These presentations and discussion sessions were held in an informal manner where ideas were exchanged freely. The detailed list of speakers and topics discussed during the conference and PhD course can be found in Table 1. Videos of the presentations can be found via the Geodesign Conference in Copenhagen homepage (Geodesign Conference, 2014).

SPEAKER	SPEECH TITLE	CREDENTIALS AND AFFILIATION
Morning session		
Thomas Fisher	The rationale, definition and history of Geodesign	Professor and Dean of the College of Design, University of Minnesota
Michael Flaxman	a) Geodesign in Environmental and Regional Planning Practice b) Applying Geodesign thinking to ongoing and advanced projects within various disciplines	CEO at Geodesign Technologies, former Associate Professor at Massachusetts Institute of Technology
Elliot Hartley	State of the art and pointers to the future of Geodesign technologies	Director at Garsdale Design Limited
Afternoon session		
Stephen Ervin	a) The making of a Geodesign proponent: A Systems View and Personal Journey; b) A Geodesign syllabus for Landscape Architecture and Urban Design c) Geodesign as a research area and academic discipline	Assistant Dean for Information Technology, Harvard Design School, Director of Computer Resources, and lecturer at the Department of Landscape Architecture, Harvard Graduate School of Design
James Querry	a) Transforming a classic landscape architectural education to Geodesign b) A Geodesign syllabus for landscape architecture and urban design developed at Philadelphia University.	Associate Professor and Director of the MSc. in Geodesign Program at The College of Architecture and the Built Environment at Philadelphia University

Table 1. Conference speakers and presentations.

4. IMPLEMENTING GEODESIGN IN THE LANDSCAPE ARCHITECTURE CURRICULUM

As of September 2015 the BSc program in Landscape architecture at IGN adopted a simplified structure with an emphasis on clearer progression and alignment. Geodesign methods and concepts play a key role in these developments, helping to bridge diverse disciplines and approaches. Geodata and related IT tools are introduced in the context of design and planning methodologies with increasing frequency and intensity through the curriculum.

Methods and topics will be revisited iteratively, building to allow students to tackle ever-increasing complexity in problem solving. Understanding of design processes will be closely coupled to assessment of design tools and their relevant application. Geodesign will act as a clearly defined way marker for a 'spiral syllabus' (Bruner, 1960) and play the key role in initiating this form of learning. The introduction of powerful IT offers a relevant impetus for such reflection.

To build the foundations of work with Landscape Architecture the first year of the program focuses on natural and human processes, creative expression and aesthetic sensibility using simple-to-use technologies and methods. At this stage, the tracks will be laid for the development of Geodesign with the introduction of key concepts. A start will be made in design work including an introduction to design frameworks (Steinitz, 2012). Teaching on the first year will include the simple use of online GIS map data, both commercial and from public bodies, specifically online repositories of planning-relevant data. Apps that students already use or can quickly become proficient in offer other easy means to 'lay the tracks'. For example Blenduko in color theory teaching and Minecraft in perspective teaching are already being used.

Other applications which the students are familiar with, e.g. Google Maps or the Danish Planning System (Danish Planning System, 2014), including The Danish Natural Environment Portal (Danmarks Miljøportal, 2015) and Historic Atlas (Historisk Atlas, 2015), provide a basis for the discussion of geo-technology in relation to design methods.

The second year is explicitly Geodesign-focused with tools such as GIS and CAD being introduced. Here data capturing, storage, analysis and presentation are combined with design projects, and 3D visualizations are developed.

The third year, where students specialize in either landscape design or urban planning, there is scope for steady development of Geodesign skills and the bachelor thesis offers the opportunity for students to demonstrate their proficiency in the use of tools and methods. By this stage in the education, the aim is to identify the extent to which Geodesign thinking informs the students' approach to their work (Table 2).

4.1 The Geodesign studio

As part of the new curriculum in September 2015 a new Geodesign course was introduced in the three year Bachelor program in Landscape Architecture. The course runs halftime throughout the first semester of the second year with 58 students enrolled. It is a studio course where introductions to geo-data, GIS and CAD inform analysis and design methodologies. Students combine a number of methodologies dependent on task, complexity and landscape scale. The study area in 2015 was the municipality of Greve, south

of Copenhagen where, in response to periodic flooding, local planners have taken a strategic regional approach that has required numerous local landscape-based solutions. Students have analysed this regional situation and planning framework as the context for their own landscape interventions. A site was selected based on situation, accessibility for students and the potential for rewarding landscape design. The site is a shallow valley covering 35 hectares of ex-agricultural land attached to an old agricultural school. The small stream Odsbækken runs through the valley and down into the urban areas of Greve where flooding has been common.

YEAR	SEMESTER 1		SEMESTER 2
1.	Plan & Design 1: Studio		Plan & Design 2: Studio
	Natural Processes 1		Natural Processes 2
2.	Geodesign: Studio		Elective courses
	Botany	Philosophy of Science	
3.	Plants & Technology 1: Studio	Plants & Technology 2: Studio	Bachelor Project and Bachelor Internship
	or		
	Urban Design 1: Studio	Urban Design 2: Studio	

Table 2. Outline of the Landscape Architecture BSc curriculum.

4.2 Teaching approach

The main focus of the teaching approach is to ensure that the development of technological craftsmanship and structured scientific argumentation and working methods can fuel qualitative creative thinking and ultimately ignite the imagination. Likewise domain specific methodologies and knowledge, inferential analytical approaches and insight into the characteristics of existing geo-data are essential components to be tackled with creative sensibility, perception and speculation. This was tackled through a series of design workshops.

Site visits have been structured to give students an unfolding understanding of both the hydrological region and the locality. By visiting the site early, before doing instructional GIS and geo-data exercises in computer laboratories on campus, students could put a landscape to the geo-data they would be handling subsequently. A second visit allowed students to correlate their perceptions and understanding of site in the light of both geo-data and their own first site-design concepts.
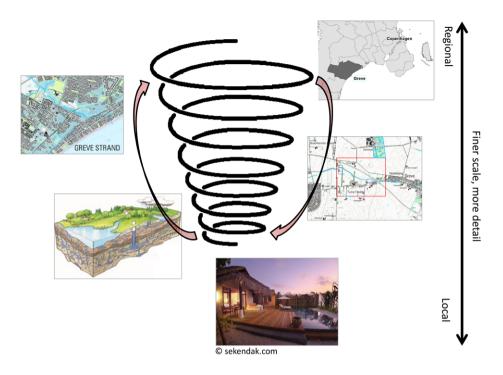
Figure 1. A spiral approach to teaching Geodesign. See the text for details.

4.3 Spiral teaching

The concept of spiral teaching (Bruner, 1960; Harden & Stamper, 1999), as applied in the present context, manifests itself through the visiting and revisiting of the same location at different geographical scales, assessing different planning and design themes and perspectives, and applying different mediations – quantitative and qualitative, digital and analogue etc. As illustrated in Figure 1, the point of departure is the region of the target area moving down towards the target area at a local scale. A core point of the spiral approach to teaching is that it is not unidirectional, i.e. approaches do not only go from coarse to fine scale. The phenomena at hand can, and should, be revisited iteratively during the design process. An example could be evaluation of more or less detailed design proposals in their immediate surroundings (e.g. assessment of visibility of designed objects) or within a larger region – for instance water retention capacity of proposed designs relative to the potential water volumes of the entire watershed.

Similarly thematic 're-visiting' is part of the spiral. For instance when a design for water retention is proposed, the potential accessibility for local recreational activities could be tested.

5. DISCUSSION

With these early initiatives at UCPH to promote the concept of a Geodesign framework, experience has been generally positive. The approach to addressing Geodesign has been broad in its reach, both through the projected changes to teaching, which engages many teaching staff directly, and through the conference format and the communication related to that. This breadth is considered important in terms of establishing Geodesign. From being an initially opaque and elusive concept for most colleagues an understanding of Geodesign as a useful framing concept has been widely taken up. Geodesign has by definition so many points of contact with other disciplines that it has proved remarkably easy to engage colleagues from across IGN in a common discussion.

It is fair to say that from across disciplines it seems easy for individuals to see themselves in relation to Geodesign and this is particularly interesting in the case of declared non-designers. The common use and understanding of GIS and other land-based tools is perhaps the key to this.

One consequence of the newness of Geodesign can be seen in the disappointing attendance at the PhD course. Despite intensive advertising through social media and professional networks only four students attended. This and experiences shared by Fisher and Querry leads to the conclusion that, at least for now, Geodesign workshops and courses should aim at supporting specific disciplines and/or address specific issues.

This relates to a discussion of the extent to which Geodesign should be considered a distinct discipline itself that might warrant a separate program of study. At the conference it was explained how Philadelphia University has established a specific Geodesign focused major, while quite consciously the University of Minnesota has implemented Geodesign teaching only within the existing curriculum. A concern raised by the Faculty at UCPH has been that as a stand-alone practice Geodesign could develop as an isolated quantitative and computational activity without the ballast of the strong design tradition of, say, Landscape Architecture. A consensus seems to exist around the idea that Geodesign should function within and across existing disciplines and that Geodesign should not at this stage be regarded as a distinct discipline. This may change, but for now there seems to be no expectation that the institution will be educating 'Geodesigners'. The potential for cross-disciplinary collaborations with their starting point in Geodesign is clear. Tackling Geodesign through existing programs and courses offers the opportunity to reach a range of disciplines and explore what Geodesign means for a range of practices. The situation at IGN seems to offer a promising test-bed for Geodesign. There is also a clear sense that Geodesign in this context will develop differently from Geodesign at other institutions.

6.   FUTURE EDUCATIONAL AND RESEARCH PERSPECTIVES

With a strong tradition of cooperation with practice at the UCPH the relevance and practicability of Geodesign tools will be regularly re-evaluated in that context. However, the specifically pedagogical potential of Geodesign thinking is also essential to success in teaching and this will not coincide with the requirements of practice 100%. This potential lack of congruence between tools for practice and tools for teaching and research will be explicitly addressed in future developments of Geodesign in Copenhagen.

With Geodesign entering the BSc curriculum in 2015, for year-two students, there will be a relatively rapid uptake of Geodesign tools amongst the students. This will mean that in 2017 the intake to the MSc will be dominated by students with grounding in Geodesign, and here courses will be able to take advantage of students' skills. It will also be relevant to look at the potential for advanced Geodesign courses at this level.

The opportunity for students to pursue individual projects is a key part of teaching at UCPH and this will allow students, who are particularly motivated, to follow up specific Geodesign themes outside the course regime. This ad hoc activity is often a precursor to master's thesis work and the active promotion of such endeavour is important.

Querry and Fisher, at the conference, gave examples of the nomadic classroom. Both explained teaching situations 'in the field', where online working and portable devices made this possible. The potential for this will be important in varying teaching styles and tailoring teaching to specific situations. Another development that is going on at UCPH, is the improvements to model-making facilities and interfaces with digital working. In 2015, vertical data projectors will be installed in the studios at UCPH as an aid to design processes.
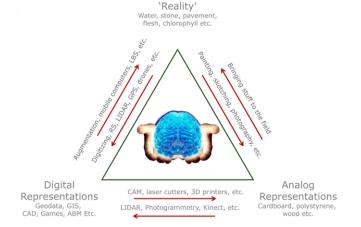

Figure 2. Representations and the real World.

Other opportunities exist to involve the departments' model lab. Here there are many possibilities to merge or entangle studio and digital model representations in teaching and research. At the same time the ability to bring digital model representation to the field is currently rather limited. Accordingly bridging the real world, and representations through studio models and digital models will be a core of future development of Geodesign at the department (Figure 2).

In terms of software and interfaces, improved understanding of programming and gaming, students arrive with will be harnessed. This will become increasingly relevant as game engines further outstrip GIS and CAD systems, particularly in terms of visualization. This is the case for static images, viewpoint movement, and moving objects (humans, wind turbines, cars etc.), and environments with shadows, clouds and water bodies. For students increasingly used to computer gaming, a game-like approach to design process would seem an obvious area for pedagogical investigation. As suggested by Elliot Hartley during the conference, the linkage of City Engine and Lumen-RT (2014) appears to be promising. Along the same lines, the use of games and apps will also be a continuing focus. Minecraft version of the Danish land use and terrain model is available (Danish Geodata Agency, 2014b; Minecraft 2014) and the use of Minecraft in early design training and as a platform for geospatial reasoning and learning should be considered.

In the future, interfaces between digital and physical 3D will be further explored. Areas of interest include technologies that can scan studio models and create geo-rectified representation that can be imported into CAD/GIS. These for instance can be indoor LIDAR, static photogrammetry, and Kinect sensors. Moreover, technologies will enable students and researchers to bring digital representations (geodata, 3D models etc.) to the field. These technologies include augmentation (2D/3D), location base services, online/on-site GIS etc. This investment is a combination of analogue, hardware and software, and will be matched by continued investment in staffing and staff development.

As Geodesign takes root and understanding of the potentials grows, it is expected that a key aspect of the work of research, and teaching, will be exploring the potentials of technology. Being asked new, and sometimes unanswerable, questions will be an important part of this development, and Geodesign as a framing concept of teaching and research, will challenge GIS as a data model, as analytical tool, as well as a science by itself. Research questions raised by these developments at UCPH will include issues of data quality, human movement patterns analysis and prediction, sociological data, ecosystem services and sustainable urban drainage and storm water management.

In addition to the current bachelor level course the aim is to develop courses at master level. Such courses can be extended along the lines drafted

above – both in terms of design/technology involvement and the integration of digital/studio representation and the real world.

Through teaching and research that builds on the strengths of the Landscape Architecture programs at UCPH, and increasingly involving colleagues from across the five sections of IGN, it is hoped that a distinctive strand of Geodesign will begin to develop. At this initial stage, the focus is, perhaps appropriately, on harnessing Geodesign as a means of facilitating improved teaching and cooperation internally at the department. This initial impetus is strong, and future stages of the development of Geodesign will be discussed and debated vigorously in the coming years. As students and teachers/researchers are picking up digital work methods as a natural part of design processes, it can be expected that such techniques will be absorbed in topics and processes taught throughout design courses of the education.

ACKNOWLEDGEMENTS

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