Geodesign A-to-Z: Evolution of a Syllabus for Architects and Engineers

Michele Campagna

Università di Cagliari, Cagliari/Italy · campagna@unica.it

Abstract: The aim of this paper is to document and present a critical reflective review on the evolution of a syllabus[1] of a Geodesign course at the Master level in an Italian Faculty of Architecture and Civil Engineering. The author discusses the urgency of fostering the uptake of such an approach due to the need of properly addressing Strategic Environmental Assessment principles which are nowadays mandatory in the planning practice in Europe, but often poorly applied. However, with reference to the Italian case study, evidence is given of low diffusion of teaching Geodesign. To address this issue, the evolution of a decade of a Geodesign syllabus for master programs in environmental engineering, architecture and civil engineering is presented highlighting opportunities for scalability, and demonstrating a workable way to introduce Geodesign teaching in architecture, engineering and planning schools where it is still lacking.

Keywords: Geodesign, spatial planning, Strategic Environmental Assessment (SEA), education, architecture, engineering

1 Introduction

The current season of spatial planning in Europe is affected by the adoption of strategies and policies at the community level, whose regulatory frameworks have to be transposed by member states into their national and regional normative systems. Among them, the Directive 2001/42/EC introduced the Strategic Environmental Assessment (SEA) as a mean to ensure policy- and plan-making processes are environmentally savvy and sustainable. According to the directive, SEA must be applied to spatial plans at all levels as a collaborative, transparent, and democratic decision support process with parallel plan-making. Unfortunately, recent analyses reported, many pitfalls are still affecting the SEA application in the Member States (PARKER 2007, COWI 2009), which are particularly evident in the SEA of spatial planning at the regional and local level, including unclear explanations of how the environmental sustainability objectives inform the plan alternatives, difficulties in properly evaluating their impacts, no or limited assessment of difficulties in analysis and uncertainties affecting decisions, and limited public participation in the decision-making process (FISHER 2010). Many of these problems are likely to be related in some cases to a lack of political will, but in many other cases to the lack of a clear and shared vision on how to implement SEA in spatial planning in terms of principles, methods and tools.

In addition, the European Directive 2007/02/EC with the establishment of an INfrastructure for SPatial InfoRmation in Europe (INSPIRE), which enabled the sharing and the public access to spatial data according to common standards, also started to drive an innovative change

[1] The term *syllabus* is used here according to the English Oxford Dictionary – Noun: 1. "The subjects in a course of study or teaching".

Journal of Digital Landscape Architecture, 2-2017, pp. 271-278. © Wichmann Verlag, VDE VERLAG GMBH · Berlin · Offenbach. ISBN 978-3-87907-629-1, ISSN 2367-4253, e-ISSN 2511-624X, doi:10.14627/537629028.

in the spatial planning media towards environmental protection objectives achievement. Indeed, more and more public authorities in European regions require the use of digital information within the plan-making and spatial governance processes, but the process is still in its infancy (CAMPAGNA & CRAGLIA 2012). Notwithstanding the two major drivers of SEA and INSPIRE, the path towards innovation in plan-making still fails to reach the expected level of improvement. This may be due both to a lack of in-depth understanding by technical staff in the administrations and by professionals of the concepts introduced by SEA, as well as a lack of competencies and skills by planning professionals to use Geographic Information Systems (GIS) methods and techniques to support environmentally savvy decision-making.

Geodesign, as a digitally aided design approach for the creation of change proposals and impact simulations in their geographic contexts (FLAXMAN 2010) – may help to bridge the gap between SEA policy principles and their implementation in practice with an operational methodology. Indeed, recent research experiences and studies demonstrated Geodesign can fruitfully address many of the pitfalls of SEA application to spatial planning in practice (CAMPAGNA & DI CESARE 2016). It is often said the Geodesign approach is not new and its origins are rooted in a long scholastic tradition in environmental planning and design and landscape architecture, however the current opportunities for a novel and wider diffusion of Geodesign innovation in the planning practice are unprecedented due to recent advanced in digital technologies. Hence, the urgency exists for a more sound and robust diffusion of Geodesign principles, methods, and state of the art techniques in planning education.

While Geodesign popularity in education is slowly growing in the United States of America (FOSTER 2013), in Europe it may be considered still at its very early stages (STYSIAK et al. 2016). In Italy, with few notable exceptions, Geodesign as a methodology approach is mostly ignored, at least looking at the numerically limited scientific production in the field by Italian scholars (i. e. in the Scopus database only eight documents on Geodesign, over more than two hundred, are found authored by Italian scholars belonging to five schools).

Also looking at the limited participation of Italian scholars at major North-American and European scientific or industry events directly or indirectly relating to Geodesign (including the Digital Landscape Architecture Conference series, AESOP Annual Conferences, AGILE Annual Conferences, or US/EU Geodesign Summits), the awareness of the Italian Academia about the "Geodesign movement" appears still limited (though increasingly attracting the interest of younger generation of researchers and students).

In the light of the above premises, the aim of this paper is twofold: on the one hand it documents the overview of the current situation and potential for Geodesign diffusion in Italy, while on the other hand it documents and critically discusses the experience in Geodesign teaching in a single course for architects and engineers. On the base of the critical review, it is argued that for properly addressing Geodesign education with limited course space, a balanced mix of theory, methods, and tools can be integrated in a course from a minimum of 60 to up to 150 class hours including lectures and lab or studio work. It is also argued that the structure of the course can be scaled to a full master curriculum in which each single teaching unit within the original course would become a course on its own.

2 Opportunities for Geodesign Teaching in Italy

Geodesign is an inherently multidisciplinary practice which involves design professionals, experts in geographical sciences, information technologists and, last but not least, the people of the place (STEINITZ 2012). Although in a few advanced cases Geodesign education might rely on multidisciplinary programs purposely built, frequently in more traditional settings, Geodesign courses are found in curricula run by schools of architecture, planning and design, sometimes in conjunction with schools of geography. In Italy, the schools of geography traditionally do not have a prominent scholar interested in design, and are rather oriented to qualitative, or in less frequent cases quantitative analysis. Thus, the following analysis of the current state of Geodesign education in Italy was conducted focusing on the schools of design, which in this case include architecture and engineering.

The Italian Academic system includes 68 public and 29 private Universities (totalling ninety-seven). Academic disciplines are classified by law in Scientific Disciplinary Sectors (or SSD), which are grouped in areas. Both teaching courses and faculty staff members institutionally belong to the most relevant SSD. The SSDs related to planning and design of cities and territories at all scales (i. e. from regional and landscape planning to urban planning and design) belong to the Area 8, namely "Civil Engineering and Architecture"; they are encoded as ICAR and they are numbered from 01 to 22. Within them, spatial and landscape planning and design disciplines, which are assumed to be those more closely related to Geodesign, are dealt with within the following three SSDs (now on the GD-SSD):

- ICAR15: Landscape Architecture
- ICAR20: Spatial planning (more prominent in the school of engineering)
- ICAR21: Urbanism and urban studies (more prominent in the school of architecture)

According to the data of the Italian Ministry of University and research, within the 97 Italian Universities in 2016, 43 of them have faculty staff and offer courses in at least one of the three SSDs, as detailed in Table 1. Among the private universities in 2016 only 3 hire faculty staff in the GD-SSD.

Table 1: Distribution of faculty staff in Geodesign related disciplines (i. e. GD-SSD) in the Italian Academic system

SSD	N° of Faculty Staff	N° of University *(min-max n° staff)*
ICAR15	**30**	**15** *(1-4)*
ICAR20	**135**	*36* *(1-21)*
ICAR21	**151**	**24** *(1-27)*
Total	**316**	**43** *(1-50)*

It should be noted that due to recent national policies which limit staff turn-over, the total number of faculty staff in the three SSDs between 2012 and 2016 was reduced from 378 to 316 (–16 %), and the trend is likely to continue in the short to middle term. Among the 43 universities employing GD-SSD faculties, nine major universities retain almost 200 faculty members in this respect (i. e. 63 % of the national total), with the POLITECNICO di MILANO (in the north), ROMA "LA SAPIENZA" (in the centre), NAPOLI "FEDERICO II" and MEDITERRANEA di REGGIO CALABRIA (in the south), and FIRENZE (in the centre) all having more than 20 faculty members, thus representing major poles in spatial planning and design education at the national level. Figure 1 shows the distribution by GD-SSD of faculty members in selected major universities (with respect to GS-SSD), while Table 2 shows the total number of taught courses in 2011 (Source: Ministry of University and Research) in the three GD-SSD by school.

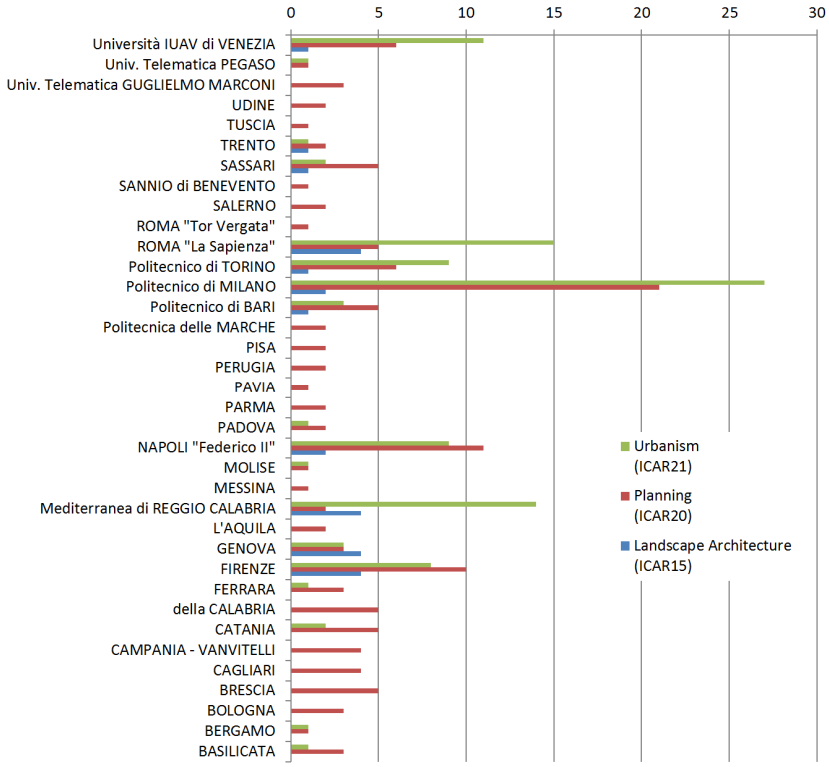

Fig. 1: Number of GD-SSDs' faculty staff members in selected Italian Universities in 2016 (Source: Italian Ministry of University and Research)

As it is possible to note in Table 2, schools of architecture have approximately half of the faculty members belonging to urbanism and urban studies, while planning dominates in the schools of engineering. In addition, a not irrelevant number of taught courses are found in other schools: among them natural science wins, and with lower rates medicine, economics, social sciences, and humanities.

While the extensive systematic analysis of the content of the taught course is still in progress and its final detail may be out of the scope of this paper, the results of a first overview assessment shows the Geodesign approach is not very common. Looking at the 2011 data, which are currently the latest available for the whole country, no course yet is titled Geodesign explicitly, and only four courses specifically focus on the GIS use in spatial planning. Such a context calls for an urgent need of developing the debate on Geodesign teaching and for documenting current efforts in order to support such a debate. In the next session, such an endeavour is given with reference with one of the first long lasting Geodesign teaching experience over more than one-decade in Italy.

Table 2: Total number of taught courses in the GD-SSD in Italian Universities in 2011 (Source: Italian Ministry of University and Research)

	School			
	Architecture	**Engineering**	**Other**	**TOTAL**
Landscape Architecture (ICAR15)	90	2	19	111
Planning (ICAR20)	94	117	21	232
Urbanism (ICAR21)	186	27	27	240

3 Evolution of a Syllabus for Architects and Engineers

At the University of Cagliari, urban studies and spatial planning courses are found in architecture, civil and environmental engineering programs and they are taught by a team of three faculty staff. As such, part of the teaching concerns urban studies, part of it Italian planning systems and instruments, and one course is specifically dedicated to Geodesign. It should be noted that the availability of Geodesign teaching is grounded on the research of one faculty member and spans between design, geographic information science, and information and communication technologies, the latter two within the spatial planning domain. Hence, the uptake of Geodesign teaching somehow emerged spontaneously without a conscious predetermined decision. However, this was demonstrated to be a favourable prerequisite condition for successfully introducing Geodesign courses, which afterwards were fully recognized institutionally in the current study program in architecture. Over time, the space given to the Geodesign teaching among the programs has varied between 50 and 150 class hours courses, mostly due to the evolution of the national academic legal framework which affected in turn the evolution of curricula design over the years, and due to the availability of teaching staff resources in a time of close to zero staff turnover which locally constrained the program design strategies. The structure of the Geodesign course under analysis, falling within to the Italian National official academic definition of the spatial planning discipline (i. e. ICAR20 SSD), involves both the analysis and evaluation of urban and regional systems within their environmental contexts, the analysis and evaluation of the quality of the development strategies and policies, and the constructions of planning instruments at the regional, local, and development scale. With this reference in mind, the adopted choice was (and still is as was

successfully demonstrated), to offer the students a 360-degree overview of the main issues concerned in spatial planning, and to guide them to handle them according to a Geodesign approach. To this end, any methods or techniques proposed in the course are applied digitally, after quick but sound basics of Geographic Information Science and Systems are taught both through lectures and computer-based hands-on tutorials (none of the student having previous GIS knowledge). Table 3 offers an overview of the time dedicated to the all topics in the short (i. e. 60 hours) and the long (e. g. 150 hours) versions of the course, divided among lectures and hands-on tutorials.

In the short version of the course (Table 3, left column), after an introductory lecture presenting the course overview, discussing quality requirements for design and introductory Geodesign principles, the demographic and territorial system analyses and forecast are the first lectures given to introduce the students to environmental issues and dynamics. These are complemented by the introduction to Geographic Information Systems and Science, and more importantly to data modelling and analyses. This first part of the course is intended to give the basic background to enable students to learn the construction of representation and process models (Steinitz, 2012). The lectures on planning theory and evaluation in planning are together intended to offer the conceptual models for understanding the dynamics of the plan-making process. Understanding planning as a process is of utmost importance in the application of Steinitz's framework within its three iterations; more specifically, planning theory is used to make the relationships between planning actors (e. g. decision-makers, professional experts, the citizens), activities, tasks, methods and tools, explicit, with reference to the more recurrent alternative approaches in planning theory. Lectures on public participation and on sustainable development complement the former, paying more attention to the role of the community (i. e. the people of the place) and the overall underlying ethical, substantive and instrumental approaches. The part on the Italian planning system aims at introducing the main planning levels at the national level (i. e. regional, land-use, and urban planning), and to ground theories and methods in the local context. The national planning system sets the three main working scales for the Italian context and the normative framework to which design ought to comply with. At this point the importance of scales in Geodesign (Steinitz, 2012) is introduced. The lecture on land-use (definition and) planning complement the former paying particular attention at the design requirements for the local level (i. e. the local land-use master-plan at the municipal level in Italy) that due to the high number of municipalities in Italy (> 8.000) represents the most prominent planning scale in practice in Italy. At a later stage, the lectures on GIS-based spatial multi-criteria decision support methods (JANKOWSKI 1995, MALCZEWSKI 1999) are aimed to offer the student the background conceptual reasoning tools to build both the evaluation and the impact models. They are complemented by lectures on Land Suitability Analysis (LSA; HOPKINS 1977, MALCZEWSKI 2004) and on Carrying Capacity analysis proposed both as underlying concepts and as operational methods. From the normative perspective, the latter are complemented by the part on the European regulations on Environmental Impact Assessment (EIA) and Strategic Environmental Assessment SEA.

While all the main lectures are dealt with in three hours modules, the hands-on tutorial can be developed in its shorter version in a minimum of twelve hours. This time span was proven to be enough to develop simple representation models/evaluation models, test the application of normative calculations in a GIS environment, and draft simple change models. Such a practical module was successfully tested for several years with classes of up to one-hundred students in architecture and in civil engineering, mostly with no previous knowledge of either planning or GIS. In the long version of the course, further advanced topics were introduced,

including extensive theoretical and practical teaching on the use of Internet and the web in spatial planning, and the use of advanced planning methods such as Scenario Analysis, and Planning Support Systems. The latter on one occasion (i. e. a course for a transatlantic master program in Environmental Planning) constituted the core topics for an advanced course on Planning Support Systems and Geodesign, which enable a group of students with intermediate GIS knowledge to apply advanced planning support methods and tools.

Table 3: Syllabus of the Geodesign course in the short and in the extended versions

	Short Course: Basic Topics (50-60 class hours / 5-6 ECTS)	**Long Course: Additional Advanced Topics (100-150 / 10-15 ECTS)**
1	Demographic Analyses	Internet in Planning and VGI, Social Media
2	Territorial System Analyses	Planning Support Systems
3	GI Systems and Science	Scenario Analysis
4	Planning Theory	Accuracy and Uncertainty
5	Evaluation in Planning	Spatial Data Infrastructures
6	Land Use Planning	Invited Seminars: Advanced Topics
7	Decision/Design support methods (incl. LSA)	
8	National Planning System	
9	Environmental Impact Assessment (EIA)	***Advanced Hands-on Tutorials:***
10	Strategic Environmental Assessment (SEA)	Extended GIS Tutorials
11	Sustainable Development	Land Suitability Analyses Tutorials
12	Public Participation in Planning	Scenario Analysis Studio
	Hands-on Tutorials: Land-use Planning Analyses/Design with GIS	Public Participation Using Social Media

While the Geodesign syllabus was developed and consolidated between 2005 and 2010, it is since 2012, when the Steinitz framework for Geodesign was published, that the latter was introduced both as backbone and as connective tissue for the original subjects, adding substantial value to the coherence and the overall rationale of the courses. In addition, recent experiences by the educator in preparing and coordinating Geodesign workshops according to the Steinitz framework contributed enormously in enhancing students' understanding of the overall Geodesign approach, both for those few students who could directly participate in the workshops, and for all those others to whom the results of the workshop were presented as detailed case study. Furthermore, beside the regular courses on spatial planning within which Geodesign was taught, a number of additional extracurricular activities were organized in the last ten years, with visiting teaching staff or when teaching resources were made available. These concerned the application of methods and models which can be applied to the six Geodesign frameworks' models building, and to the overall framework application to the Geodesign studies at hand.

4 Conclusion

This paper documents the structure of a Geodesign-based syllabus in spatial planning aiming at showing a viable way to introduce Geodesign teaching in those planning and design schools. This may be of use where Geodesign principles, methods and tools are still under-represented in more traditional curricula, as is most frequently the case in many countries, including Italy as documented in section 2. Documenting current efforts in Geodesign education is urgent for it may contribute to shaping and fostering the diffusion of the disciplines in higher education. Documenting the state of play can also support comparative analyses of current approaches aiming at developing a scalable body of knowledge for fostering the diffusion of full-fledged Geodesign programs. In Europe, such an effort should be not seen in the limited sense as a possible scholarly approach, or even fashion among many, but as a reliable way of addressing the current pitfalls in Strategic Environmental Assessment practice which affect contemporary spatial planning.

References

CAMPAGNA, M. & DI CESARE, E. (2016), Geodesign: Lost in Regulations (and in Practice). In: PAPA, R. & FISTOLA, R. (Eds.), Smart Energy in the Smart City, Green Energy and Technology, Springer International Publishing, Switzerland. ISBN 978-3-319-31155-5.

CAMPAGNA, M. & CRAGLIA, M. (2012), The socioeconomic impact of the spatial data infrastructure of Lombardy. Environment and Planning B, 39 (6) 106-1083.

COWI (2009), Study concerning the report on the application and effectiveness of the SEA Directive (2001/42/EC). DG Environment European Commission, Report no. p-67683-a, Issue n. 2.

FISCHER T. (2010), Reviewing the quality of strategic environmental assessment reports for English spatial plan core strategies. Environmental Impact Assessment Review, 30 (1), 62-69.

FOSTER, K. (2013), Geodesign education takes flight. Arcnews fall. Esri Press.

HOPKINS, L. (1977), Methods for generating land suitability maps: a comparative evaluation. Journal for American Institute of Planners, 34 (1), 19-29.

JANKOWSKI, P. (1995), Integrating geographical information Systems and multiple criteria decision-making methods. International Journal of Geographical Information Systems, 9, 251-273.

MALCZEWSKI, J. (1999), GIS and Multicriteria Decision Analysis. John Wiley & Sons, New York.

MALCZEWSKI, J. (2004), GIS-based land-use suitability analysis: a critical overview. Progress in Planning, 62 (2004) 3-65.

STEINITZ, C. (2012), A Framework for Geodesign: Changing Geography by Design. Esri Press, Redlands, CA.

STYSIAK, A., NIELSEN, S., HARE, H., SNIZEK, B. & SKOV-PETERSEN, H. (2016), Creating a Geodesign syllabus for landscape architecture in Denmark. Research in Urbanism Series, 4, 229-246. TU Delft.