

Knowledge of Experiences in Digital Landscape through Textbooks on Design and Landscape Technology

Torben DAM

1 Introduction

Digital landscape modelling is going to change the way landscape architects design and work (Jørgensen, 2004, Jørgensen, 2006). Architects in Europe even think that digital design can reveal some forces that contemporary architecture need (Nilsson, 2004). Essential questions occur in the transition period from analogue to digital design about intelligence, knowledge, and the design process. Digital 3D modelling is called intelligent, and in some parts of architecture the 3D models are ahead landscape architecture. The development with-in IT goes fast, and the software evolves in some areas, where digital development is evident. How will the 3D-model challenge the way we work, and the knowledge we have? What happens to design experience and knowledge in the transitions process? The objective of this article is to merge two separated worlds, The digital, 3D model and the analogue landscape architectural design tradition. This is done by exploring 3D models and textbooks. Since the 3D models develop and the stage is different in different regions, this article uses one Danish 3D model, made on basis of ISO 12006-2. Knowledge in this article is seen as information and theory needed to reveal a landscape architectural project. Textbook enhance a concern of gathering, understanding and editing knowledge, they are the source of this article. It is often assumed that development of digital landscape models follow a progressive linear process, this is not the case if the knowledge from the analogue design process do not be used. This article suggests that the digital landscape model is made by a mix of theory and experience in textbooks with an analysis of the structure of the intelligent 3D models. The 3D models will benefit from existing knowledge in landscape architecture. The transition from analogue to digital design can even improve our understanding of the design process. This article focusses at terrain as a subject. Terrain is used as a phrase for the surface of the landscape. Terrain is the result of grading, storm water management, preparation for the coming soft or hard landscapes. The study of intelligent 3D models and knowledge in this article shows that interaction is possible. The structure of the intelligent 3D models in an early stage of the design process need categories of terrain available that keep design options open. These categories can be found in the textbooks, but categories are made for other purposes. The 3D-model will in the later and more detailed stage of the design process benefit from the technical information in the textbook, even though there are many regional differences in soil and climate that influence the design. For terrain the data in the 3D models has to generated by ourselves, because no product suppliers have any particular interest, as e.g. windows in buildings. 3D models and classification are still dependent of a general design skill, which will be essential to the 3D-model, but not included.

2 Material & Methods

2.1 Textbooks

Knowledge from 5 textbooks is analyzed. The 5 textbooks are chosen as case studies (Francis, 2000) representing a broad range of books made for landscape architects and students with-in landscape design and landscape technology. Textbooks represent knowledge and are therefore rich accessible sources with information and experience put into a design context. 3 of the book are coming from America and 1 from Germany and 1 from Denmark. (See references below). The analysis is based on quotations, review and statistics. The objectives and purpose of the book regarding terrain is analyzed, to discuss the interaction between design and knowledge.

2.2 Intelligent 3D objects

Intelligent 3D objectics are described by Ian Jørgensen (Jørgensen, 2004, and Jørgensen, 2006). An object is defined in ISO 12006-2 as: “any part of the world, which one can experience or imagine” (ISO, 2001). In building a rchitecture some components are already far ahead landscape architecture. Windows, Façade elements, etc. which are repeated many times in a building, can give us an idea of the possibilities. The Danish Government demands digital 3D modelling from January the 1st, 2007¹. The digital model is created on an early stage in the design process. As the process proceeds the model is more and more detailed. Figure 1 illustrates the object, window at a rather early stage. The functions are evident and general. In the middle a product (window) is placed in a decision tree, ending up with a typical standard window.

¹ *Digital Construction - in Danish 'Det Digitale Byggeri' - is a united public-private initiative to stimulate digital integration - vertically and horisontally - in the building and construction sector. Initial studies have identified six central areas for further development. The areas are: Standardisation of classifications, descriptions and formats. Common solutions for: Contracting, Projectweb, 3D models and FM-data. Best Practice cases. www.detdigitalebyggeri.dk*

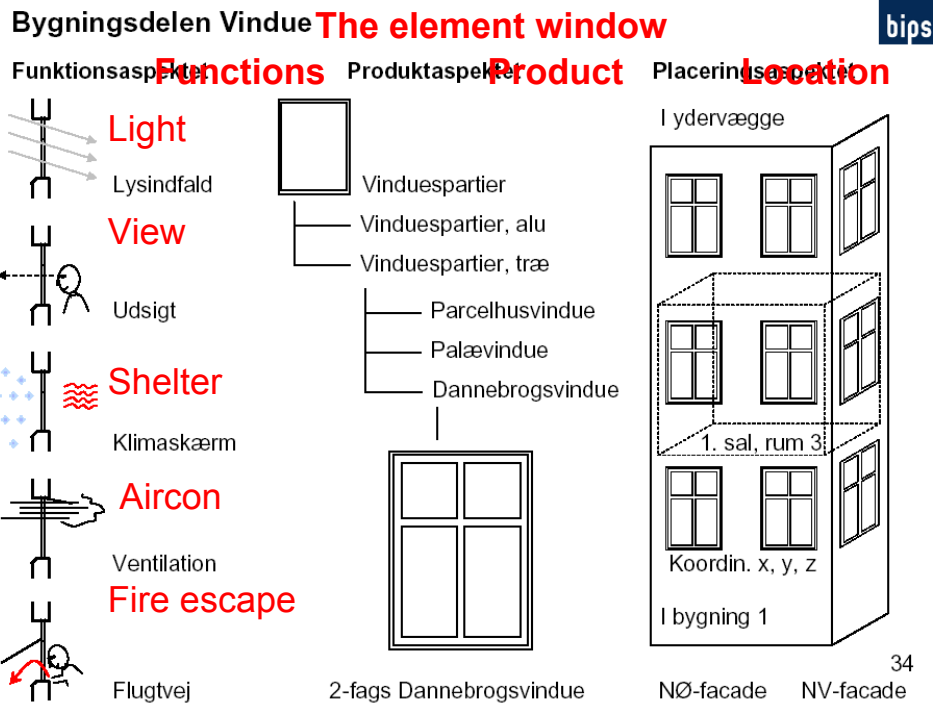


Fig. 1: A window illustrates the idea of the classification system, Function, Product and Location are three topics, following the design process from programming to as-built models. Authors translation. (bips, 2005)

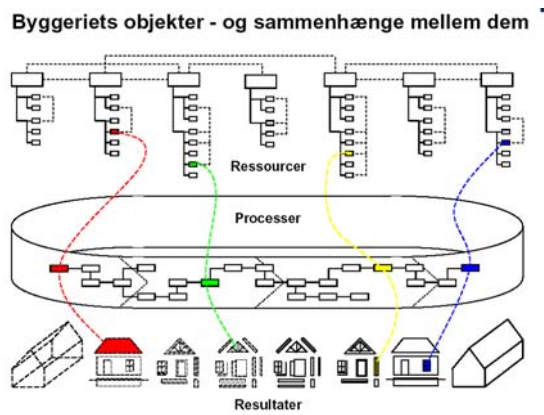


Fig. 2: A 3D-model, objects seen as resources used in a process ending up in a construction. Properties mentioned in the text refer to the 3 aspects. (DBK, 2004)

To the right the location of a window is illustrated as a process, showing the development all objects undergo during the design process.

Classifications systems have been used in many years. The digital evolution has pushed the process further. In 2001 an ISO-standard was published. The standard was based on the British and Swedish standard. The Danish Building Classification (DBK) (DBK, 2005) is updated with the 4th domain: “properties”, 1) **Resources:** Materials, Building information, Tools, Persons involved. 2) **Process:** The lifecycle of the built, Phases, programme, design, construct, maintain, use, and conduct. 3) **The result:** a type of built environment, a type of space, a type of building, part of the building, a product, a built product. 4) **Properties:** relation between components, comparable, functions, experience, symbols, administration. Figure 2 shows the idea and a list with the classification system linked to ISO, OCCS , DBK, and terrain can be seen in Figure 5.

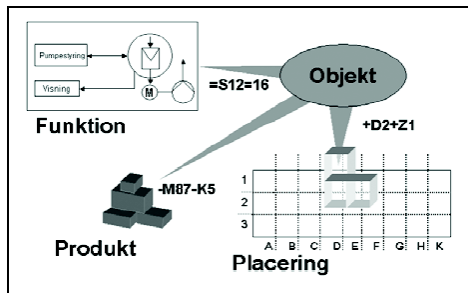


Fig. 3: The 3D object has to be defined by function, production data and placement in 3 dimensions

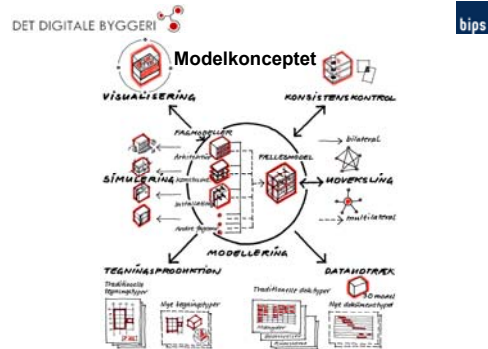


Fig. 4: 3D modelling give the opportunity to exchange drawings, to extract data, to produce drawings, to simulate specific models, to visualize, and to assess quality

3 Results

3.1 Experience in textbooks

The 5 textbooks are published from 1971 to 2002, the latest editions are from 1994 – 2002. Site Planning has its focus on the design process but shows the importance of technical information by a large appendix, and a prescriptive approach to the design process. Most of the other books have in the text considerations on the design process and the connection to

data and standards. Time-Saver Standards, Befæstelser and Bauen mit Grün however are mostly concerned with displaying data, technology and standards. (Holgersen & Dam, 2002) describes a method for the research of materials and components. Site Engineering seeks to bring the reader through topography, grading and storm water management, with formulas, examples and tables. Most of the knowledge is selected by the authors without any specific explanation even though some general remarks indicate that the selected information is valuable to the landscape architect under the design process.

The textbooks seldom have a systematic approach, as is seen in 3D- models. They present data, tables, standards and samples on a detailed project or construction level. (Holgersen & Dam, 2002) tries to divide the description of materials and constructions into three:² 1) programme, 2) outline proposal and 3) principal project, but the reader has to make her own transcription from detail or construction to programme or sketching in most of the book. Bauen mit Grün has a sample with a garden designed in connection to each chapter, here is knowledge linked to design of the garden. The high complexity of detailed natural science based knowledge on growth conditions in soil seen in the textbooks is structured in Bauen mit Grün³. 7 headlines defines a soil. Site engineering⁴ and Time- Saver Standards⁵ uses typology to make the reader aware of the potential of the general information about grading. The reader is invited to structure her own specific project.

Terrain which is the specific subject in this paper is an important part of all 5 books. Site Engineering focuses on terrain. Even books with the purpose of a total coverage of all subjects in Landscape Architecture as Timer-Saver Standards and Bauen mit Grün has a substantial part of the book concerned with terrain-related subjects. Befæstelser covering hard surfaces gives the same impression. Site Engineering introduces sketching and small calculations; all the chapters are related to terrain. Bauen mit Grün is an overall textbook, with focus on the materials (also soil) and the detailed constructions, seven chapters have some relation to terrain (growth is a focal point). Even though many subjects are of the same kind, the focus and approaches vary. The experience of the author, the regional conditions and the objectives courses the variation of the information and of the selected problems in the textbooks. The interaction between design and knowledge

Site Planning defines the design process by *being in opposition to the common account of genius*, and knowledge, even though it is important is described as a path⁶. Hideo Sasaki

² Holgersen & Dam (2002) *I program-, forslag, og projektfasen planlægger man og projekterer man sin befestelse. Her indgår mange forskellige emner der skal håndteres så løsningen bliver en helhed.* p142.

³ *Beispiele für die Bewertung von Böden. a) Bodenart nach DIN 4022; b) Bodengruppe nach DIN 18915; c) Wert; d) Allgemeine Ansprache; e) Technische Bearbeitbarkeit; f) Terminliche Bearbeitbarkeit; g) Wasserdurchlässigkeit; h) Wasserhaltevermögen; i) Ve.g. etationstechnische Bewertung; k) Was der Planer beachten muss; l) Was der ausführende beachten muss.* p125 - 130.

⁴ Steven Strom and Kurt Nathan, *Site Engineering for Landscape Architects, The visual form of grading may be broadly categorized into three types. The three categories are geomorphic, architectonic and naturalistic.* p59.

⁵ Charles W Harris and Nicholas T. Dines, *Timesaver standards for Landscape Architecture.. Grading may be done for a number of functional and / or aesthetic reasons Figures 320-1 through 320-9 show a range of typical examples.* p320-2.

⁶ *Site planning is more than a practical art, however complex its technical apparatus. The aim is moral and esthetical: to make places which enhance everyday life – which liberate their inhabitants and give them a sense of the world they live in. Professional skill – that easy familiarity with behaviour settings, grading, planting, drainage, circulation, microclimates, or survey – is only a path to that result.* p1.

writes in a foreword that: “*The data and standards it contains demonstrate how and where the profession interconnects with the efforts of many specialists from different sciences and technologies*”⁷. Under grading (Harris & Dines, 1998) makes the design process linear: *The grading scheme is a primary determinant in the total design*⁸ (Strom & Nathan, 1998) calls the design process a: “*a controlled intuitive process.*” and emphasize that: “*This shaping must not only display a sound understanding of aesthetic and design principles but also ecological sensitivity and technical competency.* (Holgerson & Dam) links knowledge to both: “*definition of the landscape architectural problem and part of the design process*”⁹. In *Bauen mit Grün* the link between landscape architectural choices and technology is taken as a fact,¹⁰ and different materials and constructions contributes different design.

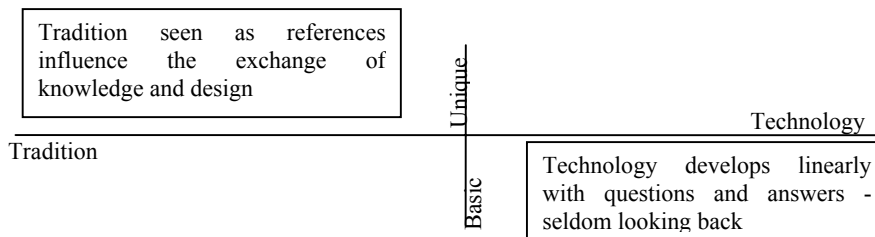


Fig. 5: The relation between design and knowledge depend on the kind of knowledge. The four aspects can help to navigate in the ocean of knowledge when transition to digital design in 3D models starts to develop product data at the early stages of the design process.

3.2 Knowledge-based, intelligent landscape modelling

Interpretations of the intelligent 3D-model and terrain in the textbooks indicate a sound structure and a rich source of knowledge. There is however work to do, when the two items has to be combined. The 3D-model has to hold some knowledge very soon in order to construct an intelligent, digital 3D-model, that can visualize, and can have quality assessment, e.g. collision of pipes and three growth. The textbooks illustrate excellently the level of detailed knowledge. Few examples in *Bauen mit Grün* and *Befæstelser* express the

⁷ *The publication of this handbook represents an historic event for the profession of landscape architecture. By scope and organization, it provides a broad practical definition of what landscape architecture is as an applied art and science. The data and standards it contains demonstrate how and where the profession interconnects with the efforts of many specialists from different sciences and technologies. (foreword, Hideo Sasaki)*

⁸ *Time Saver Standards, p.320-2*

⁹ *Viden om befæstelsernes materialer, afvanding og lagvise opbygning skal hjælpe, når man skal indkredse en problemstilling om befæstelser, og når man gennem skitsering skal finde en løsning. p141.*

¹⁰ *Garten- und landschaftsarchitekt sowie der Unternehmer des Landschafts- und Sportplatzbaues, der diese Objekte als Gesamtwerk ausführt, müssen dabei den Umgang mit diesen Baustoffen und Bautechniken beherrschen. Jeder Baustof bietet ja ein anderes Bild, und die gleiche Situation lässt in dere Re.g.el verschiedene Lösungsmöglichkeiten zu. p2.*

Bei aller Freizügigkeit in der Gestaltung sind Planer und Ausführende gebunden an die technischen und physikalischen Eigenschaften der Baustoffe. p2.

level of knowledge e.g. in the outline proposal, that will end up with very specific and detailed knowledge later. Terrain can be seen as a construction complex, a large scale complex equal to a group of buildings.

3D intelligent models			Knowledge-based
N r.	Subject/ level 3D system	Links to standards	Remarks on terrain in relation to 3D, classification with examples from 5 textbooks.
1	Construction entities by form	ISO OCCS	Topology: geomorphic forms, or geometrical forms, e.g. Site Planning A descriptive specific topology, e.g. Site Engineering and Time-Saver
2	Construction entities by function	ISO OCCS DBK	Terrain as the surface for plants, e.g. Bauen mit Grün Terrain as the surface for paving, e.g. Befästelser
3	Construction complexes by function	ISO	Terrain as part of garden, park, sports-, housing-, shopping-, parking area, e.g.. Time-Saver and Bauen mit Grün
4	Spaces by degree of enclosure	ISO	Most landscapes have some degree of enclosure from terrain, plantings, water etc. e.g. Site Planning
5	Spaces by function	ISO OCCS DBK	Play-ground, love-path, skiing, all kind of sports, swimming, sunbathing, growing vegetables, fireplace, theatre, forum, concert arena, e.g. Site Planning and Time-Saver
6	Facilities by function	ISO OCCS	Most spaces can be named after a facility, See above
7	Elements by function	ISO OCCS DBK	Subbase, topsoil, paving, drainage, e.g. Bauen mit Grün and Befästelser
8	Designed elements	ISO OCCS DBK	Grass-bed, plant-bed, plant-beds in paving, tree-hole, amphitheatre, wall, noise-shelter, encapsulated polluted soil, e.g. Time-Saver
9	Workresults by type of work	ISO OCCS DBK	Loosening of compacted soil, growing plants, nursing plants, Bauen mit Grün .
10	Management process by type of process	ISO	Pavement management, e.g.. Befästelser
11	Construction entities lifecyclestage	ISO	Phases in landscape construction process, e.g. Befästelser , Bauen mit Grün , Time-Saver
12	Project stages	ISO, OCCS DBK	Project stages, e.g.. Site Planning , Befästelser
13	Construction product by function	ISO DBK	Plant-bed, tree-pit, grass-bed, flower-bed, golf-course, football-pit, grass-meadow, grass-swale, path, e.g.. Time-Saver , Bauen mit Grün .
14	Construction aids	ISO OCCS	Landscape construction machinery, land-survey equipment, geo-engineering CAD , Befästelser , Time-Saver , Bauen mit Grün .
15	Construction agents	ISO OCCS DBK	Land-survey, constructor, architect, landscape architect, engineer, supplier, environmental controller, Site Planner, City planner (referred occasionally in the textbooks)
16	Construction information by	ISO OCCS	Information of soil in seven levels, e.g.. Bauen mit Grün Information after three project stages, e.g.. Befästelser .

	type of medium		
17	Property by type	ISO OCCS	Soil types, Time-Saver , Bauen mit Grün , Site Planning Water runoff-types, Befästelser , Time-Saver
18	Spaces by form	OCCS	Storm Water run-off types, e.g.. Befästelser or Time-Saver standards
19	Products	OCCS	Soil types, sand and gravel, geo-synthetics, bio-engineering, surfaces (e.g.. Grass, plants, paving etc.), e.g.. Bauen mit Grün , Time-Saver , Befästelser
20	Disciplines	OCCS DBK	Appendix in Site Planning
21	Materials	OCCS	Soil improvement, fertilizer, etc. e.g. Bauen mit Grün
22	Infrastructural units		Drainage pipes, e.g. Befästelser , Time-Saver
23	Resources		(referred occasionally in the textbooks)
24	Documents by function	DBK	(referred occasionally in the textbooks)

Fig. 6: A 3D object-based classification system with links to international standards. Terrain transferred in this system can be inspired by the textbooks.

Complexes are divided into constructions entities such as one building. For terrain this division can be a park. The building is divided into spaces and elements or even designed elements or work results. Similarly the park can be divided into grass meadows, woodland, flower gardens as spaces. The elements can be trees, pavings and lawns. A flower bed can be seen as a designed element and soil improvement can be a work result. Figure 5 shows a complete list of subject in a classification system for a 3D-model based on ISO 12006-2. The list is linked to terrain and the 5 textbooks.

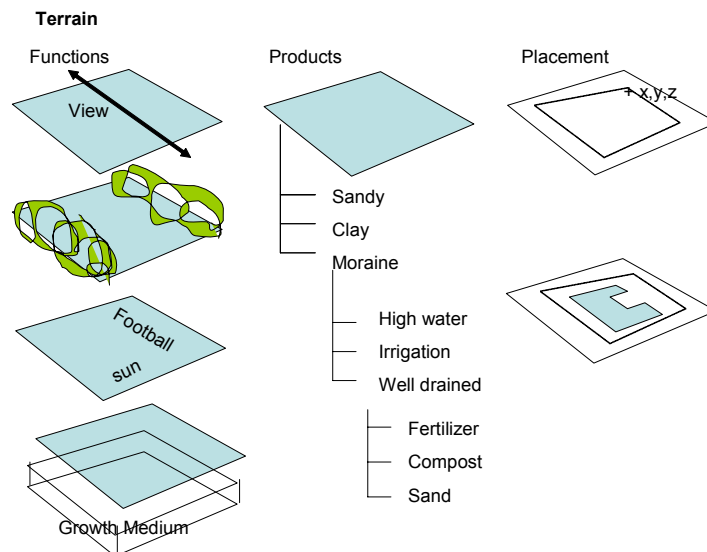


Fig. 7: Terrain in a 3D model similar to the window in figure 1. A grass-meadow was in mind. Notice under products how the first categories have to be open.

4 Conclusions & Outlook

The questions in the title can be answered: “Terrain fits the intelligence in the described 3D model.” “The kind of knowledge available is a detailed one. Other kind of knowledge has to be structured for the early stages of the 3D-model.” There is useful experience gathered in a wide range of textbooks.

The classification system has to a higher degree focus on the process, than the textbooks, which mainly has its focus on the detailed construction in the project or the process under landscape construction. The different objectives of the textbooks offer plenty of input with randomized occurrence. The challenge is to conduct the right level of knowledge to the early stages of the process, and to acknowledge that the experience not only come from one book. The separation of information in the earlier stages, e.g. process (DBK, 2005) has to be done with substantial insight in the terrain objects. High complexity seen in the textbooks has to be structured as Bauen mit Grün structures the soil in 7 headlines. There are however also in Site engineering and Time-Saver lots of formula, calculation examples and tables that do not fit into the 3D, object classification system. It can however be a valuable digital tool, as an application or a tablet in the landscape modelling program.

The idea of objects in the building is easy to follow. Objects in terrain are not necessarily an evident subdivision. Objects defined as spaces or by function have to some degree already found its way in to Landscape Architecture due to maintenance and park management. Terrain objects can however also be layers under the surface. Objects defined by functions at an early stage in programming and design include unknown information of the site, and while information on the functions are fixed in the program, information about the terrain occurs during the sketching of the proposals.

The transition to an intelligent 3D landscape model will hopefully be followed by both usage of the experience in textbooks and a theoretical study of the landscape design process:

- Split terrain (landscape architecture) into objects. Some objects are evident, some objects are important even though they are hidden in the final project
- Find the objects in textbooks on landscape architecture or - technology, in garden history, and quality standards for park management. The landscape technology textbooks gives often attention to the hidden but important objects
- Take the detailed knowledge as an end point and discuss the information needed in earlier stages e.g. the conceptual design, the outline proposal, and the preliminary project, beware of the 4 aspects: tradition, technology, basic, and unique.
- Use an international (ISO 12006-2; 2001) based 3D-model, funded on IFC (Industry Foundation Classes) and Global Unique Identification.
- Make a large network with all consultants (landscape architects, engineers, architects, city planners) suppliers, contractors, service and management persons when the 3D model is developed

- Continue the theoretical discussion about the design process, and have attention to all the rules of thumb and small calculations in the textbooks, so the landscape architect is controlling the intelligent 3D-model and not the opposite.

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6 Biography

Torben Dam is an associate professor in landscape architecture, Park and Urban Landscape, Centre for Forest, Landscape and Planning, Royal Veterinary and Agricultural University. Responsible for Msc. Course in Terrain and Technology in Landscape Architecture. E-mail: toda@kvl.dk