Landscape design based on research

*A methodological guide to design-oriented projects
for students and teachers in landscape architecture*

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Department of Landscape Architecture, Planning and Management

Abstract

The integration of research-based knowledge into landscape architecture and landscape design is often demanded by society as well as by landscape architects. However, this might include methodological challenges, as often becoming evident in many students' projects. In order to overcome these challenges, and support students and teachers in the navigation towards landscape design based on research, we have compiled this guide. It aims to support in the making of informed choices about the approach, in the methodological description, and in finding relevant literature for support and further reading. We provide an introduction to the challenges, present theoretical models and palettes of approaches and discuss the application of these. An important point to make is that there is not one way to include research-based knowledge into design, but several. Although there is much knowledge on the subject, there is also a need to test and discuss the proposed approaches and their usability in various contexts further.

Keywords: design guidelines, evidence-based design, landscape architecture, landscape design, research-based design, research-based landscape architecture, research for design, research into design, research through design

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1   Introduction

This guide is intended to support students, particularly those in the landscape architecture programmes at the Swedish University of Agricultural Sciences (SLU) who are (1) working on design-oriented projects or projects with a studio component (particularly bachelor and master projects) and who (2) want to base their design proposal on research-based knowledge. This guide is meant to offer guidance in three respects:

1. in making an **informed choice** about the research design, in particular about **how to integrate research-based knowledge in the design and the design process**,
2. in **describing the approach or method** chosen in one's design project in the written part of the project, and
3. in **finding literature** that can support the project by referring to relevant scholarship.

1.1   Who should read this guide?

This report is the hands-on result of a so called "best practice project" that we started at the Faculty of Landscape Architecture, Horticulture and Crop Production Science (LTV-faculty) in 2017. While we, the authors of this guide, would like to believe that it contains ideas relevant to a wide audience, we have had a distinct target group in mind when writing: students within (SLU's) landscape architecture programmes who are working on a particular kind of **master project** (or a bachelor project, or any kind of course project), namely projects that are "**professionally oriented**" (projects of the type B in figure 1) – as opposed to "academically oriented" (projects of type A in figure 1.), even though it might be informative also for the latter kind of projects.

However awkward or even unhelpful one may find the distinction between professionally and academically oriented projects, it is meant to distinguish projects that focus on a type of task similar to the ones one is likely to encounter in the professional life of a landscape architect (e.g. a design or planning task) from (master) projects that follow the format, aims and scopes of an academic thesis (dissertation), i.e. have the character of a minor research-oriented project. Mirroring the width and diversity of the tasks landscape architects can be confronted with in their professional lives, professionally oriented master projects can differ considerably in what they set out to do. Examples may include (but are not limited to) landscape analyses, environmental impact assessments, comprehensive planning for municipalities, expert reports on biodiversity issues, and much more (type B.2-B.n in figure 1).

Considering this width, this guide targets authors of a specific kind of professionally oriented master projects, namely those with a **design or studio component**, i.e. projects in which a design proposal is suggested, be it as the main result of the project or just one among many other results (projects of type B.1 in figure 1). There are, however, different approaches to design/studio work. This introduction is mainly meant to support students who decide to do a **research-based landscape design**, i.e. to integrate research-based knowledge in the studio work (projects of type B1.1 in figure 1), as opposed to doing what one may call a speculative landscape design (projects of type B1.2 in figure 1).

A	Academically oriented project
B	Professionally oriented project
B.1	Design/studio project
B1.1	**Research based landscape design**
B.1.2	Speculative landscape design
B.2-B.n	Other types of professional projects

Figure 1: Taxonomy of master projects within SLU's landscape architecture programmes. Highlighted is the type of project (research-based landscape design projects of type B1.1) that is in the focus of this methodological introduction.

N.B.: This guide's focus on research-based landscape design is by no means meant to indicate that we assume that this way of designing is superior to what we called "speculative" design; neither should it be misunderstood to imply any other value judgement regarding the type of project that a student decides to undertake! This guide is rather meant to respond to the challenges that we have been observing over the years regarding methodological issues with this particular type of (master) projects.

1.2 The challenge

Students working on projects within landscape architecture at SLU are thus encouraged to choose between what is called an "academic" or a "professional" type of project. From a research design point of view, the academically oriented master projects often tend to be less problematic: Students usually select an approach or method that is (more or less) common in one of the many fields that landscape architecture integrates. Students, for example, use methods from the social sciences conducting and analysing interviews or discourse analytical approaches, or they apply methods of ecology and statistical analyses, or use historical methods such as archive studies. More challenging, from a methodological point of view, tend to be professional master projects, in particular design-oriented projects or projects with a studio component, i.e. projects in which students develop a design proposal. Difficulties arise especially when the design proposal is to be linked to any kind of research-based knowledge, i.e. when the design is to be "based upon" or "underpinned by" (whatever that may mean) any kind of scientific theory and/or academic research.

There are big challenges related to the integration of academic research into landscape design. This is due, first, to the many different ideas of what is or should count as 'design' and 'research' respectively. Furthermore, this is due to how research is being conducted and formulated, and to difficulties in practice to adopt research results (Evans, 2009). This leads to insecurities among students – but also among supervisors and examiners, as well as members of the scholarly community in landscape architecture in general – of why and how this integration between research-based knowledge and landscape design is to be done.

In the following section, we give some background information of how – mainly within the field of landscape architecture – the relationship between research and design has been discussed in academic literature, including rationales for why it is regarded as valuable, contributing to the discipline's progress, to integrate research and landscape design.

1.3   Background

Landscape architecture is a relatively young academic discipline with substantial interdisciplinary thinking, a limited own theoretical base and strong ties to the practical profession of landscape architecture. It is related to many different areas of knowledge: Landscape architects need to be able to, first, handle different kinds of knowledge ranging from the natural sciences (e.g. ecology) and the social sciences (e.g. environmental psychology or sociology) to the humanities (e.g. arts, garden history), and, second, to integrate these into the design (and planning and management) of landscapes. To base the design of landscapes on research in these various fields is, according to Brown and Corry (2011) necessary to improve the quality of the profession and to retain its credibility. Today, there appear to be paramount differences between landscape architecture practice and research in their views upon research, and ways of better implementing research into practice are needed (Milburn & Brown, 2016). Research related to landscape architecture has much to offer, which can be done through producing research results, but also by finding ways of converting knowledge from research into something that is useful for practice, such as "planning and design guidelines" (Bruns et al., 2016, p. 14). The research must become increasingly useful to practice also because the practitioners require so, as "landscape architects want new knowledge in order to solve complex problems" (van den Brink et al., 2016, p. 2).

There are, however, big challenges related to the integration of academic research, especially within landscape design. This is due to how research is being conducted and formulated as well as to difficulties within practice to adopt research results (Evans, 2009). The site-specific qualities of landscape architecture have sometimes been put in contrast to generalizable knowledge, which does not have to be the case (Bruns et al., 2016). Instead, there is a need for both general (or scientific) knowledge and local (or situational) knowledge, as well as for these two types of knowledge to be combined or integrated (Thompson, 2016). In fact, the process of building knowledge through design-related research is-based upon the combination of specific knowledge (analyses of designs, designing) and generic knowledge (comparing analyses and experimental design) (Nijhuis & Bobbink, 2012). So, despite a growing amount of research-based knowledge and good arguments to adopt this into landscape architecture, the actual combination of research-based knowledge and design is not yet sufficiently studied or successfully established.

This guide does not challenge the common understanding of research-based knowledge as scientific and design as a service to society. However, it is obvious that landscape architecture, with its foundation both in academia and in practice, bridges over the commonly separated spheres of science and society and legitimates to question this separation, along with the related concepts of 'science', 'society', 'research', and 'knowledge'. Indeed, various scholars of different origin have since the 1990s been investigating how to redefine science and society while reframing their relationship. They believe in the societal need, in this particular moment of history, to forge new forms of research to complement the disciplinary knowledge production developed during the 19th century when addressing the globally interrelated problems of the 21st century, with its uncertainties and unpredictable dynamics (e.g. climate change, planetary resource depletion, mass extinction of species, demographic shifts, economic turmoil etc.). Silvio Funtowicz and Jérôme Ravetz speak about a new 'post-normal science' that integrates an 'extended peer community' into knowledge production (1993), which would include non-academic stakeholders into the knowledge generation process. Lima de Freitas, Edgar Morin and Basarab Nicolescu called this process trans-disciplinary and drafted the first *Charter of Transdisciplinarity* in 1994. Also Helga Nowotny and Michael Gibbons (2001) observed that research was increasingly carried out in dialogue with a large number of different actors who bring heterogenous skills and expertise into the problem solving process, which they came to call 'Mode 2'. Schneidewind et al. (2016) claimed that science could even take the role of initiating and catalysing societal transformation processes, beyond observing and describing them; and such a 'transformative science' would aim to increase society's capacity to reflect upon its transformation. The ongoing repositioning of science, society and knowledge production merits the attention of landscape architecture students, teachers and researchers because of its potential for explaining the gap between research and design, but it will not be further considered in this guide.

1.4   What this guide offers

Through this guide we wish to address at least some of the insecurities described above. To this end, it will present and discuss a selection of different models or ways of how (and why) to rely on research-based knowledge in landscape design, how to explain the choice for a method, and how to justify it towards objections. We thought it most useful to give an **overview of *different* ways of thinking about how the design (process) is or can be informed by research-based knowledge**.

Students in landscape architecture have surely encountered different notions of how design and research should (or should not) relate to each other. Teachers, fellow students, or the literature may have expressed different ideas. Sometimes, these notions are made explicit, but often they are expressed only implicitly, and sometimes we are not even aware of our underlying assumptions. When working on bachelor or master (or other) projects, supervisors may have an idea about this issue, which may or may not correspond to a student's own view, which may be different altogether from the examiners' notions – and from people who may read the work and look at the project. We are convinced that this diversity of ideas is inevitable. Be that as it may, this multitude of different ideas can make student life (and projects) difficult. Hence, we would like this guide to be helpful in finding and understanding own standpoints in the question of why and how design can relate to research-based knowledge. We would like to enable students to make an **informed choice** between various possible ways of integrating research and design, and to describe and justify own positions in projects – to oneself and others (the supervisors, the examiners, the readers).

It is emphatically not our intention to present the one true way of doing it. Furthermore, this guide is far from comprehensive, i.e. it only presents some of the existing approaches on why and how to integrate research and/in design. The following sections explain briefly which criteria have guided our selection of what we present and discuss here.

1.4.1 Some methodological remarks

The question of how to integrate research-based knowledge in the design (process) is inseparable from the underlying (but often implicit) understandings of 'design' and 'research'. Hence, to answer the question of how (and why) to integrate research-based knowledge in the design (process) thoroughly, one would need to take into account the myriad of different understandings and definitions of 'design' and 'research' respectively. To do this in a systematic and comprehensive manner is beyond the scope of this guide. We are thus forced to simplify matters, and two criteria have guided the selection of ideas and positions that we present: The first criterion is a systematic one. We have strived to introduce as wide a spectrum of positions, the poles of a spectrum, as it were, and important positions between these extremes. For example, design can be understood as a purely artistic, aesthetic and subjective process on the one hand/extreme, or as a rational and objective projection of the future on the other, although a more overarching description might be "giving three-dimensional form and function to, for example, the direct external living environment" (Lenzholzer et al., 2016, p. 54).

The second criterion is more pragmatic and regards in particular the depth into which we discuss the individual models: it mirrors the different areas of expertise and interests as well as the different notions about (the relationship between) 'design(ing)' and 'research' among the three authors of this study. As a result of this, this introductory guide will provide an overview of:

1. some models of how the relationship between 'research' and 'design' has been conceived in methodological literature in the field of landscape architecture and
2. how this relationship is discussed in the wider field of design research (including disciplines such as architecture, industrial design, etc.), where 'design' tends to be used in a wider sense.

This guide aims thus at presenting and discussing a spectrum of positions and perspectives both from different disciplines (both landscape architecture and the design disciplines) as well as with regards to what 'design' or 'research' is or should be and how they are to be integrated.

2 Landscape design based on research: a guide

2.1 The relationship between research and design in landscape architecture

Design can be related to knowledge and research both in academic and practical work in several different ways. Accordingly, there is a lot of academic literature on this issue and related topics. As an introduction to this rich body of knowledge and thought, we would like to present one seminal way of describing the relationship between research and design. Christopher Frayling (1993) suggested to distinguish between three different types of design research:

1. research *into* art and design,
2. research *through* art and design, and
3. research *for* art and design (Frayling 1993[1]).

Even though this distinction is now some 25 years old and is not entirely unproblematic,[2] it is still considered a useful point of departure and reference for many studies in the field (Lenzholzer et al., 2016). It has, for example, been emphasized that the development of landscape architecture research can benefit from this distinction into three approaches and that specification of methodological foundations for each of them might be important (van den Brink & Bruns, 2014).

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[1] According to Frayling, these three categories are derived from Herbert Read (Frayling 1993, p. 4 f.)

[2] For example, the dividing lines between the three types are not clear cut. Research into design has the potential to further landscape design work, e.g. "help to advance landscape architecture theory and methods by drawing conclusions from case studies and by analysing projects, landscape plans and the work of individual designers" (van den Brink & Bruns, 2014, p. 14). To some degree, research *into* design can thus be considered research *for* design. The same seems to apply to research *through* design, at least following the meaning by Lenzholzer et al (2016), characterizing research through designing (RTD) as producing "new knowledge that is applicable in design practice or further research".

2.1.1 Research into design

Research into design includes studies of e.g. historical, aesthetical, technical, ecological or perceptional aspects of design (Frayling, 1993, p. 5). "Design" is here referred to as a noun, which means that studies in this field concern the design product (*post hoc*), not the process of designing (Lenzholzer et al., 2016). This type of investigation is sometimes also referred to as research "on" or "about" design (Lenzholzer et al., 2016) or as "design research" (Nijhuis & Bobbink, 2012) – even though this latter term seems to denote more commonly the umbrella concept for the various categories of design-related research. Research into design is a common form of design research for master projects (and research in general) within landscape architecture: Studies in garden history, a critique of the oeuvre of a landscape designer/design firm, or studies about the plant biodiversity of a designed site would fall under this type of research. Depending on the research question, the methods for research into design can include (but are not limited to) literature studies, archive studies, case studies and interviews, but also evaluation of design through e.g. so called post occupancy evaluation (POE) of buildings or sites.

Compared with the other two forms of design research, research into design is – from a methodological point of view – relatively uncomplicated. As mentioned in the introduction, the methods commonly used in the pertinent disciplines (from various fields within the natural sciences, the social sciences and the arts and humanities) are applied. The end product of such a project or study is usually a text, not a design. For these reasons, this introductory guide will not deal further with methodological issues related to research into design.

2.1.2 Research through design

Research through design – or research through art and design (Frayling, 1993), research through designing (Lenzholzer et al., 2013), research by design (Barnett, 2000; Nijhuis & Bobbink, 2012) – concerns what can be learned, experienced and communicated by performing design activities, "exploring the spatial consequences or possibilities of, for example, abstract planning or political options and choices, in a visual way" (Nijhuis & Bobbink, 2012, p. 252). Examples of directions of research through design are material research (paving, plants etc.), developmental work and action research (Frayling, 1993).

In research through design, the design (process) constitutes the (research) method. The question whether design is a legitimate research method is, however, contested.

Even the question whether this is a controversial issue at all is debated: While for example Lenzholzer et al. (2016) claim that there would be no doubt within the wider field of design disciplines that design can be a valid research method, such ideas have been regarded with reservation within landscape architecture (e.g. Deming & Swaffield, 2011; Milburn & Brown, 2003). Benson (1998, p. 201) has, for example, argued that "design and research are fundamentally different in several respects", even if "design is amenable to research". Moreover, it is argued that "for design to qualify as research it would need to meet certain methodological criteria, such as a clear research question, a theoretical framework and appropriate methods" (Lenzholzer et al. 2016). While design(ing) as a (non-scientific) practice and researching would have similarities in their investigations and search for solutions, "designing per se is not the same thing as carrying out scientific research but, if properly organised, designing can become a scientific research method" (van den Brink & Bruns, 2014, p. 15). In contrast, it has been pinpointed that research through design within landscape architecture should not be given too limited definitions or frames (Barnett, 2000; Lenzholzer et al., 2013). It is considered of value to use the design process in a free way to, for example, be able to broaden and question established views. What can be concluded is that research through design requires both academic and design expertise, that it often involves collaboration with other disciplines and that it is of major importance in developing landscape architecture practice (Lenzholzer & Brown, 2016).

Based on the widely used distinction of approaches to research in general by Creswell (2003), Lenzholzer et al. (2013) identify four different models for research through design within landscape architecture: (post)positivist, constructivist, advocacy/participatory and pragmatic (see also Lenzholzer et al., 2016).

The *(post)positivist model* is often used to produce generalizable knowledge about physical characteristics from technical, functional or environmental psychology factors. Design is used to test for example different measures and functions to be able to generate design guidelines that thereafter are systematically evaluated.

The *constructivist model* is described as of large importance for landscape architecture, being context focused. There, questions about techniques, theories or concepts are explored by testing something new. It might be about studying how something can be expressed through landscape architecture, how the design affects people, or follow the own design process. The knowledge becomes context dependent and cannot be directly applied in other contexts, but can either be applied partially or as one of several comparative studies. It is of importance that the studies are carried through and documented in a structured way.

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The *advocacy/participatory model* is about social development and aims to achieve change. The researcher involves the community in the development of their close environment based on their opinions, needs and preferences. That can generate knowledge for both the community and for the researcher/academia. Even though the direction has some methodological weaknesses, Lenzholzer et al. (2013) recommend it as an approach to solving many contemporary and future problems, such as how to handle the effects of climate change.

The *pragmatic model* concerns how different methods and knowledge areas can be combined to generate context-based solutions. The starting point is research questions and through them selected methods and theory. According to the pragmatic model, the end product can be a complete context-based design, with the knowledge incorporated. Thereby, this model of research through design reassembles research for design.

2.1.3 Research for design

According to Frayling, research for design is investigation "where the end product is an artefact – where the thinking is, so to speak, *embodied in the artefact*, where the goal is not primarily communicable knowledge in the sense of verbal communication, but in the sense of visual or iconic or imagistic communication" (Frayling, 1993, p. 5, italics in original). This type of design research is, for Frayling, the "thorny one" (Frayling, 1993, p. 5), i.e. the one with most methodological and epistemological problems. However, in more recent studies on design research, research for design has been defined in a slightly different way. This redefinition has turned the concept of 'research for design' into a far less problematic category. According to Lenzholzer et al. (2016), research for design includes "all types of research that support the design product or design process" (Lenzholzer et al., 2016, p. 55). In this introductory guide, we use the term "research for design" in this latter sense.[3]

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[3] According to Prominski (2016), all design research can be considered research for design since all design research is or should be relevant for improving the design product or process. This is a valid point; however, sometimes the results from, for example, research on design cannot be directly fed back into a design process.

Given the complex nature of landscape architecture, research for landscape design can draw on a wide knowledge base, ranging from the natural sciences and social sciences to the arts and humanities. Often, however, within individual research-for-design-studies, focus is put on one specific area of knowledge. "The design is informed by specialized knowledge (quantitative and qualitative) which is delivered as building stones to the design process" (Nijhuis & Bobbink, 2012, p. 252). Research-based knowledge about noise reduction and soundscapes is applied in an area with much car traffic, about children's outdoor play in a schoolyard or about restorative environments in a park. Research for design might be interpreted as research-based knowledge developed specifically for design or, more generally, that can be used for it. However, it is important not to see any information as "research", but to either conduct thorough research studies based on design cases (Prominski, 2016) and/or to engage in how to apply knowledge from various research disciplines into the design process (van den Brink & Bruns, 2014). The outcome of research for design is then any knowledge that can "inform the design process" (Lenzholzer et al., 2016, p. 55), including also translation of different types of knowledge into design guidelines that are useful and meaningful for the design or for the design process (Lenzholzer et al., 2016).

Research for design can be conceived of as the creation of knowledge through the generation of scientific 'data' for application in landscape design. This is the case in **evidence-based landscape architecture** (Brown & Corry, 2011), evidence-based design (Evans, 2009), or evidence-based landscape design (Lenzholzer & Brown, 2016). The next section will discuss research-based knowledge and landscape design, starting with the concept of evidence-based landscape architecture, as it resembles in many respects what this guide is about: how to integrate research-based knowledge in the design process or product.

2.2 Research-based knowledge and landscape design

2.2.1 Evidence-based landscape architecture and design

Evidence-based landscape architecture (EBLA) has been defined by Brown and Corry (2011, p. 328; italics in original) as "*the deliberate and explicit use of scholarly evidence in making decisions about the use and shaping of the land*". EBLA is described as a way of supporting decisions in design without dictating them. It "uses knowledge – generally from methodologically studied experiment or experience – as the principal information source for design". Brown and Corry (2001) recommend the following four-step process for evidence-based landscape architecture: "(1) formulate clear goal or question based on the issue or on client's request (e.g. design for the use of a specific user group); (2) search for relevant scholarly literature; (3) critically evaluate the evidence for both validity and usefulness; and (4) synthesize and apply the findings to the problem at hand."

Evidence-based design can also be described as a combination or triangulation of three different parts, which is the interpretation by Refshauge et al. (2015) of the ideas presented by Brown and Corry (2011). The parts are: practical knowledge (own or others – best practice), literature studies (research-based knowledge) and the needs of the client (analysis of the design task). These three are then used to create space-specific design solutions.

The concept of and motivation behind evidence-based landscape architecture and design approximates the issue we address in this guide, how research-based knowledge can inform the design process and the design. We would argue, however, that the concept of evidence-based landscape architecture is unnecessarily narrow in one respect in particular: it is biased towards just one type of research, namely post-positivistic science, which limits the concept's usefulness and applicability. In the following, we will present our critique of the concept of evidence-based landscape architecture in more detail, and explain how a narrow focus on post-positivist science can be overcome.

2.2.2 Towards research-based landscape architecture and design

The definition of evidence-based landscape architecture given by Brown and Corry (2011) cited above reveals a rather narrow understanding of what counts as "evidence": Legitimate evidence is limited to knowledge generated through "methodologically studied experiment or experience". This characterization of how knowledge is gained is reminiscent of what Creswell (2003) refers to as the postpositivist approach to research, which would sometimes also be referred to as the "scientific method", or doing "science" research "quantitative research", "positivist research" or "empirical science" (Creswell, 2003, p. 6 f.). Characteristic for a postpositivist knowledge claim is the assumption that knowledge "is-based on careful observation and measurement of the objective reality that exists 'out there' in the world" (Creswell, 2003, p. 7). Without any doubt, such knowledge is essential in answering many topical and pressing issues (see for example the role of postpositivist research for microclimatic urban design discussed in Lenzholzer and Brown 2016). However, Creswell (2003) identifies three other types of knowledge creation, namely social constructivism (which is often coupled with an interpretative paradigm), an advocacy/participatory approach, and pragmatism. In these approaches, knowledge is not, or at least not primarily or exclusively, generated through methodologically studied experiments or experience. We would therefore argue that the definition of "evidence" that Brown and Corry (2011) lean on in their explanation of evidence-based landscape architecture tends to exclude non-postpositivist types of knowledges and forms of knowledge creation.

If you have difficulties in imagining how research-based knowledge from the arts and humanities[4] may inform landscape design, have a look at Susan Herrington's book *Landscape theory in design* (2017). The book contains numerous examples of how for example phenomenology, semantics, structuralism and post-structuralism have influenced landscape design (Herrington, 2017). Herrington admits that not all landscape designers may have consciously turned to these theories to base their design upon. However, she argues, first, that some designers have done so (for example makes Anu Mathur explicit reference to Gayatri Chakravorty Spivak's postcolonial feminist theories) and, second, that there lies grand potential in doing so. Knowing a range of theories (i.e. having access to research-based knowledge) "may cause you to think more deeply about the designs you create" (Herrington, 2017, p. 7).

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[4] Herrington (2017) does, however, not talk about research-based knowledge, but about "theories", which she defines as "debatable explanations concerning how you interpret phenomena in the world, make sense of experiences, discover patterns, and produce meaning" (Herrington, 2017, p. 1). Unlike theories in the sciences, "in the humanities most theories remain in the contested territory of debate" (Herrington, 2017, p. 1).

For the one who wants to learn more about these different modes of knowledge production, Ian Thompson's text *The role of theory* could be of interest (Thompson, 2016). In this text, Thompson outlines different roles that the concept of theory plays in what he refers to as the "three great empires of academia": the natural sciences, the social sciences, and the arts and humanities. While "theory" denotes something slightly different than Creswell's "knowledge claims" or "types" or "modes" of knowledge production, Thompson makes a similar argument: in each empire of academia, knowledge claim, or type of knowledge creation, there are "different norms, values and even language[s]" (Thompson, 2016). This does not imply, however, that one of these empires or paradigms is better, or – even more radically – that only one of them is 'true science'. Rather, it is a matter of selecting "the right sort of theory for the job" (Thompson, 2016). One needs to understand what sort of theory or mode of knowledge production is relevant for the problem at hand and able to give the right answers to the question one would like to answer. It's not that for example the natural sciences *per se* give better answers than the social sciences – they answer *different types* of questions than the social sciences, which in turn answer different kinds of questions than the arts and humanities. To understand this and to know which academic empire or type of knowledge production to turn to is of crucial importance for landscape architects, since this discipline of ours occupies a position in the borderlands between the natural sciences, the social sciences, and the arts and humanities.

One could critique another point of Brown's and Corry's (2011) characterization of evidence-based landscape architecture: At first sight, the four-step process description seems quite straight-forward and easy to agree upon. However, upon closer scrutiny, it turns out to be not overly helpful as crucial questions are not explained in more detail. It remains for example unclear how to critically evaluate the "validity" and "usefulness" of the evidence. What are the criteria for this evaluation, and what is actually meant by "validity" and "usefulness"? And, maybe more crucially: how exactly are the findings to be applied to the problem at hand? Maybe this "application" is less problematic for research results that are produced with the help of methodologically studied experiments or experiences, but it is far less obvious for e.g. constructivist research or the other types of research distinguished by Creswell (2003).

In response to these two objections, we would like to present in this handbook different ways and diverse types of or approaches to how research and scholarship can inform the design and the design process. This can be understood as a further development of the concept of evidence-based landscape architecture and design in two ways: First, by using the term "research-based" instead of "evidence-based", we intend to signal that we do not only conceive of knowledge gained through postpositivist research as "evidence" but include – to use Creswell's (2003) terms – knowledge gained through constructivist, advocacy or participatory, and pragmatist approaches. Secondly, to unpack the difficulties in evaluating and applying research-based knowledge that may be relevant to a design task or brief, we will present and discuss a variety of different ways how the 'integration' of research-based knowledge in the design process or the design product can be conceived.

2.3 Different models for landscape design based on research

In the last section, we have argued that the research that landscape design and designing could or should be based upon should not be limited to postpositivist, natural science, or quantitative research. Knowledge gained through other approaches (e.g. interpretative ones) is not only equally legitimate, but depending on the research question or design issue at hand, may be the right sort of knowledge to inform the design(ing). In a similarly pluralistic mindset, we would like to suggest that **there is not only one legitimate way that research-based knowledge can inform the design process – but many**. In the following, we exemplify this by presenting and discussing a selection of different models or ways of integrating research-based knowledge into design(ing).

Our starting point is the paper *The relationship between research and design in landscape architecture* by Milburn and Brown (2003), who have identified different models of the relationship between research and (landscape) design. They have, first, compiled models based on a literature review and, second, identified different models through a study of their own, which comprised in-depth interviews with educators in landscape architecture and a questionnaire to faculty in departments of landscape architecture in North America.

They found that the models presented in the literature did not display the reality of how design educators and designers make use of research-based knowledge and therefore described five new ones. While the literature models described certain aspects or phases of landscape design(ing) correctly, no one model was embraced in its totality by one designer. Instead, the models were rather "considered complementary and congruous" (Milburn & Brown, 2003, p. 56). From their own empirical material, they concluded that "the relationship between research and design is defined by timing of research, type of research, function of research, and approach to integration" (Milburn & Brown, 2003, p. 56). These five aspects are the criteria that the new models are based upon, and the factors that describe how they differ from each other.

Milburn and Brown (2003) do not use the concept "research-based knowledge" but write – supposedly synonymously – about "information" or "research". While one of their conclusions is that the "key issue in understanding the relationship between research and design is not an adequate understanding of the design process, but rather the definition and application of research" (Milburn & Brown, 2003, p. 64), their concept of "research" remains rather fuzzy, arguing that definitions of research are "highly individual and linked to fields of expertise" (Milburn & Brown, 2003, p. 64). Whatever is referred to as "research", "information" or "knowledge", may mean something different in every model. While this is surely the case, one can criticize that this is not more explicitly discussed in their paper, given that "research" is one of its central concepts. Be that as it may, we would argue that Milburn's and Brown's concept of "research" does surely *not exclude* research-based knowledge as we understand it. This is why we thought it legitimate and fruitful to use the models they have identified as starting points for our discussion.

In the following, we present and discuss the models Milburn and Brown (2003) have developed successively. These are: the artistic, the intuitive, the adaptive, the analytical, and the systematic models. They can be regarded as a spectrum of approaches, with a gradient of growing influence of research-based knowledge on the design. At the end of this section, a table compares the different models (table 1).

2.3.1 The artistic model - "Research set aside from Design"

The artistic model mainly builds on a creative process that is not involving research. Research is "set aside" prior to concept generation (Milburn & Brown, 2003, p. 62), i.e. prior to developing the design solution. Proponents of the artistic model sometimes consider research-based knowledge as actually hindering the creativity and limiting the design(ing). Milburn and Brown (2003, p. 62) cite one of their study participants as saying that "too much research leads to a loss of creativity – you can not [sic!] move on. At some point you have to go from all the stuff you know and move on to the way you feel about it". In this model, research must be "transcended to be truly creative" (Milburn & Brown, 2003, p. 62). However, research-based knowledge still has a role to play in this model. It is educating and informing the designer; and this knowledge is drawn upon "to assess, prioritize, judge and modify the concept" (Milburn & Brown, 2003, p. 62), i.e. the actual design solution. According to Milburn and Brown (2003, p. 62), the design approach is creative, and the focus of the design process is the product, the design.

As this model's name indicates, 'design' – or what Milburn and Brown (2003) refer to as the "concept generation" – is understood to be primarily or essentially an artistic endeavor. While this is not explicated by Milburn and Brown (2003), one can assume that the proponents of this model consider 'design' to be primarily a question of form-giving whose products are to be judged aesthetically, i.e. by the way one "feels" about it, whether it creates (aesthetic) pleasure or not. Critics of this model may object that such an understanding of 'design' – and hence of the design process and the integration of research-based knowledge – does not adequately describe the nature of landscape design. The 'design' of a landscape, the critics may argue, cannot be limited to form-giving – especially not in many contemporary complex large scale projects where landscape architects have leading roles. Other aspects, such as ecological, hydrological, social or economic aspects are crucial to consider for the design to work. Proponents of the artistic model may counter this demur by arguing that the critics are right in emphasizing that other aspects than aesthetics are important too, but that stating that aesthetics are essential (in the philosophical sense) does not exclude that these other dimensions are addressed as part of the design work or in the design process.[5] In this model, this could be said to be reflected by the role ascribed to research: research-based knowledge (e.g. the ecological, hydrological, social or economic knowledge) is used to assess, prioritize, judge and modify the design solution.

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[5] One interpretation of how such an emphasis on the notion of aesthetics as the essential feature of 'design' does not need to except functional considerations within landscape architecture is given in van Etteger, Thompson and Vicenzotti's (2016) discussion of the aesthetic creation theory by philosopher Nick Zangwill.

2.3.2 The intuitive model - "Research inspires Design"

In the intuitive model, research-based knowledge is "absorbed and inspires the concept" (Milburn & Brown, 2003, p. 62), i.e. the design proposal. This model is dominated by emotion, or rather: by an instinctive, intuitive response to research-based knowledge. Proponents of this model "trust something intuitive in themselves to integrate information [such as research-based knowledge] in when it is appropriate", as one study participant put it (Milburn & Brown, 2003, p. 62). However, the concept or design solution is not a direct reflection of the research, but rather "a *transformation* which involves a dialogue of idea and site" (Milburn & Brown, 2003: 62; italics by the authors). As in the artistic model, research-based knowledge is used to assess, prioritize, judge and modify alternative design concepts (Milburn & Brown 2003, p. 59, table 5). The site is incidental to the design process, with the focus on the product.

In practice, it may be difficult to tell apart whether a designer has worked according to the intuitive or the artistic model. She or he may think (and claim) to have "set aside" research-based knowledge prior to concept generation while the knowledge has unconsciously been absorbed and inspired the design solution.

2.3.3 The adaptive model - "Research translates into Design"

The adaptive model is more clearly than the two models described above having the place as starting point, being responsive to the site, even if the model is still dominated by a focus on the design product. Like the intuitive model, research-based knowledge is "absorbed prior to concept generation […] and inspires the design concept" (Milburn & Brown, 2003, p. 62). However, in contrast to the intuitive model, "the concept *translates* the research" by retaining the form and content of the information on which it is based (Milburn & Brown, 2003, p. 62; italics by the authors).

Unfortunately, Milburn and Brown (2003) do not explain any further what they mean with the opposition of the "transformation" of research-based knowledge in the intuitive model and its "translation" in the adaptive model. In both approaches, research-based knowledge "inspires" the concept and is used to assess, prioritize, judge and modify alternative concepts (Milburn & Brown, 2003, p. 59, table 5). One difference between the two models lies in the role the site plays for the design(ing). One can thus assume that the difference between the "transformation" of knowledge versus its "translation" has something to do with how research-based knowledge is changed to respond to the site. The adaptive model seems thus to imply some degree of "adaption" of the research-based knowledge to the site's condition. However, this adaption is said to *not* concern its form or content (which leaves to wonder what it is then that gets adapted). Furthermore, it must be a weaker form of adaptation than the 'transposition' of knowledge that takes place in the analytical model, as we will introduce shortly. Given that the order in which the models are presented in the paper by Milburn and Brown (2003) follows a gradient of growing influence of research-based knowledge on the design, one could further assume that they want to indicate a stronger degree of determination of the design through the research-based knowledge in the adaptive model compared to the intuitive model. The designer's creativity is less free, as it were, compared to the intuitive model, and more bound by both the knowledge based on research and the place.

2.3.4   The analytical model - "Research is central to Design"

The analytical model describes a more pragmatic approach to design. Research-based knowledge is "central to the design approach" (Milburn & Brown, 2003, p. 62) in that it "informs concept generation, and the concept […] transposes the research" (Milburn & Brown, 2003, p. 62). That research is (or rather: has to be) transposed is due to the insight that the research may not be applicable to the site in its traditional form. "Research is interpreted in light of site issues and program concerns, and interacts with the design problem" (Milburn & Brown, 2003, p. 62). This re-interpretation of the research happens in the analytical model in a "cognitive process" (Milburn & Brown, 2003, p. 62) – in contrast to the other models presented so far since in these models the reference to research-based knowledge has been less reflected and more intuitive.

This model differs from the other ones presented so far also in that its focus is on the process rather than the end product, which might be both valued and criticized. The analytical model further emphasizes the re-interpretation of research-based knowledge, which can often be needed to make it useful for site-specific landscape design.

2.3.5 The systematic model - "Research determines Design"

In the systematic model, research-based knowledge "determines the concept" (Milburn & Brown, 2003, p. 63). The design approach tends to be "formulaic" (Milburn & Brown, 2003, p. 63), and design solutions can even be standardized. In this approach, design is primarily seen as "a problem solving exercise, which is driven by established rules and procedures" (Milburn & Brown, 2003, p. 63). Still, Milburn and Brown (2003) claim that the systematic model is more focused on process than product.

The understanding of "design" that underlies the systematic model is very different from the one that the artistic model is based upon: In this model, "design" has little to do with an artistic act and is not to be judged aesthetically. The designer has no degree of (artistic) freedom, since the design is *determined* by the concept. This means that if all designers defined the site and the brief in the same way, and if they referred to the same research-based knowledge, then they would come up with similar design solutions. Some critics would argue that the concept of design that the systematic model is based upon should not be referred to as "design", but rather as "planning". We think that it is rather pointless to try to police how certain words are used. It is, however, of crucial importance to be aware of the fact that the different models are based on very different understandings and conceptualizations of "design" (and "research") accordingly.

Table 1: *Overview of the different models of how to integrate research-based knowledge and design(ing) (based upon Milburn & Brown, 2003, p. 59, table 5).*

Name of model	Research (based knowledge) is … prior to design.	The research (based knowledge) … the design.	The design … the research (based knowledge)	The design is … the site.	Alternative designs are … according to research (based knowledge)	Design approach	The site is…	Focus
Artistic	set aside	is separate from	Transcends	applied on/ linked to/ connected with	assessed, prioritized, judged and modified	creative	extraneous	product
Intuitive	absorbed	inspires	Transforms	overlaid with	assessed, prioritized, judged and modified	emotive	incidental	product
Adaptive	absorbed	inspires	Translates	adapted to	assessed, prioritized, judged and modified	responsive	contingent/ conditional	product
Analytical	carried along	informs	Transposes	interpreted to	assessed, prioritized, judged and modified	pragmatic	important/ significant/ prominent/ emphasized	process
Systematic	carried along	motivates/determines	Transmits	integrated with	assessed, prioritized, judged and modified	formulaic	critical/paramount	process

2.4　Further reflections and applications

2.4.1　Discussion of the models

The compilation of this guide shows that there is a multitude of ways to integrate research-based knowledge and design. In order to incorporate research-based knowledge into design, it appears to be of value both to process and analyze this in a way that suits the work, and by having a suitable level of structure and pragmatism, compared with when the knowledge is for example more experience-based or intuitive. Thereby, also in the own study by Milburn and Brown (2003) a gradient is described from a more free working process, where the role of the research is mainly as educational background, to a more structured model where the research has a clear, explicit role. For projects by students and others, it might be of value to discuss and clarify in which way and to which extent research-based knowledge is included in the design(ing), and how that can be described, using support in the literature. It does not forcedly mean that one of the five models needs to be "picked", but the understanding for that gradient can serve as a starting point for making own statements of the approach used.

In the five models presented, the site-specific spatial and social context is given various amounts of focus and importance. However, one might argue that in landscape design, the site generally is (or should be) in focus, no matter the level of structure in the inclusion of research-based knowledge.

2.4.2　From theory to design – design guidelines

Regardless of which of the models or starting points that is used, the challenge in the process of going from theoretical knowledge into practical design remains to be sorted out. There is much recommendation of providing generic and transferrable knowledge in the process of different approaches to research and design - particularly in research for design (Tress et al., 2006; Nijhuis & Bobbink, 2012; Prominski, 2016). How can it be conducted and described in a transparent way? How is the theory processed in order to suit the design process? There are many opportunities, but also some challenges as these possibilities are seldom clearly described.

Milburn and Brown (2003) in their literature studies found four concrete ways in which one might bring knowledge/research into design in landscape architecture: as **criteria** to test design concepts against, as information to set up **general principles** for design, as an **intellectual framework** for design and as a **subconscious understanding** of issues and problems.

These four ways all imply that there might be an inter-stage, conscious or not, where knowledge or theory is compiled into starting points for the design work. Brown and Corry (2001) describe synthesizing and application as one unified stage, but one might still interpret it as first containing a processing of the literature/theory through synthetizing, before the knowledge is to be applied into the design process. Kuiper (1998) mentions criteria in the form of planning objectives and design principles as basis for planning and design when she studies plans for river areas.

Prominski (2016) proposes evidence-based **design guidelines** that are abstracted and transferrable to be used to inform landscape design. They provide guidance for designers as looking for solutions in a site-specific context, providing possible directions. Design guidelines should be "neither totally specific nor completely universal and represent structured knowledge bundles of an intermediate level" (Prominski, 2016, p. 196). The starting points for developing design guidelines can be existing research results/theory but also the development of new research with the aim to form design guidelines through studying practical examples and test designs. In this way, design guidelines relate to all the types of relations between research and design (into, through, for), specifically research for design. Design guidelines act as an intermediate step between the complexity of research evidence and best practice, applied to site specific contexts through the creativity of landscape architects. They thereby serve both to facilitate the speed and quality of practice (Prominski, 2016).

2.4.3 Combined approaches

In the complexity of relations between research and design, there are often combinations of more than one of these three approaches (into, through and for). For example, repeated design works can be influenced by both own experiences and other research and thereafter evaluated to generate knowledge that is useful in other (similar) contexts. In fact, the three approaches are interacting (Prominski, 2016). Nijhuis and Bobbink (2012) have proposed "research-based-design", a combination of research into and through design (which they call design research and research-by-design) that starts in analyses of existing designs or designed landscapes and leads to "experimental design study" and design in a knowledge accumulating process.

Nijhuis and Bobbink (2012) also describe generic knowledge as a middle step, which resembles 'design guidelines' in research for design, for example as a result of comparative analyses of designs: "we acquire generic spatial design knowledge reflected by different possible spatial solutions, which can be applied in other contexts as well. It offers as it were a 'toolbox' for the landscape architect providing an overview of available spatial types of principles" (Nijhuis & Bobbink, 2012, p. 248). Lenzholzer and Brown (2016) found that transitions between research through and for design were used in post-positivist microclimatic design research studies, but also that research for design – generation of empirical knowledge aimed for use in design – was more common than research through design(ing). Tress et al. (2006, s. 20) describe "the circle of knowledge creation" where specific problems can be solved using knowledge from persons in the project group or knowledge from previous projects (development projects), or new knowledge that is being produced (research), or preferably a combination of both. Thereafter, reflection is used to generate generic, transferrable knowledge that can be used in design. However, this requires another working method than the common division between research and design. Collaboration, for example as having designers who take part in research work, has also been emphasized as valuable for research results to be used and useful in design practice (Evans, 2009).

2.5   Conclusions

Research-based knowledge has an important role to play within landscape architecture and can be used to strengthen and improve design work. It is important to find and develop ways to integrate research with design in order to improve landscape architecture practice, but at the same time to keep a freedom within the profession of landscape architecture, where other knowledge than the research-based, such as experience and intuition, are continuously needed. Landscape architecture will continuously be complex, also in the connection between research and practice. There are several different ways and models that can contribute to advance both theory and practice and facilitate their interrelation. The models can be suitable in various contexts and function as support rather than as a framework.

Research can be combined with design within landscape architecture through one of the three types: **research into design**, **research through design** and **research for design**. Out of these, research into design is relatively uncomplicated, even though it of course also has its challenges. Research through design is generally more complex but lacks clear definitions and models – something that might be positive considering the need for loose frames in that experimental approach, where the design process is used as a method. Research for design is sometimes considered the main challenge since it is so complex, with several ways of bringing knowledge, also research-based, into a design work.

When bringing research-based knowledge into landscape design, everything from intuition-based knowledge, where the research is mainly an education background, to systematic approaches, e.g. analyzing research literature into design guidelines being systematically applied into the design, can be used. The approach can be different depending on the aim and the context of the design task. The five proposed models: **the artistic**, **the intuitive**, **the adaptive**, **the analytical**, and **the systematic**, can be regarded as examples in a spectrum of approaches, which can support making an informed choice in each project.

The site and its physical and social context is often of paramount importance in landscape architecture and of main relevance also in approaches to integrate research and design. There is a need to proceed in testing what research-based landscape design can be, through various approaches, and specifically to further develop and test the many possible ways of integrating research-based knowledge that also lift the site-specific approaches of landscape architecture and design.

3 Examples

3.1 The five models applied

In relation SLU's framework for master projects in landscape architecture, this guide concentrates on the category 'research-based landscape design'. In this chapter the authors seek to illustrate the models found in literature (Milburn & Brown 2001) using contemporary design projects, retrieved from the 5th edition of the book series *Landscape Architecture Europe* (Diedrich et al., 2018). The series has been initiated by the professional landscape architecture head association IFLA Europe and is produced by the Landscape Architecture Europe Foundation as an ongoing critical state of the art survey. This guide only quotes very shortly from the professional book, which can be studied more in detail for the one who wishes.

3.2 The artistic model

"Research set aside from Design"

- Creative process
- Not involving research directly, but through e.g. education, assessment etc.
- Focus on product/design
- Critique: design becomes form-giving only
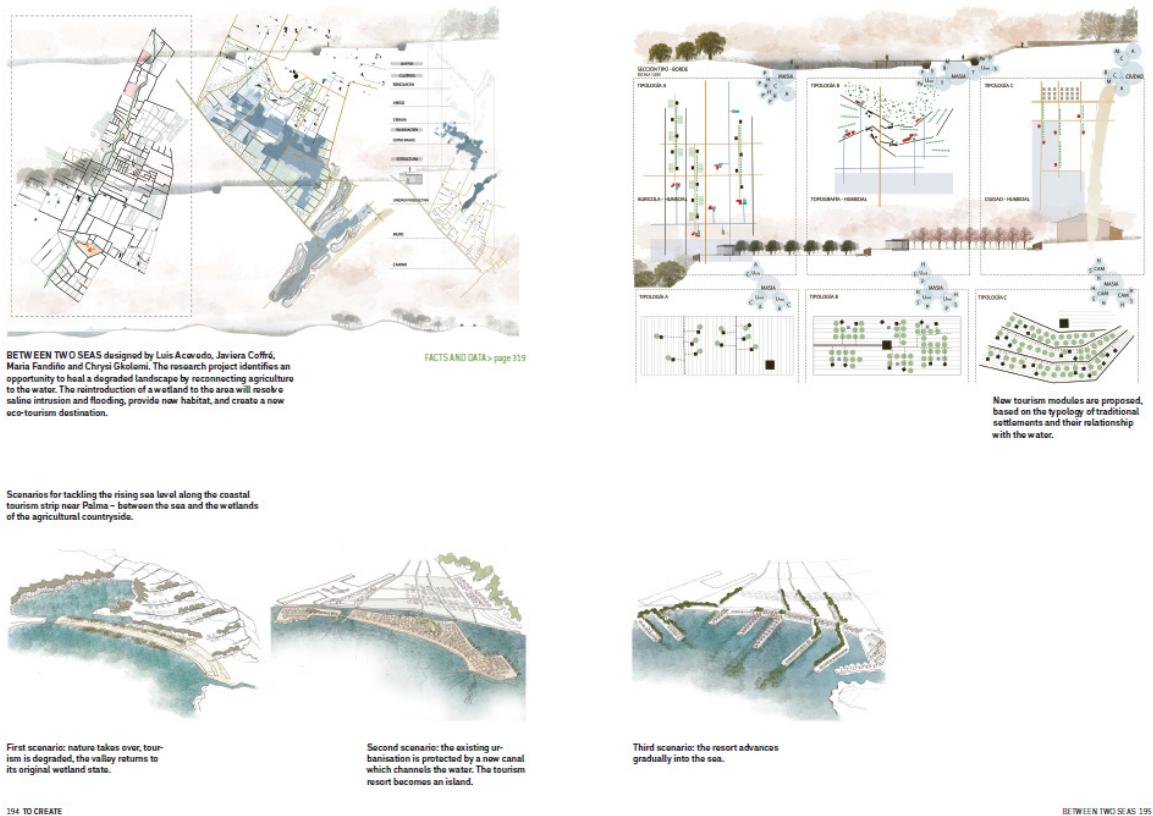
Figure 2: Luis Acevedo et al., Between two seas, Mallorca (source: Diedrich et al., 2018)

This study on the development of a coastal region of Mallorca has been elaborated by a student group with an accent on the materialisation of water-land encounters according to three different scenarios of urbanisation and land use. Research reports on tourism economy, agricultural production, climate change etc. have not been taken as the basis for this design but can be considered as the wider framework for it.

3.3   The intuitive model

"Research inspires Design"

- Research-based knowledge transformed to inspire concept
- An instinctive, intuitive response to research-based knowledge, used to assess, prioritize, judge and modify
- Site incidental, product in focus
- Critique: similar to the artistic model?

Figure 3: AW Architecture, Rehydrant, Budapest (source: Diedrich et al., 2018)

This project transforms the fire hydrants of the city of Budapest during the hot summer season into drinking fountains. It has been proposed by young designers in response to the city's heat island problem and with the idea to enliven public spaces through provision of free drinking water. The project initiated further research into technological, economic and social aspects before implementation, involving collaboration with engineers, the technical services of the city, and other experts.

3.4   The adaptive model

"Research translates into Design"

- Research-based knowledge inspires the design concept
- Translating research
- Responsive to site, but dominated by product focus
- Critique: not fully explained
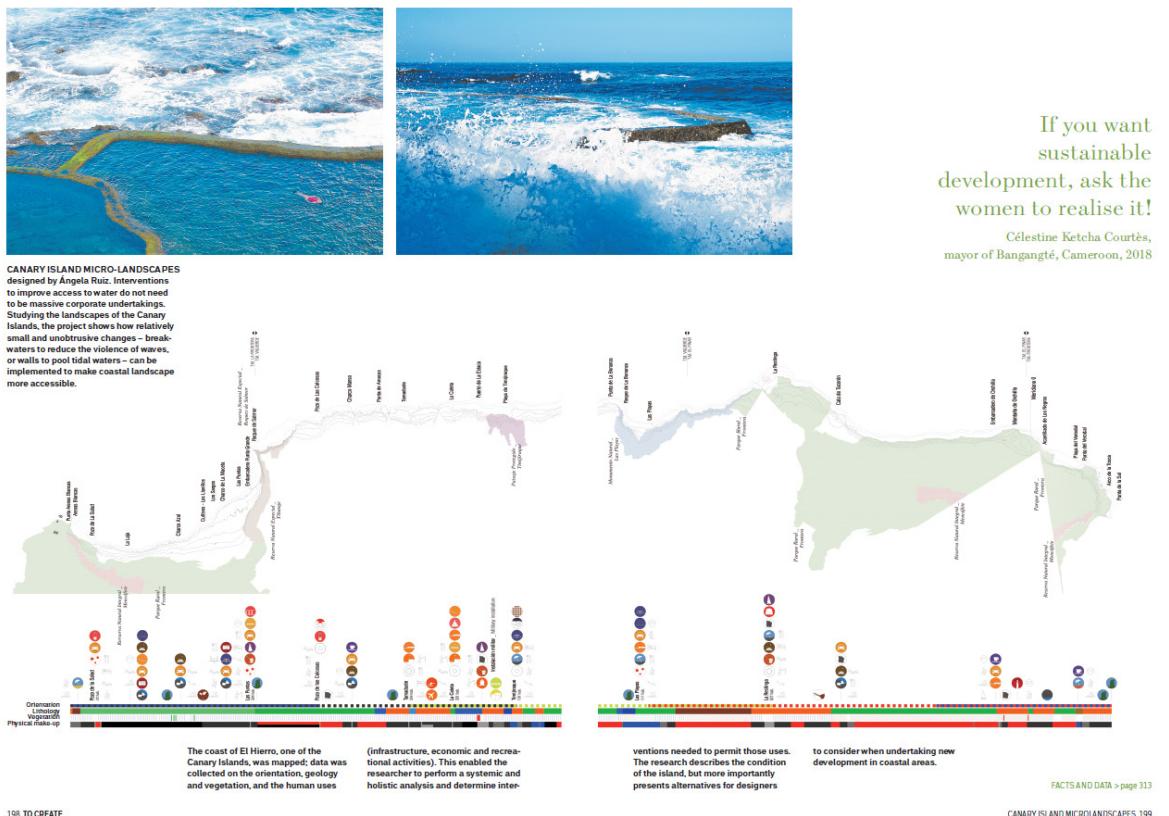
Figure 4: Angela Ruiz, Micro Landscapes, Canary Islands (source: Diedrich et al., 2018)

This project suggests the adaptation of traditional Canarian rockpools and other coastal formations to topical leisure uses with a minimum of alteration and a maximum of respect for existing structures. It is based on a comprehensive mapping of the Canarian archipelago's coast, its forms and uses, carried out as a PhD research. This research can be seen as the first to acknowledge the Canarian coastline as a series of micro-landscapes of their own right, and the project to forge the respective design strategy would not have arisen without this research.

3.5 The analytical model

"Research is central to Design"

- More pragmatic approach
- Research-based knowledge central to the design approach: informs concept, is transposed/interpreted in light of site and design problem
- Focus on process rather than end product
- Critique: less creative?

Figure 5: Studio Marco Vermeulen, Dutch Smart Thermal Grid, NL (source: Diedrich et al., 2018)

This project is based on the recognition of the existing gas pipeline infrastructure in the Netherlands, retrieved from research reports on energy infrastructure, and it studies the spatial possibilities of reusing this infrastructure for thermal energy in a post-fossil period, which is anticipated in research reports on energy transition.
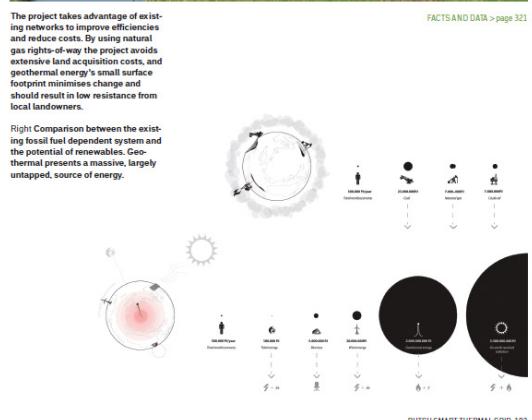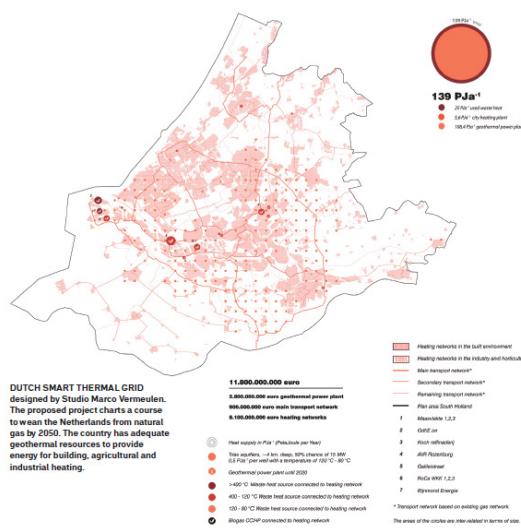
3.6 The systematic model

"Research determines Design"

- Research-based knowledge determines the concept
- Design seen as problem solving, driven by rules
- Can include standardization
- Critique: More "planning" than design?
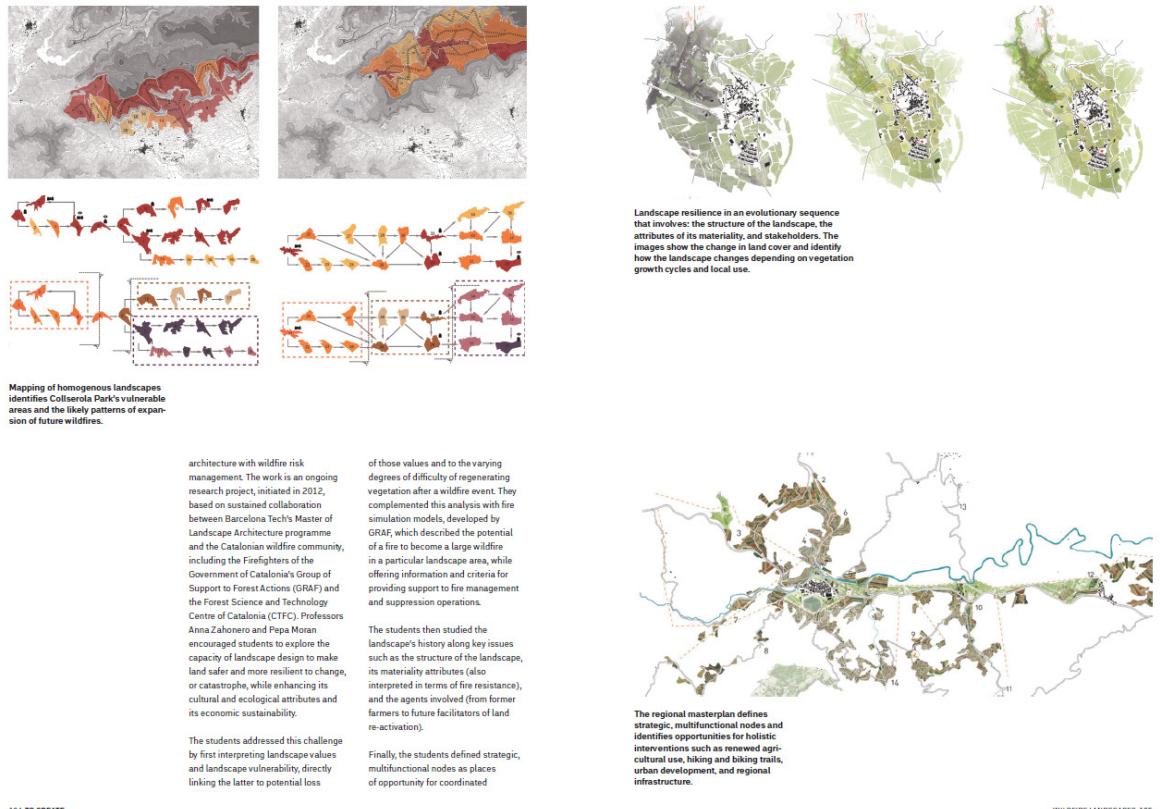
Figure 6: Llorenc Castell et al., Wildfire Landscapes, Barcelona (source: Diedrich et al., 2018)

This project is based on data retrieved from research reports on wildfire propagation in the Collserola mountains around Barcelona, on land use plans, on fire-resistant species and on fire management research. It involved researchers and managers of the respective fields and elaborated a design proposal for how to urbanise and how to afforest the fire-prone areas in order to reduce fire propagation and damage for densely built-up areas.

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