Landscape Architecture into the 21st Century –
Methods for Digital Techniques

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1 Introduction

People have designed the landscape for thousands of years and there is a recorded history tracing back about 1000 years of design processes that closely resemble what most of us are doing today. However, as we are in the early part of the 21st century, the theories and methods which have been successfully used over the past thousand years are in a period of radical transformation. I believe that our current education and practice in landscape architecture will be hard to recognize even by the middle of this century. The claims of the profession regarding stewardship of landscape are strongly challenged by other professions and by the public at large, and justifiably so. It remains to be seen what the responses of our professional and educational institutions will be.

Some things are not likely to change. The six questions that must be asked in any situation of design, including those of landscape architecture, will still be relevant (STEINITZ, 1990).

- How should the landscape be described?
- How does the landscape operate?
- Is the current landscape working well?
- How might the landscape be altered?
- What predictable differences might the changes cause? And
- How should the landscape be described?

And we still will need to skilled at drawing and making clear diagrams by hand.

However, the ways and means by which we perform our activities in landscape architecture are in a context of great change. The societal and environmental issues which we face and to which we can direct our work, the scales and content of designs, the decision making models within which decisions are made, the process models by which we evaluate current and potential future conditions, the actual ways in which we design, and the technologies which we use are all changing at accelerated paces.

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Fig. 1: “Steinitz Framework” 1990, 2003
This diagram above has three axes: Scale and the implications for content, Decision models and their needs for information, and process models and their complexity. It leads to the several ways of designing from which we must choose. In each of these basic aspects of education, research and professional practice, I believe that we are in a much more complicated situation than was foreseen by our illustrious predecessors.

Many devices which work on a small scale do not work on a large scale."

Galileo
Fig. 3: Scale Matters
Scale matters and Galileo was right. Many methods, many processes, many ideas which work at one scale, don’t work at another scale. My school has architects, landscape architects, urban planners and designers. We have a studio-dominant culture, and there are different scales of “problem”. Most students’ studio sequence starts small and gets larger and more complex but does not include the full range of scales. Problems dealing with the landscape include placing a building on a difficult site, designing a garden, and then designing an urban complex in a difficult ecology, or a large urban park. Most students who think about the landscape stop at what can still be considered “project scale”. They stop at the scale where the assumption is that you have a client, a site and a program and eventually something will be built. Relatively few students, the ones who work with me near the end of their studio sequence, think about regional scale urbanization and regional conservation.

There are many people in the world who think in the other direction, from large to small. Geographers, cultural historians, hydrologists, geologists, ecologists, political scientists, and even lawyers and bankers, tend to see things and work from large to small and they almost never get to the details so important to architects and landscape architects. The question is: what is the lens through which we should look at the problem. I am interested in the larger scales. I have spent a long time working at the territorial scale, and sometimes I get to the project scale but I stop before the details. I tend to think from larger to smaller.

The focus of design decision changes with scale. At large scale, you are dealing with strategy, at middle scale you are dealing with tactics and at small scale, you are really dealing with details, and here the details do matter.

The wise school mixes scale-direction, but must recognize that there are real differences at the extremes of these two scales. At the large scale, if you make a mistake or decide something badly, you have a very high risk of harmful impact. The concept of risk dominates working at this scale. You want to minimize it. Why? Because the landscape is big, it has lots of people, lots of money, lots of change, and the larger decisions are very important. The benefits can be great, but the risks are serious.

As you go to a smaller scale, the risk goes down: I don’t care so much if my neighbour has a modern house or a baroque garden. What’s the risk to me? However, I do care greatly if I don’t have drinking water. That’s a very important risk. The greater the risk, the greater the need for serious analysis, and this is much more a need as scale-related risks gets larger.

Minimizing social risk, economic risk, ecological risk, etc. while seeking their benefits makes a landscape-scale plan essentially defensive. Here, the design processes emphasize “allocation”, deciding what goes where or where not. At large project scale the design emphasis is on “organization”, how different elements relate to each other. At small project scale, the emphasis is more on “expression”, what it looks like, what it feels like. These are very different.

At large scale, you must have a high reliance on science; and you must have a much more complicated formal strategy. At the larger scale, the idea that you can make a simple “design concept” diagram and really see it on the ground is foolish; it doesn’t work. At this scale, however, you must have much more public understanding, and this is not easy. At large scale there is no single well informed ‘client’. At small scale there usually is. People normally understand their own house, they may understand their neighbourhood; they
usually don’t understand their city and regional problems. In a democracy, informing the public requires clarity and transparency in both assessment and presentation. There are necessarily differences in roles between experts and popular decision-making at the different scales.

As a result, at large scale, important design decisions are made by experts and elected people and unelected people. Elected people are the people who you vote for, your government. Unelected people are the heads of banks and development companies who make planning decisions. These larger decisions are not normally made by popular vote. However, at small scale, everybody makes decisions.

As the spatial scale gets smaller, you have more of a demand-based strategy. A client says “I want something!” You happen to agree and you do it. It is based on demand; it is based on the push of the market. At large scale, it is more supply-based and defensive. You have to understand the landscape, you have to understand the cultural values, you have to establish priorities, and then you do have to defend them.

Scale does matter. It implies the content of designs, and the levels and models of decision making which are likely to be involved. Landscape architecture has had a long tradition of professional activity at the small project level, at the local level for larger projects, and that the municipal scale. There have been periods of intense activity at regional scale. But as society recognizes the cumulative effects of population increase, climate change, biodiversity changes, threats to food and water, and the emergence of mega cities, there will be a serious and appropriate transformation of pressures from the global and regional scales to the smaller scales. The decision criteria for a private or public client at small scale will be socially and legally influenced by larger levels of society and government. This will necessarily transform professional activities across all scales. It is likely to increasingly constrain landscape architecture at the smaller scales but it is equally likely to enable some landscape architects to act at the larger scales, likely in collaboration with other professionals.

Decision models will be increasingly altered in a fundamental way. This can be especially foreseen in Europe. The Council of Europe has as one of its mandates the influencing of policy towards the landscape for the more than 40 member states. In November 2001 it passed The European Landscape Convention, also known as the Florence Convention.

“In Article 5 each party undertakes”

A) To recognize landscapes in law is an essential component of people’s surroundings, and expression of the diversity of their shared cultural and natural heritage, and the foundation of their identity;

B) To establish and implement landscape policies aimed at landscape protection, management and planning for the adoption of the specific measures set out in article 6;

C) To establish procedures for the participation of the general public, local and regional authorities, and other parties with an interest in the definition and implementation of the landscape policies mentioned in paragraph B. above; and
D) To integrate landscape into its regional and town planning policies and in its cultural, environmental, agricultural, social and economic policies, as well as any other policies with possible direct or indirect impact on landscape.

This is an extraordinary undertaking. The key transformation is the recognition of the value of landscapes in law and the requirement for the participation of the general public in the definition of landscape policies. This is a profound redirection (and in my opinion a welcome one) of the role which landscape architects have always assumed as a professional responsibility. The European Landscape Convention is an international treaty and it has been ratified by more than 35 of the member states, in which it is now law. Interestingly both Germany and the United Kingdom have not ratified the treaty presumably because they believe that they are already doing this well.

From a professional perspective and especially when working at larger scales, this will codify the need for stakeholder input into the beginning of any future policy or design, with the design team then organizing its work to produce materials for public review and decision-making. It is likely that the balance between designed change and designed conservation is likely to shift substantially towards the latter.

Fig. 4: Norbert Wiener’s Communication Model
It will also transform the representation models upon which we rely for communication. Norbert Wiener was a famous professor of physics at MIT in the mid-20th century. During World War II he produced a model of the process of communication. It has three basic elements: the message, the medium and the meaning. Note the small arrows as they go in both directions.

Most designers (including landscape architects) believe that both of the arrows go from left to right, from the message to the meaning. The designer has something to say and gives it expression. The medium is the landscape which is transformed although the medium could also be a policy, a law, or an investment. The viewer gains an impression of the changed medium and (one assumes) obtains the meaning.

The European Landscape Convention reverses the arrows. The viewer now actively seeks the meaning from his or her impression of the medium. The assumption is that the viewer knows what is being sought. The designer must then provide that expression. It is not the designer's message which is paramount, but rather the message being sought by the viewer. This is certainly not the perspective of many of our students and our more egocentric colleagues.

In his model, Wiener's arrows go both ways and it is only when they are co-joined that communication can exist. Consider the alternative—a lack of communication. I believe we are putting far too much of our educational and research resources visualization, and without thinking about issues of communication. We place far too much faith in the assumption that people will understand our representation models. Consider the words of the great English painter John Constable: “I understand; therefore I see.” He did not believe the reverse: “I see; therefore I understand.” Too much time of our students is spent on idiosyncratic expression using the latest technologies. At the same time, we do not have a single uniform classification and color code by which to describe land-use across political or even project boundaries.

The process models on which we base our evaluations of the current situation and the impacts of potential change vary greatly in complexity. For most landscape-related processes, I believe that there are eight levels of analytic complexity associated with process models. Each of the eight levels is organized to answer a cumulatively more complex set of questions. The questions and the answers—which are the analytic capabilities of the model type cumulate. The spatial and temporal analysis aspects of the models also cumulate. I think that the larger the scale and the consequent greater risk, the more the analytic methods should aim to achieve more complex levels. The smaller the scale and less the risk, simpler analytic levels may suffice.
Fig. 5: The needs of different decision processes and the increase in risk as scale increases will dramatically increase our need to really understand the processes involved in landscape change.

There is a special complication in any study when selecting or designing appropriate models to apply. The more complex models require more (and presumably better) science and more effort, but the simpler levels are easier to communicate and easier for the general public and decision makers to understand. One must either compromise the analytic complexity appropriately or simplify communication to an audience increasingly interested in “transparency”.

What are the spatial-analytic needs of “designers”? It all depends on scale and complexity. There cannot be one answer. At its simplest, and frequently at smaller scales, the direct personal experience of the designer may be sufficient, and without any formalized spatial and temporal analysis. At the other large scale extreme, it will frequently require a very complicated and costly effort, and yet it also may suffer from a lack of public understanding. Answering this dilemma and deciding on the appropriate methods and their level of complexity requires judgement and experience ... At this time there is no other way.

Assuming the increased complexity of scale, of decision models and of process models, our ways of designing are also likely to change (and I mean “our” in the broadest sense, including users). The tools and techniques with which we develop our visions of the future will change dramatically as computer technologies become more powerful, decentralized, inexpensive, ubiquitous, and user friendly.
We will have a much more complex perspective on what constitutes a design process. There will certainly be more options than what is taught in most landscape architecture programs around the world.

The basic problem of design can be stated as follows: “How do we get from the present ($T_o$) to the future ($T_N$)?” In the Steinitz framework (STEINITZ, 1990, 2003), the question: “How might the landscape be altered?” is responded to by the change model, the product - and more likely the products - of the design method which is applied.

There are two basic design strategies. The first is to conceive of and design the future state, and then ask “By what scenario from the future back to the present might it be achieved?” Essentially, one works from the designed future back to the present in figuring out how to get the design accomplished.

The second strategy is to design a scenario – a set of assumptions in the present that can get from the present state to the future – and then ask “In what future might this scenario result?”

There are seven basic ways of designing which can be applied to this problem. They are all adaptable (at least in part) to digital GIS technologies but are not dependent upon them. They are frequently used in various combinations but they are perhaps most easily understood if described separately. They are: anticipatory, participatory, sequential, combinatorial, constraining, optimizing and agent-based.
The anticipatory design approach is based on the premise that the designer's experience provides the concept of what might be the basis for a good design. It is assumed that the designer has sufficient experience so that his/her case memory has a range of diagrammatic concepts broad enough to be adapted to new conditions. In the anticipatory method, the designer “sees the whole solution”. (This is not a rare occurrence for experienced designers). There is frequently a clear and often diagrammatic “concept”. The difficulty is almost always in trying to apply deductive logic to figure out how to get from the imagined future back to the present conditions and to specify the number of (backward-in-time) assumptions that are needed to potentially implement the design. As a generalization, this approach is frequently successful for smaller and short-term design projects. It is less likely to succeed when the design problem is large, complicated, and long-term.
One can fairly ask how this process occurs. Perhaps the best explanation is the model presented by Kristian Hammond, co-director of the Intelligent Information Laboratory, Northwestern University. Clearly, this model places a premium on having a large and sophisticated case memory in one's brain (or accessible to it). The case memory consists of a wide range of design solutions. It also has also of the principles which allow the designer to select from memory and also to adapt and evaluate the selected designs.

Possibly most importantly, the case memory also stores failed designs, and this aids the designer in deciding what NOT to do.

Enlarging the case memory can be achieved in many ways: by reading, travel, living longer and having a wider range of experiences, or -- for today's designers -- access to the many sources available via search engines on the Internet. A potential liability is that seeing or even reading about past solutions, whether in a library or on the Internet, does not necessarily lead to understanding how they might be relevant to the current problem under study. The anticipatory approach favors the experienced designer.
The participatory design approach assumes that there is more than one designer, and that each has a concept about what the future design should be. The participatory approach is based upon the premise that the designers (in this case presumed-to-be-direct users of the design) have a sufficient sense of place and time to provide a future oriented design. It is also assumed that a diverse group of participants may not be initial agreement. This is a common circumstance when a committee is formed to make the design. It is also common when the social context of making the design directly involves a group of final-users. The advantage of this approach is its (more) democratic position, based on the ideas that the users know best and that making a design is not such an obscure activity. Its major liability is the need to reconcile the potentially conflicting designs of a large number of participants into one coherent plan that can be implemented. This then also requires application of deductive logic to move from a single design for the future back to the conditions in the present.
The sequential approach. This makes the assumption that the designer is certain in making the series of choices which are the design. It starts in the present and moves directly towards the future through a single scenario of assumptions. It uses abductive logic. While the designer may be aware that each of the assumptions has alternatives, these are not seriously considered, either singly or in combination with others. The decision to move forward toward the future design is based principally on the preferences and experience of the designer, possibly influenced by the client(s) desires.

The sequential approach is frequently used when the design process is the work of a committee. Frequently the committee would discuss one issue – one assumption regarding the scenario toward which the future design is being directed – and make a decision before moving to the next issue. Eventually, a design can be achieved.

There are typically a large number of decisions which must be made in a design at any scale typically around 20 to 50. The liability of the sequential approach is that the likelihood of making the best feasible decisions that many times in a row is small. (This may be a reason why committee-generated designs take so long to accomplish or simply fail).
The combinatorial approach is useful when the designer or the “client” is not sure of the appropriate choices in the sequence of decisions which creates the design. In the combinatorial method, the designer must first identify the few most significant assumptions required for the scenario which will guide the design. The method relies on inductive logic. Each of these central assumptions is likely to have a range of requirements and/or partial solutions, for example population demands or the route of a proposed highway. Several – but not too many as the number of alternatives will propagate fast – of these alternatives are selected. A useful set to include is what can be considered the extremes of the possible range. The method then takes simultaneous combinations of these requirements and partial solutions and creates what generates design alternatives.

These alternatives must then be systematically evaluated before one is selected for further development. The great advantages of this approach is that it tests the most significant assumptions before proceeding much further into the design and it can therefore avoid serious mistakes. The liability of this approach is that it is both difficult to identify the most significant assumptions a-priori, and that the number of designs that must be generated from the simultaneous combinations can be very large indeed.
The constraining method is in many ways similar to the combinatorial approach. It is useful when the client is not sure of the decision criteria. It also requires the designer to identify the most significant assumptions and their ranges. However in this method, the designer would systematically and experimentally test the sensitivity of the assumptions’ ranges, narrowing them to the point where one or a small number of design options can be developed.

An advantage of this method is that it allows the designer to retain good partial solutions and avoid errors on the most important issues. It is a method which can be efficiently used in a circumstance where a committee or direct public participation is expected to produce the design.
The optimizing approach requires that the client and designer understand the decision criteria and the relative importance of the desired design outcomes. This is perhaps the most difficult of all of the above design methods to implement. The decision model is based on the cultural knowledge of the decision-makers. It is reflected in their goals, the values by which they make judgments about the design, and the relative importance which they attach to these goals and values. It makes the assumption that the designer can integrate the decision model’s criteria which will eventually decide whether the design is approved and implemented with the design actions which best fulfil those criteria. The designer would then direct the design process – frequently a computer program – towards trying to identify the optimum solution for that decision model.

The principal advantage of this approach is that it doesn't waste time. It can be specifically directed towards the articulated objectives and priorities as presented by the decision makers. A principal liability is that it is extremely difficult to cause the decision-makers to articulate their goals and values a-priori -- before actually seeing some design alternatives.
The agent-based approach assumes that there is an interaction between purposeful design decisions which direct, attract or constrain the independent but rule-based actions of other aspects of the design’s development. The independent “agents” and their rules of location and interaction are embedded into a computer model. This approach has been demonstrated theoretically and experimentally, and has been applied in several case studies.

The principal advantage of this approach is based on the strength of its theoretical position, in that it models the location-responses of many independent actions in reaction to prior and more strategic designed actions. This is much more reasonable position for the planning of large complex urbanization-related contexts than the assumption that all actions can be designed.
The several ways of designing can be combined in whole or in part in an almost infinite number of ways (but one hopes with intelligence). In the example above, the designer gets a concept for the design and partially develops a way to achieve it. The partial solution is then transformed into the input for an agent-based simulation model with updating of assessments between stages. This model then locates the other components of the design. A real-world example might involve having the idea to make a linear design for a town, making the design for roads and utilities (which transforms the locational attractiveness and constraints of the study region), and then allowing the market (as represented by the computer agents) to locate new residential areas.

The seven ways of designing described above are not equally efficient and they are not equally effective. None of these seven ways of designing is typically used alone. However each of them can provide the starting point and the central approach which guides the development of a design. The choice depends greatly on the scale(s) of the design problem, the decision model and needs for information regarding the potential impacts of the design(s), the consequent needs for complexity in the study’s process models, the technologies available to the design approach, and the skill and experience of the designer or the design team.
Fig. 16: Different Contexts Require Different Methods
Fig. 17: Research Themes
There are relationships among the major factors which have been discussed: scale, decision models, process models, and ways of designing. They are not sharply bounded. They are fuzzy and overlap. But it is very clear that depending upon where you find yourself in this diagram one does not approach design in the same way. There is a difference between what one does when making a design at smaller scale, as it gets larger, and even larger.

What are the implications of all of these changing conditions for research, education and practice of landscape architecture in the 21st century?

As a frequent attendee and contributor to international conferences focused on landscape architecture education, we increasingly see research being focused around six themes:

- A content-problem seen over varied scales and locations, such as suburban sprawl, cultural landscapes, river restoration, etc.
- A decision model and its implications, such as public participation;
- A comparative study of a landscape process and its models, such as visual preference, landscape ecology, etc.;
- A design method and its applications, such as agent-based modeling;
- A representation type across all methods such as realistic visualization or animation;
- A newer technology and its applications, such as I-phones, computer-eyeglasses, supercomputers, etc.; and

The history of any of the above themes.

These will cause profound changes in the organization of curricula in landscape architecture. It does not seem reasonable to attempt to do everything related to the landscape at an equal level even though this may be the ideological claim of the professional societies in landscape architecture. Most landscape architecture programs in the world focus on the inner part of this diagram: smaller scales, fewer and more well defined clients, simpler process models and traditional design methods. One possibility is to spread our energy in a more diverse way and let our students’ preferences, experiences and opportunities decide where they chose to be, and then continue to learn in later life. Another option, which is only available to larger schools, is to have enough opportunity so that students can find their own path through this increasing set of choices.

The temptation will be to specialize, to draw our energy inward and to focus on one or a few combinations of smaller scale, problem type, decision process, and method. This is clearly a safe path as this has been the basis for a long tradition in the practice of landscape architecture. A corollary to the above will be the temptation to specialize at the larger scale, public client, more complex processes and the more model –based design methods.
Fig. 18: The Future of Landscape Architecture?

However, when one looks at the research with which our more advanced students are engaged and combines this with the model and technology-driven development which seem to be accelerating in effectiveness, we can see an emerging pattern. It will favor larger scales, and it will interact with the smaller scales. It is likely to be the dominant force shaping the practice of landscape architecture in the 21st century.
There is very likelihood that the students we are teaching today will be practicing in a world where they will have an overload of methodological options and that they will have to choose much more wisely than we do today. We will be living in a world where landscape related decisions are made simultaneously and interactively at several scales. We will be managing the process (as best we can) or we will be managed by it. The easy solution is to retreat toward the small scale which has been the traditional mainstay of landscape architecture profession. This has happened before in our professional history and it can happen again. A much more important challenge will be to move to the outside of this diagram and try to contribute significantly to managing the landscape of this more complicated world.

This perspective is clearly seen by other professions: by geographers, engineers, planners and others. The large question will be whether landscape architects participate in driving these changes. Whether they do or not is perhaps a personal and institutional decision but these changes are developing, they will develop, and they will dominate. The reason is simple: the serious issues facing the planet demand it.

2 References


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