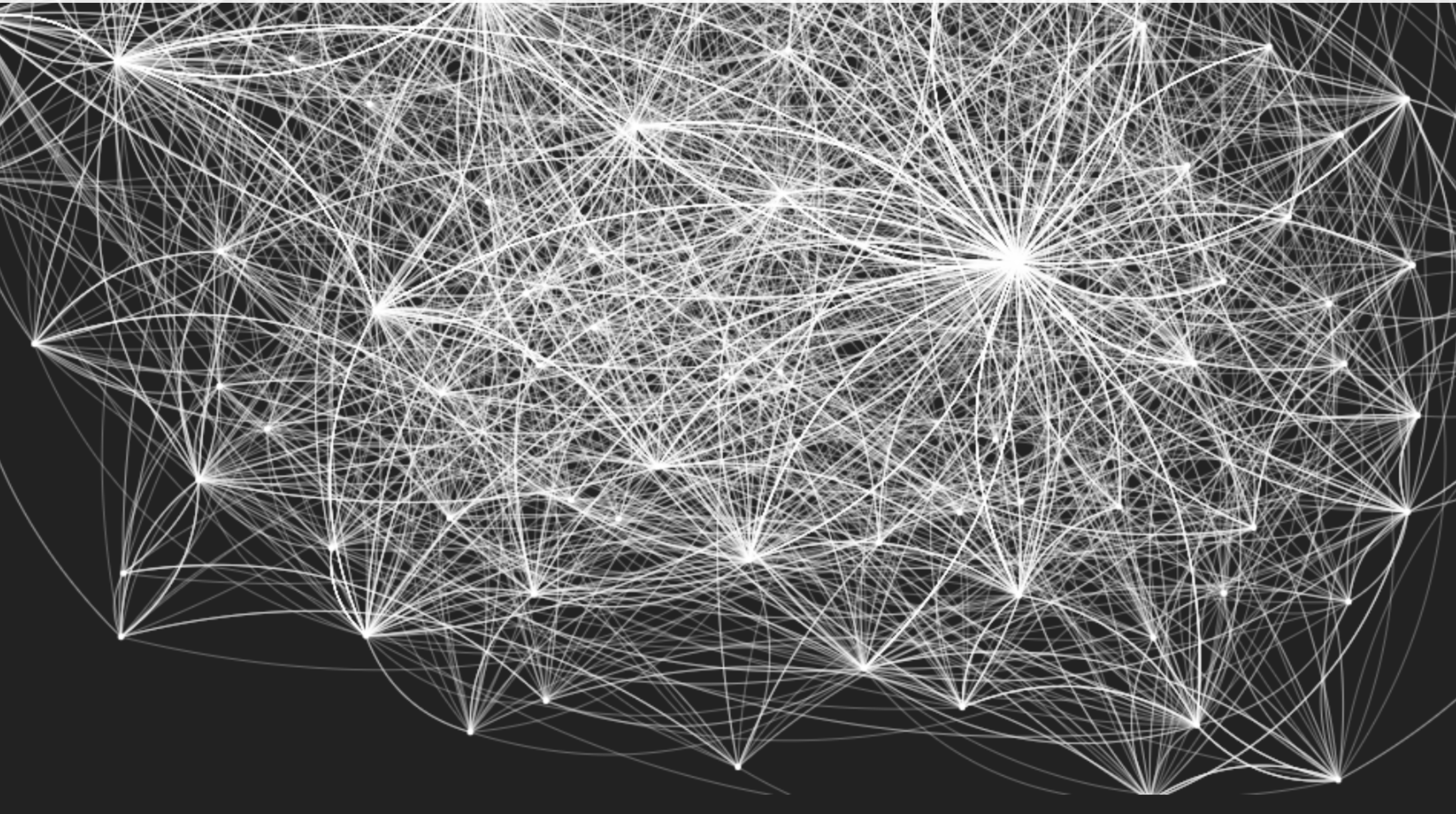
# INTANGIBLE LANDSCAPES

an argument for the realignment of landscape representation and theory through network visualization

Elizabeth Stapleton, MLA Candidate 2016



# INTANGIBLE LANDSCAPES

an argument for the realignment of landscape representation and theory through network visualization

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Submitted in partial fulfillment for the Master of Landscape Architecture,
Department of Landscape Architecture, University of Oregon

*With thanks to my family, friends, and the University of Oregon Department of Landscape Architecture*

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# ABSTRACT

The graphics we make influence the ways we create and conceive of landscape. The static graphic conventions currently preferred within landscape architecture often fall short of capturing the intangible characteristics inherent in dynamic landscape systems. Such graphics leave intangible landscape characteristics unaccounted for in not only our representations, but also our designed spaces and common understandings. This trend runs counter to the foundations of contemporary landscape understanding, most notably ecological theory and phenomenological philosophy. This is problematic for viewers as it perpetuates the common perception of landscape as immutable object. Similarly, such static images deprive researchers of potentially revelatory graphic experiences. Structured as a classical argument, this project begins to build the case that landscape architecture does not prioritize the representation of intangible and non-spatial landscape qualities. When reflected in our built work, this may function to the detriment of such intangible landscape qualities as community connection, ecological functionality, and landscape perception.

Networks represent the intangible concept of connection, a crucial characteristic of landscape in both ecological and social capacities. Graphic depictions of networks are widespread outside the field of landscape architecture, and common graphic trends emerge across disparate subjects and fields of study, as shown in the research of designer and data visualization expert Manuel Lima.

This project evaluates the degree to which landscape architecture as a field has embraced these graphic trends in its depiction of landscapes through a comprehensive examination of the graphics used in award winning landscape architectural projects over the past 10 years. In doing so, the project supports the argument that landscape architectural graphics continue to preference the depiction of spatial, projection-based imagery over the depiction of intangible landscape elements and suggests tools from outside the field as possible strategies for rectifying this misalignment.

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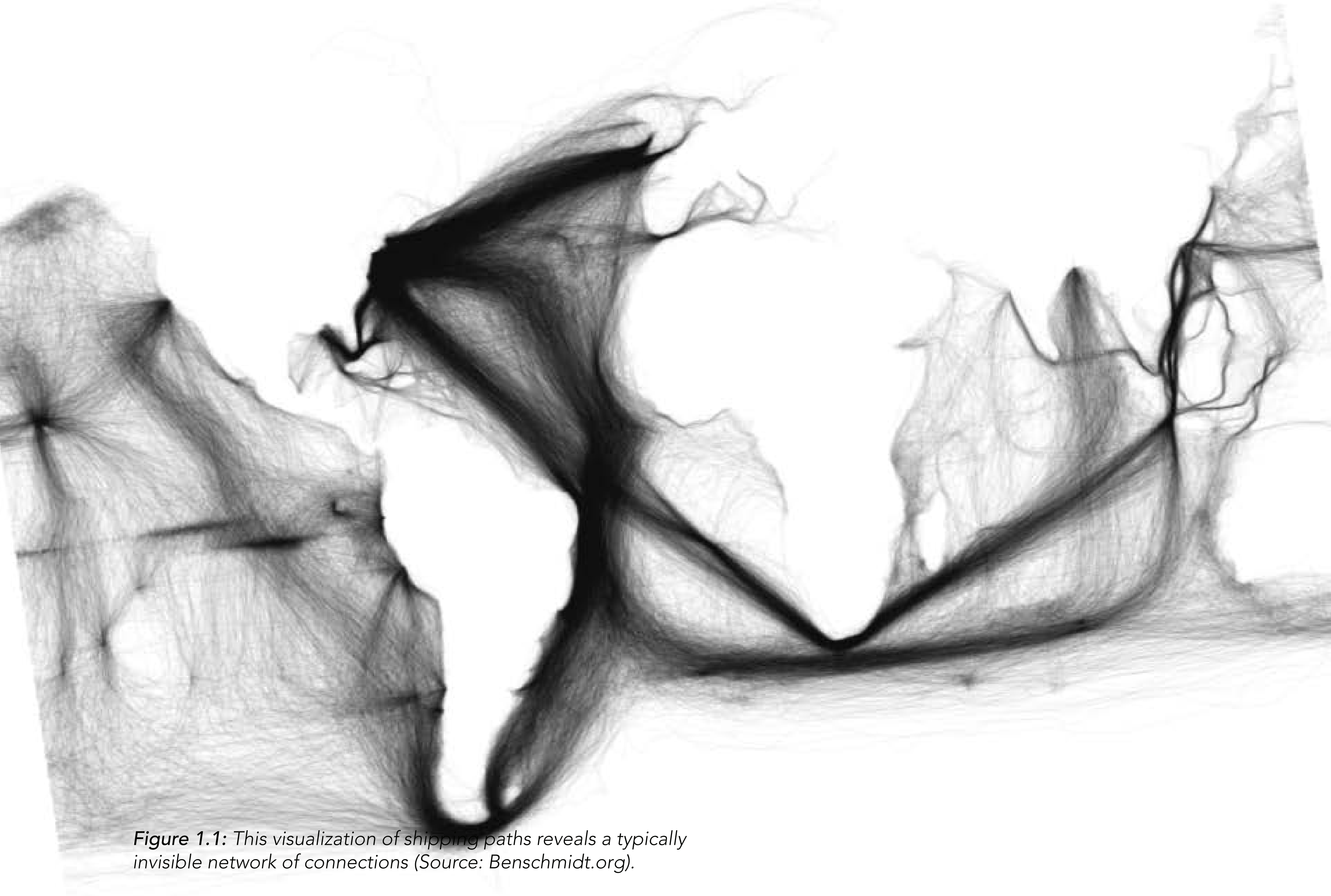


*Figure 1.1:* *This visualization of shipping paths reveals a typically invisible network of connections (Source: Benschmidt.org).*

# 1. INTRODUCTION *rethinking representation*

## LANDSCAPES AS NETWORKS

Throughout the 20th century, changes in ecological theory have shifted the common scientific understanding of landscape from a deterministic view of static equilibrium towards a greater acknowledgment of dynamism, complexity, openness, and change (Pulliam and Johnson 2001, Hill 2005). Broadly speaking, such changes have paralleled a general cultural and philosophical trend of increasing skepticism towards rational objectivity. Such skepticism of a rational, intellectually discoverable reality is seen broadly in postmodernist critiques and, particularly relevantly for landscape architecture, in phenomenological thought.

Through these lenses, landscape theorists increasingly conceive of landscapes as complex, intangible, and indefinite systems rather than externally defined discrete physical objects. Such views may be seen in the writings of influential theorists such as James Corner and Catherine Howett, among others. Yet despite these dramatic changes in theoretical understanding, the graphic conventions we use to represent landscape remain largely unaffected.

Landscape architectural graphics have traditionally focused on the physical characteristics of landscapes, leaving intangible characteristics visually underrepresented. While this is practical in some instances (for example, construction documents), it may also be problematic in presenting a depiction of landscape that is misaligned with our broader theoretical understanding. Given that the graphics we make influence both the way we create landscapes and the way we iteratively generate our conception of landscape, this graphical bias tends to leave intangible landscape characteristics unaccounted for in our designed spaces and common understandings (Dee 2004).

Networks represent one specific intangible aspect of landscape, that of connection. Connections within the landscape, while frequently invisible, are crucial components of ecological and social processes. If we consider landscapes as more than physical objects, but bundles of such processes, the understanding of connections may help illuminate the interstitial aspects of landscapes, leading to a fuller appreciation of landscape as a whole (**Figure 1.1**). Network connections are only one among many intangible aspects of landscape systems but they provide an accessible starting point for considering the representation of intangible landscape characteristics due to their ubiquity, relative breadth of study, and existing conventions for visual depiction.

The study of networks outside of landscape architecture has developed rapidly in recent years in the field of network science (Barabasi 2012, Newman 2003). The ramifications of such study have broad interdisciplinary relevance. Though it has seldom, if ever, been linked directly to landscape architecture, the importance of understanding landscapes as networks of connections is well-understood ecologically and philosophically, and a direct connection between landscape architecture and network science is thus germane.

## NETWORK VISUALIZATION

Ideas from network science, coupled with the tradition of data visualization, have led to the development of strategies for visualizing networks. These strategies typically rely on graphic conventions for representing nodes (discrete components) and edges (the connections between them) (Barabasi 2012). The research of Manuel Lima is at the forefront of investigations into network visualization, characterizing various strategies for visually depicting networks (Lima 2011).

This project uses the practice of network visualization and the research of Manuel Lima as a lens for evaluating graphic depictions of intangible landscape elements within the field of landscape architecture. While network visualization is only one strategy for such depictions, its interdisciplinary relevance makes it an appropriate first step in such research. Similarly, while connection is only one of the previously discussed intangible aspects of landscape, the prevalence of its depiction in other fields makes it a well-documented starting point for investigation.

Casual observation suggests that network visualization strategies such as those documented by Lima do not play a major role in landscape architectural graphics, however there is little or no research confirming this or suggesting reasons why such potentially relevant graphic strategies may not have been adopted. It is possible that these strategies appear in landscape architecture practice but have not been codified or formally acknowledged within the field, limiting their prominence and applicability. Alternatively, other strategies specific to the field of landscape architecture may exist in their place. It is also possible that one or more characteristics of landscapes may make typical network visualization strategies less applicable in landscape architecture than they are in other fields. The purpose of the current project is to examine the prevalence of network visualization within the field of landscape architecture and to consider the theoretical and representational ramifications and implications of these findings.

## PROJECT OVERVIEW

This project is structured as a classical argument, which includes the following five sections: introduction, narration, confirmation, refutation, and summation. The project's thesis argues that landscape graphic conventions do not adequately emphasize connection and network, which may result in built works that are insensitive to the diverse social and ecological connections that exist within the landscape. While this thesis represents a broad and general claim, the project employs a more narrowly focused methodology to build evidence in support of this phenomenon. In building the argument's confirmation, the project reinforces its claim through examining the degree to which network visualization strategies are used within award winning landscape architectural projects. The methodology is designed to answer the following question:

*"To what degree are landscape architects graphically representing the networks present within the landscapes they study and design?"*

This question is addressed specifically in the form of two subquestions:

1) *"To what degree are landscape architects utilizing common conventions for network visualization from outside of the field to communicate or investigate*

**RESEARCH QUESTION:**

***"To what degree are landscape architects graphically representing the networks present within the landscapes they study and design?"***

*landscape?"*
2) *"Are there any common strategies used by landscape architects for representing networks that are not documented in visualization literature outside of the field?"*

Further described in Chapter 4, the methodology looks to the current state of representation in landscape architecture as displayed by American Society of Landscape Architects national award winning projects to indicate the degree to which network representation is utilized in landscape architecture. The results of this investigation reveal the degree to which network visualization strategies are used to represent premier works of landscape architecture. These results strongly indicate the general standing of network visualization within the field and may also suggest trends in representation of intangible landscape elements in general.

The outcome of the methodology (seen in the answers to the research question) will be used to help structure and build the project's argument for greater attention to network visualization and the representation of intangible landscape elements. Through calling attention to a representational shortcoming within the field, this project advocates for a greater breadth of representational strategies, less dependent upon traditional perspectival and orthographic conventions. The project offers up data visualization techniques as one potentially relevant strategy for representing landscape systems worthy of further consideration. By promoting and encouraging more representation and greater understanding of intangible landscape elements, the project ultimately hopes to prompt greater social and ecological sensitivity in the designed landscape.

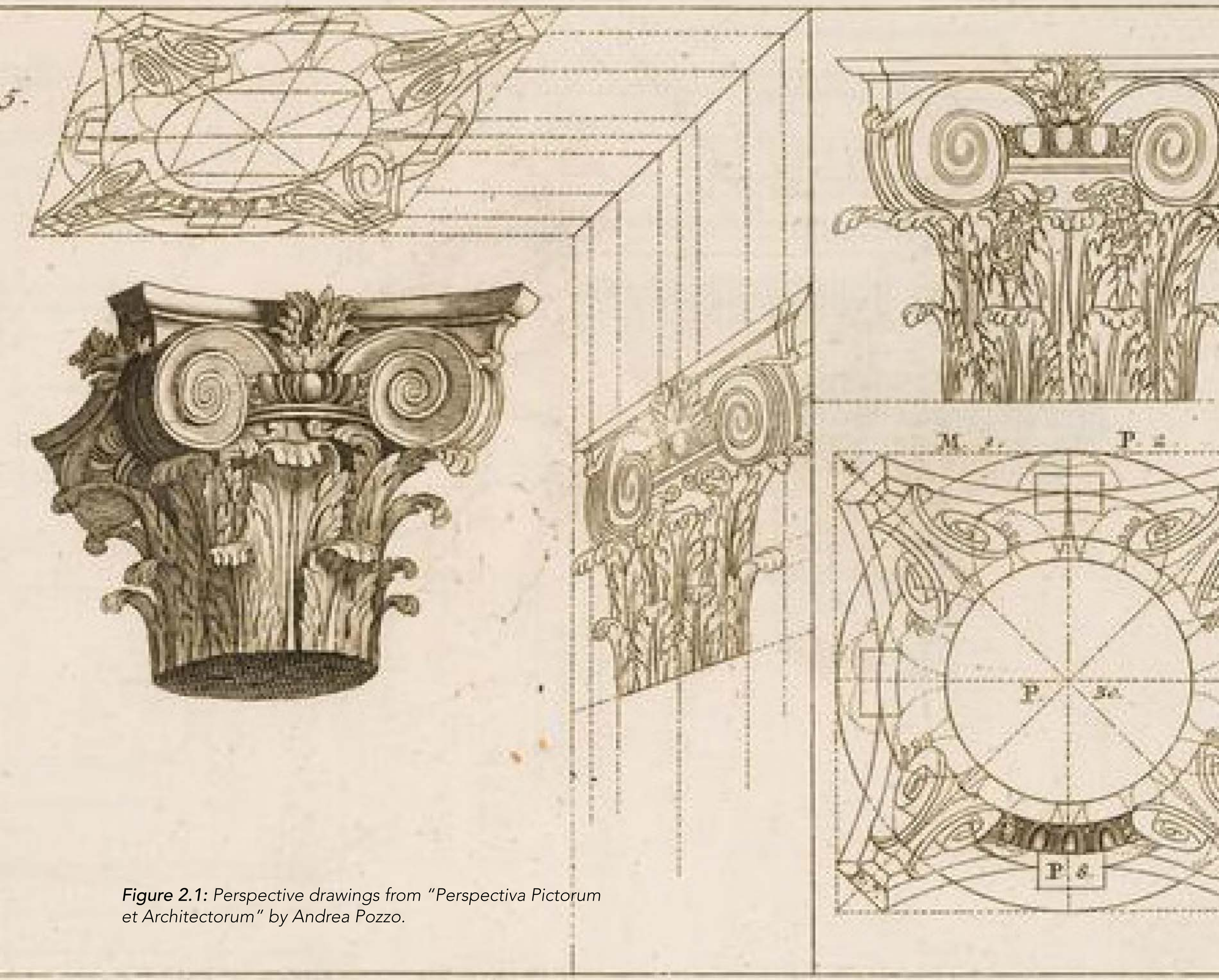


*Figure 2.1: Perspective drawings from "Perspectiva Pictorum et Architectorum" by Andrea Pozzo.*

# 2. NARRATION *the case for revolution*

## REPRESENTING THE LANDSCAPE

The shortcomings of traditional 2-dimensional representation techniques for depicting landscape have been extensively remarked upon. In his seminal work on the subject "Representation and Landscape: Drawing and Making in the Landscape Medium," James Corner underscores the challenges of representing physical landscape elements in the detached medium of drawing. This translation between physical form and two-dimensional representation, argues Corner, at its worst can turn drawing into a useless and invalid facsimile of the actual landscape, what Corner calls an "impossible analog, dangerously reductive and misused" (Corner 1991).

Corner divides architectural and landscape architectural drawing into three types: projection ("direct analogies"), notation (the identification of component parts), and representation (images aimed at evoking experiential truth) (Corner 1992). Each of these strategies has its own strengths and valid applications and differs from the other strategies in the kinds of information it conveys. Thus, one way of characterizing the shortcomings of current landscape representation practice is as a problem of unequal distribution between these three categories. It could be argued that landscape architectural drawing overemphasizes projection and a narrow segment of representation called "pictorial representation," and underutilizes other kinds of representations and notations.

A crucial problem with projection and pictorial representation is that such static graphic conventions obscure the true nature of landscapes as networks of connections in time and space. Landscapes are more than just assemblages of objects, they are assemblages of processes, yet this is unaddressed (and perhaps unaddressable) by such traditional forms of representation. Corner's choice of terminology for describing landscape imagery—"flat," "autonomous," "static," and "immediate"—effectively highlights this challenge inherent in pictorial representation of the landscape. As Corner states, "The phenomenological qualities of landscape space, time and material present unsurmountable (sic) difficulties for drawing and representation" (Corner 1992). While the problems associated with fully capturing the complexity of lived experience in visual form may be "unsurmountable," Corner nevertheless asserts throughout his writing the myriad opportunities for greater revelatory, interpretive,

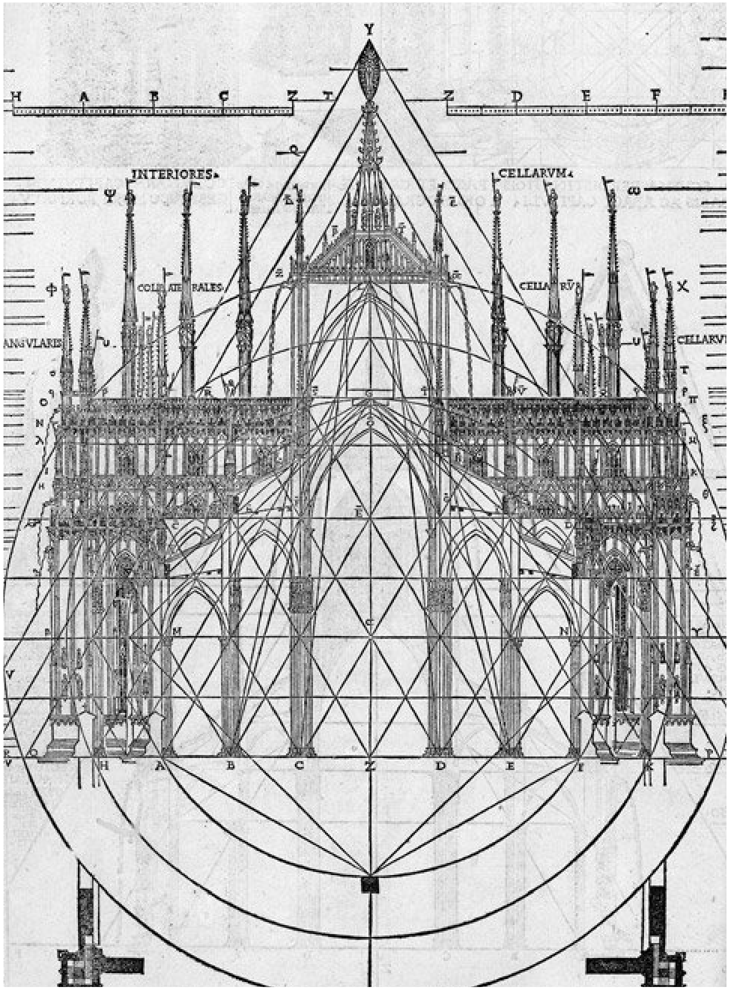


*Figure 2.2:* *Design for Milan Cathedral, by Vitruvius*

and imaginative opportunities for the holistic representation of landscape. Although there may be no substitute, no complete representational analog, for living and lived landscapes, there is nevertheless significant room for improvement in the techniques we use to graphically approximate it.

Corner's criticisms and suggestions have spawned much consideration and debate over the last two decades, but the exploration of innovative representation remains largely conceptual, more at home in written literature than in physical practice. Cesar Torres points out that, years after Corner's seminal works on the topic, there remains relatively little advancement towards innovative and enhanced representational strategies within the field. "There is a disconnection between the theoretical representational framework within landscape, more specifically mapping, and the production of innovative (but not necessarily novel) techniques," he states, in his aptly titled article, "Crisis in Landscape Representation" (Torres 2009). While Torres' focus is specifically on mapping, Catherine Dee similarly echoes and builds upon Corner's ideas more generally in advocating the development of "critical visual studies," innovative modes of investigation that utilize imagery as both a "method to investigate and as a form to communicate." (Dee 2004).

## ROOTS OF REPRESENTATION

Given the indisputably complex and challenging nature of landscape as process and experience in addition to formal object, it is perhaps surprising that our graphics tend to be relatively conservative, reductive, and simplistic in their approach to representation. This situation is readily attributable to several interacting forces that have traditionally aligned graphic conventions in landscape architecture with techniques for the formal representation of physical objects. These forces are largely historical in origin, stemming from landscape architecture's intertwined relationships with architecture, landscape painting, scientific process, and art history.

### *Architecture*

While modification and design of the natural landscape have been occurring at least as long as human society has existed, landscape architecture as a discipline and practice is much younger and has therefore derived many of its graphic conventions from the more established field of architecture—a lineage that is readily apparent in the name of the field itself. Architecture and landscape architecture do indeed possess many similarities that make theoretical and practical cross-pollination fruitful, however the contrasting nature of buildings as objects discrete in time and space and the inherently indiscrete nature of landscapes makes wholesale translation of architectural standards into landscape architecture problematic. As Corner states "…temporality in landscape distinguishes it from buildings and other spatial artforms: landscape is a living biome that is subject to flux and change by natural processes operating over time" (Corner 1992).

Architectural graphic standards— plans (*ichnographia*), elevations (*orthographia*), and sections—have been documented since well before the Common Era in writings such as Vitruvius' *De Architectura*. According to architectural historian Alberto Perez-Gomez, it is only within the past several centuries that these strategies have taken on the potentially problematic aspects of reductive representation seen today (Perez-Gomez 1982) (**Figures 2.1** and **2.2**). "Descriptive geometry opened the way for a functionalization of the 'lived world,'" writes Perez-Gomez regarding the evolution of drawing in architecture. "The original architectural ideas were transformed into universal projections that could then, and only then, be perceived as reductions of building, creating the illusion of drawing as a neutral tool that communicates unambiguous information, like scientific prose." (Perez-Gomez 1982). Plans and sections have become what Perez-Gomez describes as "neutral and functional vessels for the display of operationalized geometric relationships" and perspectives, which were historically non-technical in nature have been "operationalized as a sort of optical study" (Perez-Gomez 1982). As Catherine Dee points out, it is these exact technical drawing techniques, derived from architecture, that have dominated the field of landscape architecture

*Figure 2.3: "Landscape with Dancing Figures", by Claude Lorrain*

to date (Dee 2004).

Perez-Gomez's critique makes it clear that operationalized graphics may not be wholly desirable for architecture itself, and these concerns are only amplified when translated into the less object-oriented field of landscape architecture. Landscape architecture is arguably what architectural theorist Stan Allen refers to as a hermeneutic practice, which is "devoted to the interpretation and analysis of representations," in that its subject, medium, and object of creation (all interrelated) are largely pre-existing to the creative act (Allen 2009). Thus, while Allen justifiably situates architecture as a material practice—an activity that "transform[s] reality by producing new objects or new organizations of matter"—landscape architecture spans the hermeneutic/material dichotomy in a way that architecture does not.

Buildings fill voids with objects; designed landscapes are themselves neither object nor void, but a seamless integration of the two, definite and designed locales with timelines stretching in both directions. They do not come into being as do buildings, but experience states of intervention as the works of landscape designers are temporarily situated within their midst. It is the work of landscape designers, then, not only to "produce new objects or new organizations" within the landscape, but to interpret, intervene, halt, change, accentuate, or otherwise engage with site as evolving entity. "Drawing in architecture is not done after nature, but prior to construction; it is not so much produced by reflection on the reality outside the drawing, as productive of a reality that will end up outside the drawing," writes architect Robin Evans (Evans 1986). This is only partially true in landscape architecture, where drawing is necessarily done after nature and prior to construction, and is both reflective and productive.

### *Landscape Painting*

The translation of techniques from architecture has resulted in the operationalized character of landscape graphics, but it is the historical connections of landscape architecture to landscape painting and photography—the pictorial traditions within which our field is grounded—that seem to have encouraged the focus on "the view," rather than on holistic landscape depiction. J.B. Jackson's influential article, "The Word Itself" traces the close connection of landscape architecture to landscape painting in its early days, and the more recent divergence of the fields (Jackson 1984). Indeed, "landscape" itself was originally a term specifically used in regards to art and painting (**Figure 2.3**).

As landscape architecture professor John Lyle points out, "at least since the 18th century in Western culture, the landscape has been what we see and landscape design has been a matter of reshaping what we see into pictorially acceptable scenes" (Lyle 1991). This phenomenon, he argues, continued and perhaps even expanded with the advent of photography. While Lyle and Jackson reflect upon how the pictoriality of landscape imagery has been brought out of the gallery and into the physical landscape, this trend has also worked in reverse, reflecting static pictorial landscape views back into the landscape images we make.

### *Disciplinary Theory*

Though it is possible to partially attribute the limited and operationalized nature of landscape representation to historical relationships with architecture and landscape painting, it is impossible to escape the role of disciplinary theory in shaping the methodological state of representation within the field. Landscape theory itself has thus far failed to fully and cohesively embrace the complexity of landscape systems, arguably due to conflicting theoretical camps. In tracing the historical trajectory of theory, Corner attributes much of the contemporary pragmatic and functional approach to landscape theory to the Enlightenment sensibilities of the 18th century (Corner 1990, 1991). This trajectory has resulted in two extremes in landscape design sensibility, one overly aesthetic and formal, the other mechanical and scientific, but both derived from the same technical foundations forming what Corner describes as a "language," a set of standards that facilitates the serial creation of landscape (Corner 1991).

Professionally, landscape theorist Catherine Howett traces this phenomenon back to post-

> “...We find ourselves living in a world of imagery, an unreal world with human beings seemingly set apart from nature.”
>
> -John Lyle

Olmstedian early practice, when the field “spread out thinly between the poles of landscape architecture as decorative outdoor art at one extreme, and workmanlike urban, community, and park planning with a progressive social dimension at the other” (Howett 1998). Ana Berrizbeitia frames these same theoretical poles as deriving from art historical models and environmental models respectively, and asserts that it is because of this divide that a comprehensive theoretical understanding of the conflicting dualisms and complexity of landscape has not yet been achieved (Berrizbeitia 2001). Whatever terms we use to define these positions within the field, it is clear that rigid adherence to traditional theoretical extremes has left the field ill-equipped to deal comprehensively with our evolving understanding of landscapes as complex systems.

## PROBLEMS IN REPRESENTATION

### *The View*

Whenever a failing or shortcoming of current practice and perspectives comes to light, it is reasonable to ask what the results and implications of such a shortcoming might be. In the case of landscape representation, images are powerful tools for shaping human perception and our theoretical perspectives on landscape may be greatly influenced by the way we choose to represent the natural world. To quote Catherine Dee, “The way landscape architects make images influences both what and how places are conceived and made" (Dee 2004). How we depict our landscapes is therefore not a neutral act, but one imbued with values and implications. By including or omitting facets of the landscape, we generate representations that emphasize or obscure these particular aspects from the viewer's experience. If we consistently elect to obscure or reveal the same components, we begin to construct a collective image of landscape that diverges from the external world and our lived experiences.

As we have seen, our representational traditions have emphasized the "objectness" of landscape, focusing on the components of landscape that can be easily depicted by perspectival and projection-based drawing techniques, and on the aestheticized "view." Indeed, this has become a metric by which projects may be evaluated, since "primacy is most often given to aesthetic values in judging the success or failure of a given project" (Howett 1998). It has simultaneously obscured other aspects of landscape, those that are less easily captured in plans and perspectives, those that are problematically intangible. It is worth emphasizing here that such depictions are not specifically erroneous, they are merely incomplete. They do not necessarily present a false reality, but rather lie by omission. The result is imagery that fails to acknowledge the full breadth of landscape and that imposes this understanding upon the physical landscapes we build.

The implication of failing to graphically engage the intangible, systemic, and process-based nature of landscape is the continual reinforcement of the belief that landscape is static, that designs are "things," and that aesthetic considerations are the most important aspects of landscape designs. "The conception of a designed landscape as purely a work of art—as a visual object arrayed 'out there' in space to be admired as beautiful by a distanced human observer—obviously works against awareness of the landscape as a dynamic, changing, and exchanging force field of ecological process in which humans are actively immersed and engaged," writes Catherine Howett, "However, it does accord quite well with the familiar experience of enjoying scenery" (Howett 1998). If we wish for people to experience more than just enjoyable scenery in the landscapes we create then it is imperative to move away from reductive representation techniques to strategies that broadly represent this "force field of ecological process." As John Lyle states:

> *All landscapes, natural and human, live, change, and die by nature's ongoing processes. Substance remains behind the mask, though much of the time we take image for substance without question. As a result we find ourselves living in a world of imagery, an unreal world with human beings seemingly set apart from nature. A philosopher might say that form and content have parted ways.*

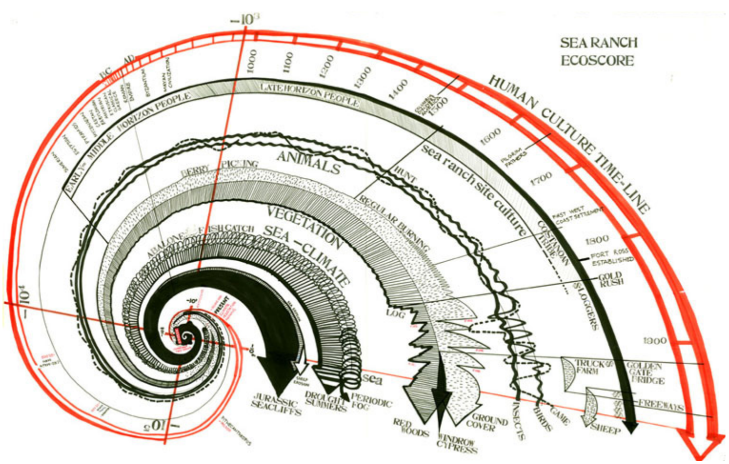



*Figure 2.4: "Sea Ranch Ecoscore", by Lawrence Halprin*

### *The Revelatory*

It is not only the viewer and the collective societal perception of "landscape" that suffers from the conventionalized nature of modern landscape graphic conventions. Corner argues that the original value of projection drawings, one that has largely been displaced by an overly operationalized and formulaic approach, was their role in "making visible what is hidden and prompting one to understand something at a higher level" (Corner 1992). Though it has been misused, Corner argues, drawing is an eidetic and generative activity, and it "holds the possibility of forming a field of revelation, prompting one to figure previously unforeseen landscapes of richer and more meaningful dimension" (Corner 1992). Such revelations are not solely or even primarily intended for viewers, but for researchers and designers as well, the creators of such representations.

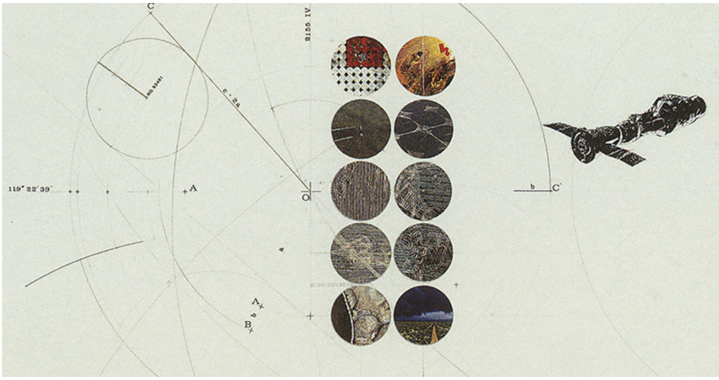
While Corner speaks here specifically of projection drawing, he and others have made a similar case for a diversity of visual representation strategies within landscape architecture. In "A Discourse on Theory II," he states that "only through the temporal and phenomenal processes of doing and making can revelation occur," and lists such diverse media as imaginary drawings and models as examples of such "perception-based work" (Corner 1991). Similarly, Catherine Dee speaks broadly of the process of image-making as an activity imbued with critical consideration, that may encourage the researcher to turn their critical abilities to subject matter not investigable or intelligible through other means (Dee 2004). Cesar Torres makes a similar case regarding maps and mapping, stating, "As a map explores, confirms and syntheses, it is evident that some phenomena are invisible to the naked eye and can only be seen by means of the map: achieving visibility through representation rather than through direct experience." By aestheticizing and operationalizing the field's approach to landscape graphics, we deprive ourselves of such revelatory experiences, replacing generative visual thinking with convention-based production.

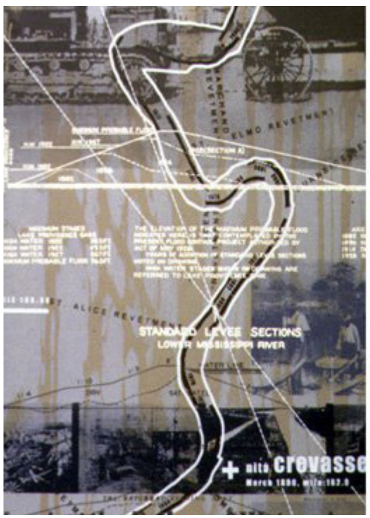
## THE BASIS FOR AN ALTERNATIVE
### *Graphic Precedents*

It would be an unfair generalization to assume that landscape architects have not explored strategies for representing intangibility, process, and complexity within the landscape. While examples are not plentiful, the explorations of Lawrence Halprin in scores and scoring are of note (Figure 2.4). Inspired by the performing arts, Halprin saw scores as a more broadly applicable form of notation, as a means of visually describing process. Halprin recognized the particular value of such a strategy to landscape, stating "I hope that scores will lead into new ways of designing and planning large–scale environments of regions and large communities whose essential nature is complexity" (Halprin 1970).

Halprin's attempt to acknowledge the intangible in landscape is well recognized by theorists. Howett asserts that the work of Halprin "suggests that it is an illusion to see a design as nothing more than an objectified physical form arrayed in space for visual analysis and appraisal" (Howett 1998). Similarly, Corner notes Halprin's scores as one of the few examples of what he terms notational representation in landscape architecture, a strategy he considers valuable for combatting the shortcomings of traditional graphics (Corner 1992). The value of these contributions should not be underestimated, and their relevance continues to this day as our appreciation of landscape complexity increases. As Howett remarks, the work of Halprin paves the way for how we understand modern ecological views as seen in "more recent descriptions of ecological process as open to unpredictable, nonlinear, fundamental change" (Howett 1998).

Though perhaps the best known, Halprin is by no means the only landscape designer to acknowledge the role of intangible characteristics and complexity in landscape or the importance of graphics in their understanding. Landscape architecture professor Anita Berrizbeitia argues that nearly all of the entries in the Downsview Park design competition engage process in that they are not so much designed landscapes as they are "the design of potentials for variation to





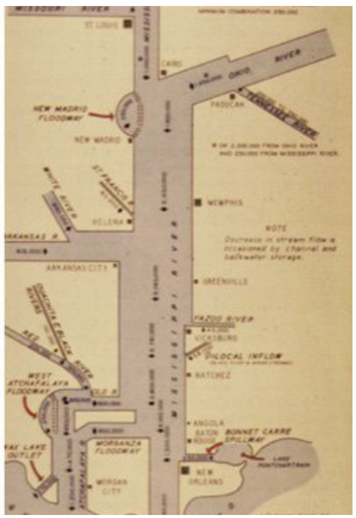
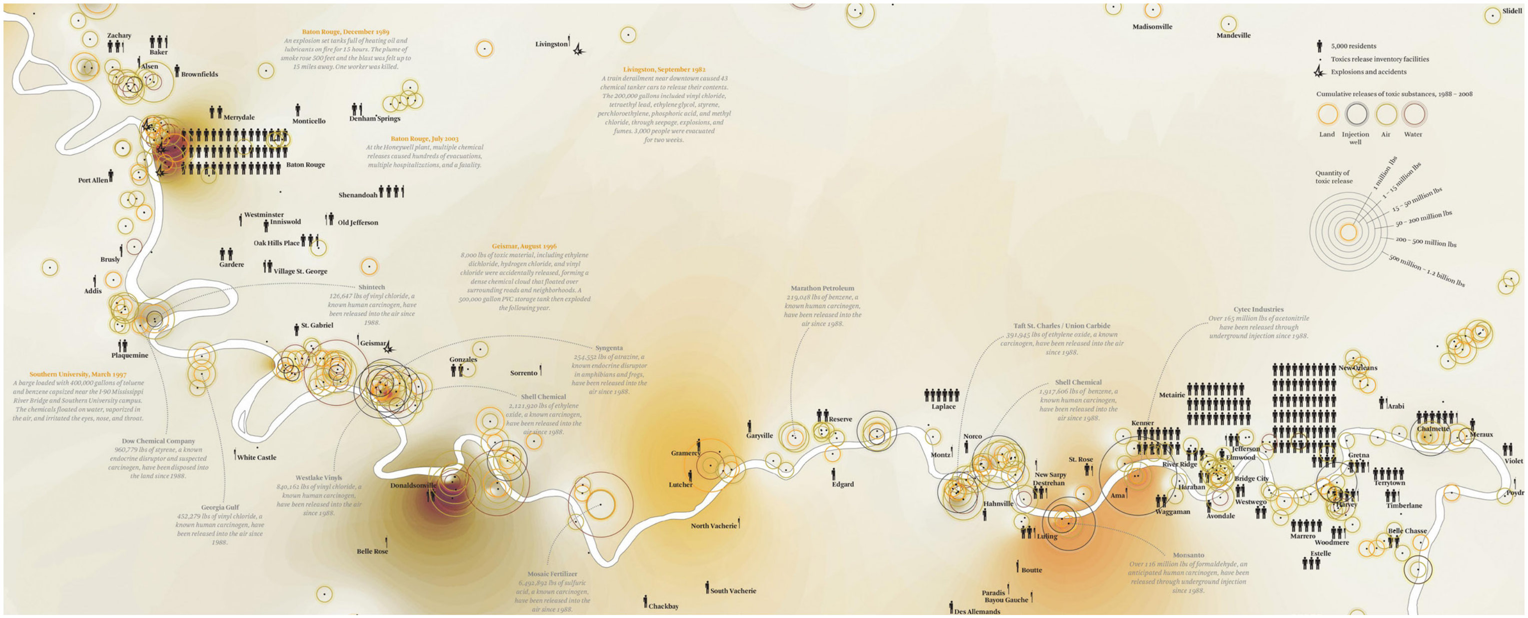



*Figure 2.5 (top): Imagery from "Taking Measures Across the American Landscape"(Source: Corner 1996).*
*Figure 2.6 (bottom): Imagery from "Mississippi Floods" (Source: Mathur and Da Cunha 2001).*
*Figure 2.7 (right): Imagery from "Petrochemical America" (Source: Orff and Misrach 2014).*

emerge." Thus, landscapes are created as "poised systems," starting points with the possibility for emergent behavior embedded in the design. Other approaches to transcending pictorial depictions have tended to relate to mapping, as can be seen in James Corner's *Taking Measures Across the American Landscape*, Anuradha Mathur and Dilip Da Cunha's *Mississippi Floods*, and Kate Orff and Richard Misrach's *Petrochemical America*. While innovative and well-regarded in the field, these projects still ultimately rely heavily on projection based imagery (**Figures 2.5**, **2.6**, and **2.7**).

Despite the presence of innovative techniques for representing landscape complexity as exemplified by Halprin, Corner, and others, it is clear that such sensitivity is not the norm for practice. Corner notes that landscape architecture's inherent similarities to temporal art forms recommends notational strategies of representation, however he also acknowledges that, with the exception of Halprin, such works in the field of landscape architecture have been "few and far between" (Corner 1992). Dee echoes this point, referring to such studies as "isolated and infrequent expositions in landscape, architectural, and cultural geography research." Work such as Halprin's serve more as exceptions that prove the rule rather than as a barometer for the field as a whole.

As Berrizbeitia has noted, even when theoretical opportunities present themselves, it is challenging for designers to step outside of the box of convention to




explore representational alternatives. While praising the overall innovative and systems theory-based design approach employed in the OMA team's entry in the Downsview Park competition (**Figure 2.8**), Berrizbeitia laments the run-of-the-mill rendering approaches employed to represent this scheme. Berrizbeitia (2001) notes:

> *There seems to be a profound discrepancy between the lightness and flexibility of the plan and diagrams, and the perspective views. In these views, instead of seeing the broad array of possibilities afforded by their process, we see nature and urban life reduced to one vision, that of logolike landscapes frozen as stage sets of human and vegetal performances. Instead of a heterogeneous site, filled with the tensions created by the contradictory juxtapositions of contemporary urban life, we see a comfortable, homogeneous park.*

This description could arguably refer to the vast majority of landscape architectural graphics today, and underscores the degree to which designers are

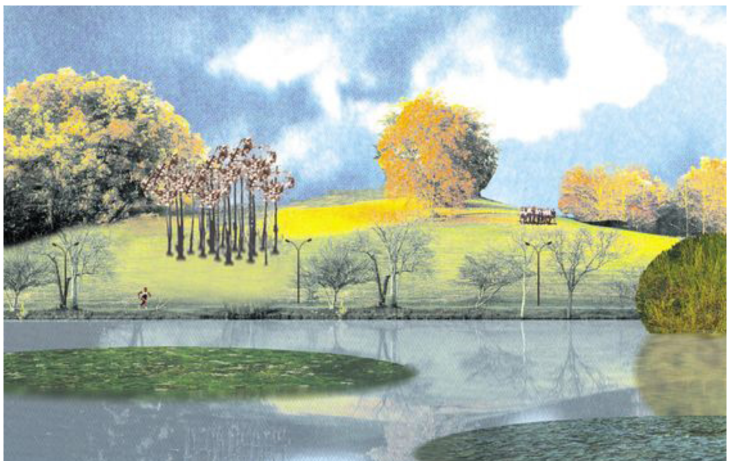


*Figure 2.8: "Tree City" rendering submitted for the Downsview Park design competition, by OMA*

graphically challenged by landscape complexity, even when it is understood to exist.

This fault arguably does not lie with the individual designers, but with the field as a whole. The disconnect between theoretical understanding and the graphics created is "amplified by the limited generation of inventive techniques as is apparent from a review of international projects and design competitions," writes Cesar Torres (2009). In part because the field of landscape architecture has not codified such graphic conventions, most designs within the field are still communicated largely through the use of conventional plans, sections, and perspectives. Without the language or framework within which to place graphic strategies for representing the intangible, we diminish their utility, forcing each designer to "reinvent the wheel," so to speak, each time they graphically explore such concepts.

It is important to note that while the operationalized nature of graphics is part of the problem, it is here also presented as part of the solution. While narrow and entrenched practices may hamper creativity, a shared language and framework of understanding frees individual creators from addressing these basic considerations, allowing them to work at a higher level of abstraction. Thus, this project advocates not for a graphic "free-for-all" or an abolishment of convention, but for a sensitive consideration of the alignment of values and theory with conventional practice.

### *Theoretical Precedents*

The dependence on conventional representation strategies—plans, sections, and perspectives—continues to preference the visual over the analyzed, experienced, and interpreted site, despite an inherent misalignment of this approach with the foundational influences of modern landscape architectural theory. It is worth addressing two critical components of contemporary landscape thinking at this point to further illuminate the importance of a shift in approach to landscape representation, phenomenological philosophy and ecological theory.

### *Theoretical Precedents: Phenomenology*

Phenomenological approaches are recognized as a common aspect of theory in landscape architecture and related fields (Dee 2001, Thompson 2009). As a broad philosophical stance, phenomenology deals with the conscious perception of the external world. While various philosophers have extended this basic concept to a variety of conclusions, the notion of embodied consciousness espoused by Maurice Merleau-Ponty has been particularly apparent in landscape architectural writings. Merleau-Ponty regarded the body as the medium through which we acquire knowledge of the world and exist within it. As such, the world is less like a static image to be viewed than an experience to be immersed within.

Such ideas are readily apparent in the writings of James Corner, who echoes Merleau-Ponty when stating: “insight is primarily grounded in perception and cannot exist outside the *a priori* of the human body and its engagement with the world.” (Corner 1990). Similarly, when Catherine Dee asserts, “the ‘embodied thinking’ of image-making parallels and suggests the physical experience of landscape in ways that purely cerebral investigations may not,” she draws upon phenomenological language and concepts (Dee 2004).

I underscore the importance of phenomenological philosophy to the field here as a tool to reveal the inherent misalignment of holistic landscape thought and understanding with conventionalized and operationalized theory and technique seen in the field. Thus, while broadly theoretical writings by the likes of James Corner draw connections to relevant and revelatory concepts outside of our field, the operationalized approach, the tacit stance of the profession, lags woefully behind. We abstractly conceptualize the phenomenological nature of our field, but we hardly derive these considerations into operable theory, and even less to applied strategy.



### *Theoretical Precedents: Ecology*

Thomas Kuhn describes how advancement in the sciences occurs through adherence to paradigms and the occasional dramatic rupture when the accepted paradigm, no longer reconcilable with observations, is replaced in what he calls "scientific revolution." There is general consensus among ecologists that something akin to this phenomenon has occurred in the second half of the 20th century. "Ecology is in the midst of a major paradigm shift" write landscape ecologists Pulliam and Johnson, and though they suggest that it may have occurred more gradually than many Kuhnian revolutions, it "nonetheless has resulted in a radically different view of how the natural world works" (Pulliam and Johnson 2001).

The major tenets of this change can be characterized as what landscape architecture professor Kristina Hill calls "a wholesale reevaluation of boundaries and predictabilities" (Hill 2005). In contrast to deterministic ecological models that view ecosystems as relatively self-contained entities progressing through a logical sequence of phases towards a defined endpoint, ecological theory now considers landscapes as much more spatially and temporally open systems, not predictable through equilibrium models. "Simply put," Hill writes "ecological scientists have replaced their expectations for determinism and predictability with expectations of greater complexity in ecosystem behavior" (Hill 2005). Pulliam and Johnson voice a similar sentiment when suggesting that we now have "a new view of natural systems that emphasizes how local ecological conditions are greatly influenced by events that occur at other times and in other places" (Pulliam and Johnson 2001). The impact of such changes should

***"Recent work in the ecological sciences seeks to envision landscapes as composed of shifting nodes of interaction, driven by temporal relationships rather than deterministic trends."***
***-Kristina Hill***

not be underestimated.  Such developments, suggests Hill, have quite literally “changed the way scientists think about the nature of nature” (Hill 2005).

This sea change in ecological thinking is not only important within the sciences, however.  As Hill suggests, as an instrument of culture, science serves as a lens through which we may view the world, shaping how we see and perceive (Hill 2005).  Landscape architects, whose subject, object, and medium of design are all the natural world, are inevitably influenced by advancements in ecological understanding as seen through the lens of science.  It is no surprise, then, that a shifting and evolving relationship between designers and scientists has been widely noted in conjunction with shifting ecological views (Pulliam and Johnson 2001, Hill 2005).

Given the intertwined nature of ecological science and landscape design, one might reasonably expect ecological theory to inform landscape architectural design decisions.  While this is overtly clear in the stated intent of myriad ecological design projects, the persistence of graphic conventions predating ecology’s major paradigm shift clearly indicates that landscape representation has yet to embrace this new understanding of landscape systems.  While Hill asserts that “recent work in the ecological sciences seeks to envision landscapes as composed of shifting nodes of interaction, driven by dynamic temporal relationships rather than deterministic trends,“ the graphic conventions to display such understanding have yet to be made operational.  As Louise Mozingo writes, “Landscape architecture has ecological thinking at the core of its legacy, yet ecology’s meaning and significance in design attenuates, if not divides, the profession” (Mozingo 1997).

## TOWARDS A SOLUTION

### *Representational Revolution*

Kuhn’s previously mentioned theory of scientific revolutions describes a scientific paradigm as representing a shared and operational model of reality that provides a common basis for further investigation (Kuhn 1962).  Operating on a foundation of shared assumptions allows investigators to push the field ahead by allowing them to focus their attention on higher-level concerns rather than continually rebuilding fundamentals. As investigation yields new understanding, the necessarily incomplete paradigm will grow less and less aligned with the fundamental nature of our understanding of reality, eventually resulting in a “revolution.”  As our understanding of landscape has progressed, the graphic conventions that have served the likes of Le Notre and Repton, Olmsted and Kiley, no longer fully succeed in capturing the intangible complexity of the landscape as we now understand it.

Plans, sections, and perspectives represent the graphic paradigm of the field of landscape architecture.  By relegating other graphic approaches to the periphery of our field, we tacitly perpetuate the perception of landscape as object, as we relegate graphics depicting non-spatial and intangible landscape characteristics to the category of "other." We have tried, for a time, to push ahead with the our classic representation strategies, augmenting here and there with innovative diagrams or unique mappings, applying GIS or time-lapse video, or whatever our personal expertise leads us to, in order to capture the complexity of our subject, the complexity of our medium, and the complexity of our canvas. Yet it seems that we are at a tipping point, a time when our graphic capabilities, our analytical processing power, and our theoretical climate align to suggest the need for a new paradigm, the need for a graphic revolution.

This project argues that only by elevating the depiction of the intangible qualities of landscape to the same prominence as the depiction of form will we truly begin to internalize and conceptualize the landscapes we design as the complex networks of processes, experiences, and connections that we are coming to understand them to be. If we hope to mitigate the pressing environmental and social challenges of contemporary times, it is imperative for us to develop a more well-calibrated view of the natural systems within which we design and live.

***"To generate deep form requires a rational understanding of natural systems in combination with intuitive imagery, and thus a design process that combines high levels of both analytical and creative thinking."***
***-John Lyle***

### *Visualizing The Future*

There are diverse strategies for depicting intangible landscape systems and an investigation of the breadth of such approaches is beyond the scope of this project. Instead, this project takes Cesar Torres' recommendation to look beyond the narrow scope of landscape architectural strategies and consider techniques used by other fields to approach similar challenges. While precedents for representing landscape complexity are few and far between within the field of landscape architecture, this is not necessarily the case outside of landscape architecture. This project is intended as a rallying cry to encourage the innovative exploration of graphic techniques from outside of the field of landscape architecture, as well as to serve as an example of one such exploration.

As John Lyle states, "To generate deep form requires a rational understanding of natural systems in combination with intuitive imagery, and thus a design process that combines high levels of both analytical and creative thinking." If we wish the landscapes we design to evoke the sort of "deep form" promoted by Lyle, we must start by infusing our representation of landscapes with both thoughtful analysis and inspired creativity rather than continuing to generate conventional imagery based on outdated understandings of landscape. This project proposes network visualization as one strategy among many for reevaluating representation within landscape architecture and for more appropriately and sensitively representing the inherent and intangible complexity that is landscape.

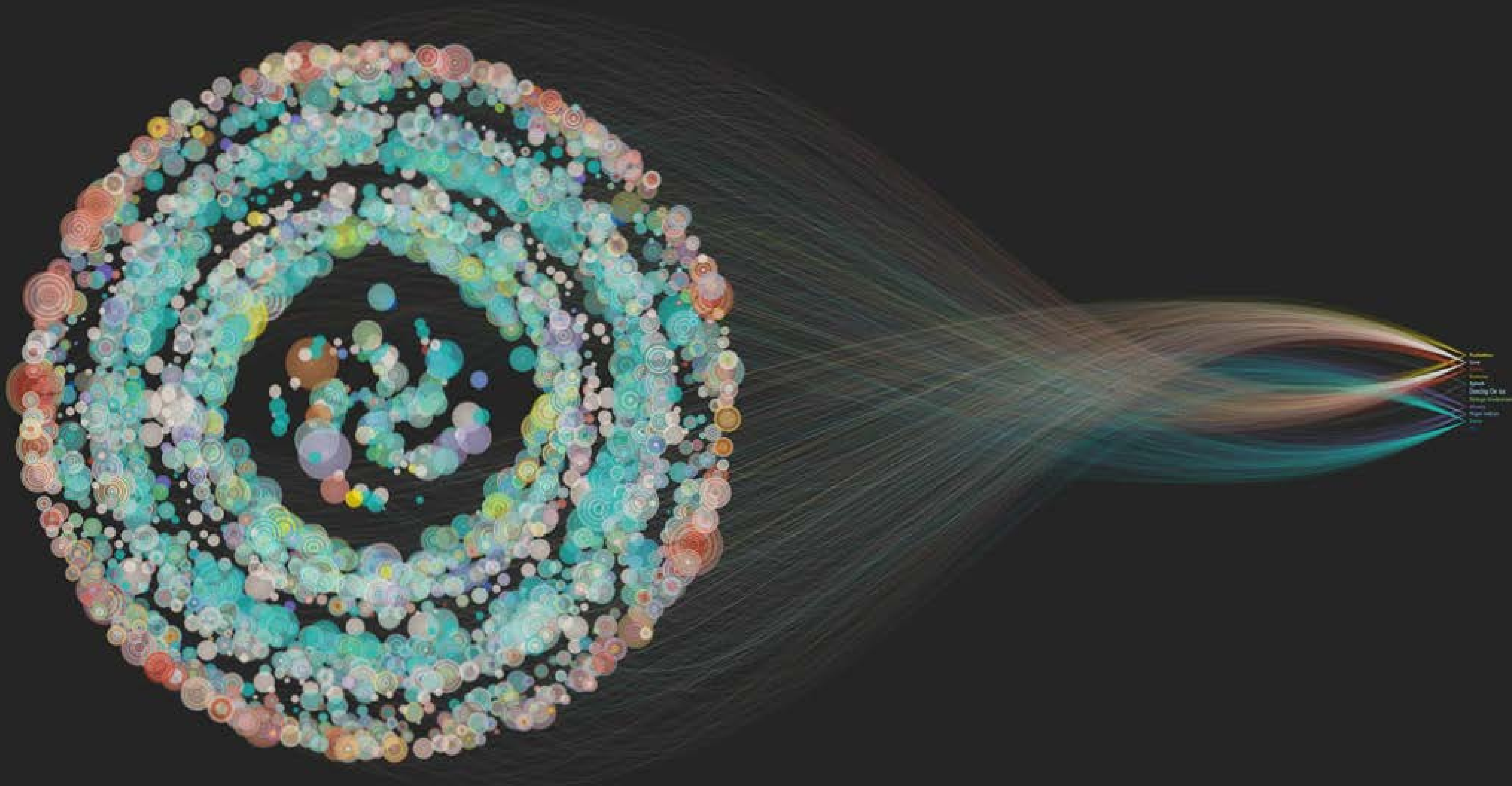


*Figure 3.1:* *This digital city portrait of Southampton represents common conversation topics by aggregating large amounts of communication data (Source: brendandawes.com)*

# 3. NARRATION *visualizing complexity*

## DATA VISUALIZATION
### *A Brief Introduction*

Though repeated to point of cliché, the classic phrase "a picture's worth a thousand words," is not without merit or accuracy. Visual depictions can help describe, explain, and clarify an enormous range of objects, ideas, and phenomena, but they may be especially helpful when dealing with large amounts of complex information (**Figure 3.1**).

The use of graphics to help give meaning to such information is often referred to as "information visualization" or "data visualization." At times these terms are used more or less interchangeably and in other situations data visualization is nested as a sub-category of information visualization. According to the *Handbook of Data Visualization*, "the term data visualization is related to the new field of information visualization. This includes visualization of all kinds of information, not just data, and is closely associated with research by computer scientists" (Chen et al. 2008). In their study on visual preferences in information graphics, information scientists Quispel and Maes state: "The term data visualization often refers to the visualization of large, complex, computer-generated data sets. The term can also be used in a broader sense and refer to the visualization of all kinds of quantitative information from simple univariate to large multivariate data sets" (Quispel and Maes 2014).

### *A Note On Terminology*

As with many emerging and rapidly evolving fields, there is no single agreed-upon term for images designed to explain specific information, or set definitions for many of the competing terms within use. The goal of this study is to investigate the use of graphic strategies for conveying information, not to qualify or evaluate the kinds of information being represented. Thus, this study has elected to set and define its terminology internally to avoid any confusion resulting from outside use of the terms. For the current study, the term "data visualization" is used exclusively, and the term "information visualization" omitted from use. For the purpose of the current study "data visualization" refers to images that are specifically designed to represent and convey data, which is here defined as a systematically derived set of related pieces of information, which may or may not be quantitative in nature.[1] The use of a single term is desirable because it reduces confusion and clarifies the overall project argument.  This choice also represents a deconstructionist approach to scholarship in the desire to avoid imposing an external, potentially biased, hierarchical judgment as to what qualifies for the more selective category of "data" and what is merely "information."  The term "data" is considered preferable over information due to its more targeted specificity.[2]

### *The Use of Data Visualization*

Two major contemporary uses for data visualization are generally agreed upon, exploration and presentation (Chen et al. 2008).Generally speaking, exploratory graphics are process work used to gain understanding, while presentation graphics are final products used to display results. [3]

In terms of data exploration, graphics provide a tool for making sense of information that might otherwise be challenging to decipher.  The foreword to *Visualization in Landscape and Environmental Planning: Technology and Applications* explains, "Because the human eye-brain system is so sophisticated in pattern recognition, difference detection, and so on, visualization can be an effective aid in detecting correlations, implications, and anomalies—not just rendering aesthetic verdicts" (Ervin 2005).    Exploratory graphics are intended to help answer questions and find results. Therefore, they may be quick, iterative, incomplete, and unpolished (Chen et al 2008).

In contrast, graphics for presentation are



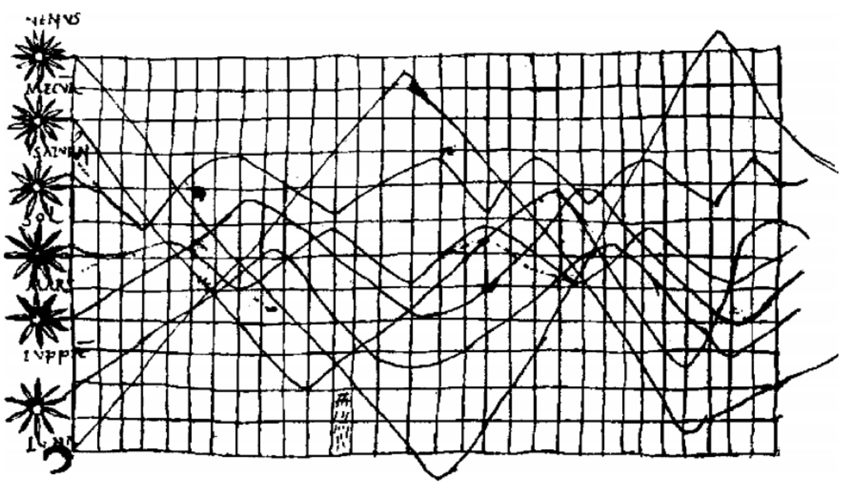


*Figure 3.2:* *Planetary movements depicted by unknown 10th century astronomer (Source: Friendly 2008).*

intended to convey the results of an investigation or study to individuals who are not the researcher. This can be challenging when representing a complex reality. As information designer Edward Tufte states, "All communication between readers of an image and the makers of an image must now take place on a two-dimensional surface. Escaping this flatland is the essential task of envisioning information—for all the interesting worlds (physical, biological, imaginary, human) that we seek to understand are inevitably and happily multivariate in nature." (Tufte 1990). In contrast to exploratory graphics, presentation graphics are typically static, self-contained, complete summaries of information – thus, they "give no hint as to how a result was reached, but they should offer convincing support for its conclusion" (Chen et al. 2008).

### *Data Visualization: A Short History*

Data visualization is not a modern development though it has experienced a recent surge in popularity. Perhaps the earliest depiction of quantitative information in a graphic form can be seen in a 10th century plotting of planetary movement over time by an anonymous author (Friendly 2008) (**Figure 3.2**). As our ability to measure and quantitatively understand the world has increased, so has our need for strategies to present this information. The increases in measurement capabilities of the 17th century led to some of the first truly compelling data sets and accompanying theories and also set the stage for what data historian Michael Friendly terms "the beginnings of visual thinking" (Friendly 2008).

It is generally agreed upon that the 18th century gave birth to many of the graphic standards for data representation still used today (Friendly 2008, Quispel 2014). William Playfair's 1786 publication *The Commercial and Political Atlas*, contained the first known example of a line graph and its author went on to contribute the bar graph and pie chart to our collective arsenal of visualization strategies (Quispel and Maes 2014). With the increasing prevalence of statistical data in the 19th century, statistical graphics and thematic mapping exploded, reaching their height in the late 1800's (Friendly 2008).

Although the early 20th century saw waning interest in the field, several advances in the 1960's sparked a renewed interest in visualizations that continues to this day. In addition to several influential texts in the fields of statistics and semiotics, this resurgence of interest was sparked by advances in computing, specifically the creation of FORTRAN, the first high-level computing language (Friendly 2008). Advances in technology and computing power throughout the late 20th and early 21st century have continued to lead not only to more widespread availability of data sets, but also to the refinement of techniques for visualizing such data (Quispel and Maes 2014). Such advances in information technology have

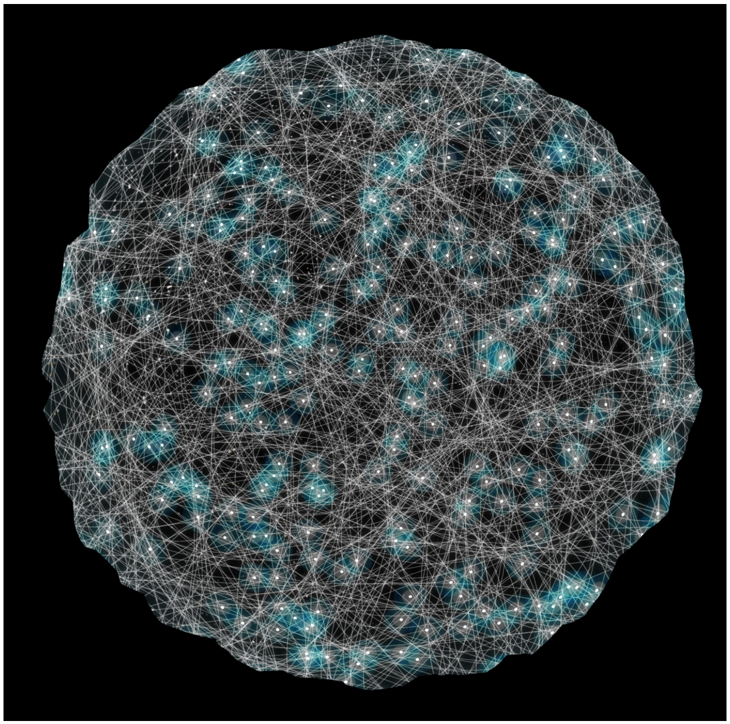


*Figure 3.3: A 2005 visualization of low-earth orbiting satellites (Source: www.cmlab.com).*

led to the rapid evolution of the practice and possibilities for data visualization in diverse fields, including design (Quispel and Maes 2008) (**Figure 3.3**).

### *Future Directions in Visualization*

While the rudimentary visual capabilities of early computers contributed little to output graphic quality, more recent advances in computing power have had enormous impacts on the kinds of graphics produced and their aesthetics. The ability to easily generate and print graphics with incredible complexity and precision has been an enormous benefit, especially in the use of graphics as iterative research tools from which to glean new information (Chen et al. 2008). In addition to the generation of graphics, advances in computing power allow for the continual incresase in size and complexity of datasets (Friendly 2008). As Edward Tufte states, "All the history of information displays and statistical graphics—indeed of any communication device—is entirely a progress of methods for enhancing density, complexity, dimensionality, and even sometimes beauty" (Tufte 1990). Indeed, while visualization strategies originated out of a desire to quickly and accurately represent data, aesthetics are also crucial for communication, especially to laypeople (Quispel and Maes 2014). Despite the long history of statistical graphics and their broad relevance across many fields, research into the theoretical aspects of data visualization is scarce, especially from a design perspective, and there are many challenges and issues for future research (Chen et al. 2008, Friendly 2008, Quispel and Maes 2014).

## NETWORKS

### *A Brief Introduction*

In its most basic form, a network is simply a collection of items and the connections between them (Newman 2003). While terms vary, items are typically referred to as "vertices" or "nodes" and connections are called "edges." For the duration of this paper, the term "nodes" will be used in place of "vertices" because of the parallels this nomenclature draws to the works of Kevin Lynch.[4] "Behind each complex system, there is an intricate network that encodes the interactions between the system's components," writes Albert-Laszlo Barabási, one of the best-known researchers on network theory (Barabási 2012). "Networks permeate science, technology, and nature to a much higher degree than may be evident upon a casual inspection. Consequently, it is increasingly clear that we will never understand complex systems unless we gain a deep understanding of the networks behind them" (Barabási 2012).

The formal study of networks and their properties has exploded in recent years. Advances in computing, including digital storage capabilities and the Internet, have facilitated the collection, processing, mapping, and analysis of networks to a degree that was previously impossible (Barabási 2012, Newman 2003). With these increasing capabilities, the focus has shifted from studying specific networks and their individual components to examining large-scale properties and commonalities between different networks (Newman 2003).

### *Network Science: An Interdisciplinary Field*

The study of diverse networks through the use of a common set of tools and principles is known as network science (Barabási 2013). "Despite apparent differences, many networks emerge and evolve, driven by a fundamental set of laws and mechanisms, and these are the province of network science" (Barabási 2013). Networks have been the subjects of study in other fields for quite some time, including in discrete mathematics and many social science disciplines (Newman 2003). Nevertheless, network science differs from these studies in its focus on utility—using real data to gain insights about the structure and evolution of systems (Barabási 2012).

Network science draws on a wide array of disciplines and this interdisciplinary study has made enormous progress in the characterization and modeling of networks structure (Newman 2003). The interdisciplinary nature of the field is not surprising, given the diversity of systems that take the form of networks. Networks occur in natural, social, and technological systems. Systems ranging from the Internet to the circulatory system, from the interactions of businesses to the interactions of predators and


*Figure 3.4a (above) and 3.4b (below): Network graphics featured in the first chapter of Barabasi's introductory text on network science (Source: Barabasi 2012).*

prey, all operate as networks. The enormous apparent differences between such systems might suggest that their structures and behaviors would have little in common; one of the major discoveries of network science is that such networks are actually quite similar if we look past the individual components and the specifics of their interactions (Barabási 2012). "Network science offers a language through which different disciplines can seamlessly interact with each other," writes Barabási (2012). While the specific needs and challenges may vary from field to field, the "common character" of the challenges and ideas explored across disciplines has led to valuable cross-disciplinary strategies and insights (Barabási 2012).

## NETWORK VISUALIZATION

### *Overview*

The increased understanding that arises from network science when married with data visualization techniques has resulted in a suite of strategies for visualizing networks. Researchers studying these intangible systems have developed strategies for their visual depiction for both presentation and exploratory ends. Indeed, "this has been one of the primary methods of network analysts since the field began," writes Newman. "The human eye is an analytic tool of remarkable power, and eyeballing pictures of networks is an excellent way to gain an understanding of their structure" (Newman 2003).

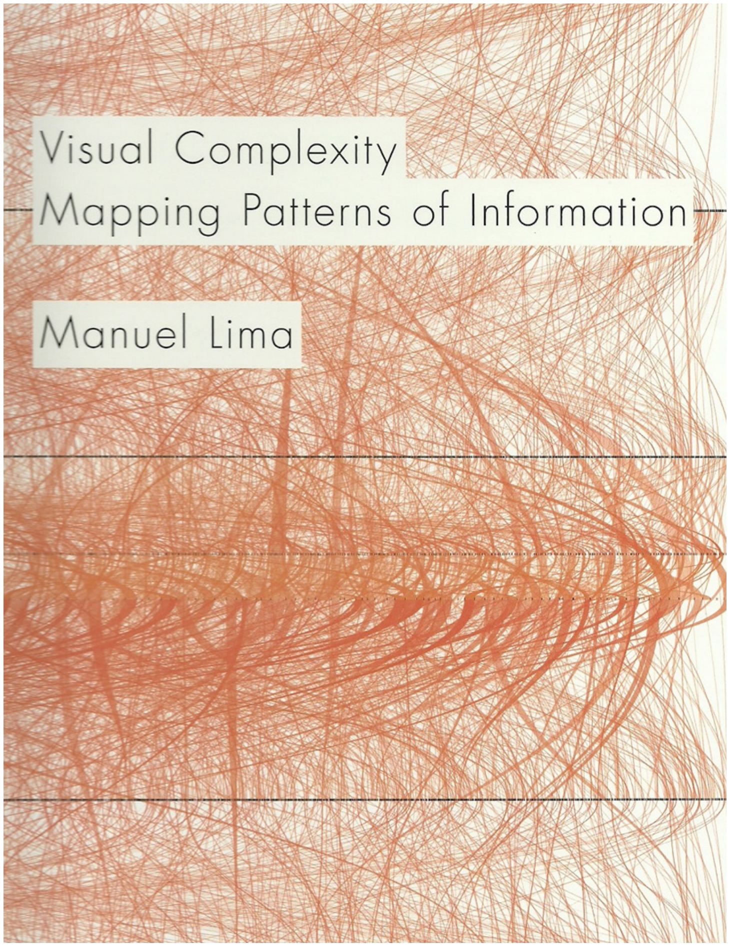



*Figure 3.5: Manuel Lima's 2011 text Visual Complexity*

An examination of texts or articles on network science reveals what might seem like a surprising number of graphics for such a theoretical field (**Figure 3.4**). Many of these images draw upon common graphic trends and strategies to depict a wide variety of networks. It is around this phenomenon that the research of Manuel Lima is situated.

### *Manuel Lima and the Network Visualization Taxonomy*

Manuel Lima's well-known text *Visual Complexity: Mapping Patterns of Information* grew out of the author's MFA work at Parsons School of Design (**Figure 3.5**). Now an instructor of data visualization at his alma mater as well as a prominent UX designer and lecturer, Lima's research focuses not only on visualization but specifically on the visualization of networks. The published book actually developed out of an online collection, VisualComplexity.com, which Lima maintains with the self-stated goal of "facilitat(ing) a critical understanding of different network-visualization methods across the widest spectrum of knowledge" (Lima 2011).

Though not strictly an academic text, *Visual Complexity* probably provides the most significant look to date at network visualization from a design-oriented academic stance. As computer science professor Lev Manovich states, "Lima is likely to have the best understanding of the creative impulses, exciting

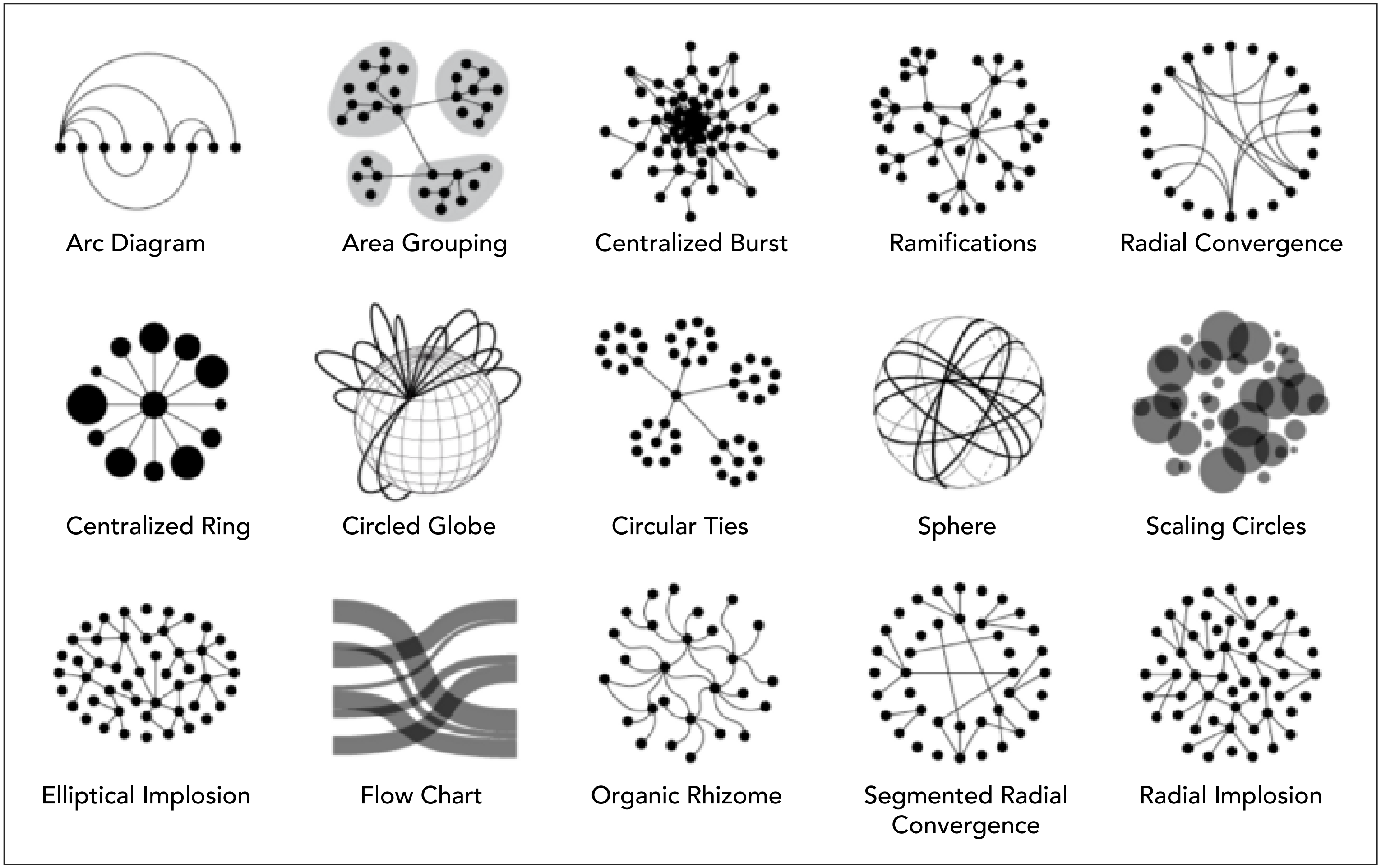



***Figure 3.6:*** *Lima's taxonomy of 15 network visualization strategies (Source: Lima 2011).*

discoveries, and sheer range of work produced today in this area" (Manovich 2011). In addition to providing a multitude of graphic examples of network visualization, the text provides an overview of the history of network visualization and considerations in network thinking. Most relevant to the current project is the text's fifth chapter entitled "The Syntax of a New Language." This chapter provides the taxonomic basis for the investigation that drives this project's methodology.

Lima's taxonomy identifies 15 categories of common network visualization strategies based on the state of current practices. While the breadth of topics covered is wide, common trends emerge in the graphic strategies used to depict networks (**Figure 3.6**). "As designers, scientists, and researchers across the globe portray an increasing number of network structures in innovative ways, their collective effort forms the building blocks of a new network-visualization lexicon," writes Lima in the introduction to *Visual Complexity* (Lima 2011). While Lima acknowledges that this taxonomy is constantly evolving, he also asserts that it "provides a portrait of the current state of the practice and reveals the initial building blocks shaping a new visual language" (Lima 2011). For this reason, Lima's taxonomy provides an apt model for the current state of the field against which to compare visualization practices in landscape architecture.

## WHAT LANDSCAPE ARCHITECTS CAN LEARN

Although landscape architects are increasingly competent with the tools and skills of graphic design, the field seems not to have embraced contemporary data visualization strategies formally within its practice or literature. The 2005 text *Visualization in Landscape and Environmental Planning* provides an apt representation of the ways we use and conceive of visualization within landscape architecture. Despite pointing to the advances in computing power and our ever-increasing ability to study, model, and depict the world around us, the text focuses solely on visual simulations of physical reality. Though it is hardly fair to assume the scope and breadth of a text is representative of an entire field, it is worth noting the perception of what the word "visualization" has recently, if not presently, signified within the field.

In its opening chapters this project has established the perceived need within the field for more diverse and original representational strategies within landscape architecture (Torres 2009, Corner 1992). The complex and intangible qualities of landscape suggest that landscape might be more fully depicted by the use of strategies that display landscapes as more than mere objects. Data visualization offers one rapidly evolving source for suitable graphic strategies to augment current practice. They may be particularly fitting because they can embody large amounts of information, and can draw upon and represent intangible elements of the landscape. Their recognized use for exploratory

> *"...It is increasingly clear that we will never understand complex systems unless we gain a deep understanding of the networks behind them."*
> *-Albert-László Barabási*

purposes in addition to presentation responds to Catherine Dee's call for "critical visual research studies" and to James Corner's ideas regarding the eidetic function of graphics.

Enormous amounts of data are readily available in contemporary times, but such information must be presented and analyzed to have meaning and yield understanding. Conventional strategies for data analysis yield results that, while perhaps surprising or unpredictable, must necessarily be within the expected realm of possible outcomes. That is, the output results are dependent on the questions one chooses to ask. Graphics provide a medium for revelation, a strategy for eliciting meaning with fewer—or different—constraints than those presented by the typical strategies applied for data interpretation. Similarly, the use of landscape data provides one option—among many—for infusing our images with meaning that transcends the snapshot perspectives and maplike plans that the profession clings to.

Networks represent a particularly apt starting point for visualization in landscape architecture because of their omnipresence in landscape. Connections and interactions are integral to ecological function, social behavior, and human experience within the landscape. These networks of connections are one common example of important landscape phenomena that are often intangible and non-spatial. In addition to their importance to landscape, their prevalence in other fields has helped establish an extensive body of knowledge surrounding their general characteristics, in the form of network science. Such a body of knowledge not only makes their study both more feasible but also potentially more fruitful, as connections can be drawn across fields. Finally, the prevalence of graphics and visual representations in network science aligns well with the design-based practice of landscape architecture, assuring a fit not only in subject matter but in methodology as well.

"Network science is an enabling science, offering new tools and perspective for a wide range of scientific fields from social networking to drug design," writes Barabási. "Given the wide importance and impact of networks, we need to develop the tools to study and quantify them" (Barabási 2012). This project uses the practice of network visualization and the research of Manuel Lima as a lens for evaluating graphic depictions of intangible landscape elements within the field of landscape architecture.

## Endnotes

[1]*A valid case could be made that, given this definition, spatially explicit graphics used in landscape architecture, such as planting plans and construction documents, might be considered "data visualization." It is outside the scope of this study to argue this nuanced interpretation in depth. The study is, however, explicitly bounded to eliminate common forms of projection and perspectival imagery from its scope due to their ubiquity in the field.*

[2]*The Oxford English Dictionary defines data as "Related items of (chiefly numerical) information considered collectively, typically obtained by scientific work and used for reference, analysis, or calculation." Information is defined as "Knowledge communicated concerning some particular fact, subject, or event; that of which one is apprised or told; intelligence, news." This study accepts the premise that data represents a collection of information, essentially "information in context," though it questions the assumption that it is "chiefly numerical." Because all works examined in this study have more than one component and contribute to analysis or reference in some way, the term "data" may be fairly used in all cases.*

[3]*The dual functionality of data visualizations for presentation and exploration parallels the role Catherine Dee describes for critical visual studies in landscape architecture: "A critical visual study is one in which imagery is employed both as method to investigate and as form to communicate a research study." (Dee 2004).*

[4]*The works of urban planner Kevin Lynch should be generally familiar to most of the landscape architectural community. His popular text, Image of the City, asserts the existence of five basic elements in the human experience of space: paths, edges, nodes, districts, and landmarks. It should be noted that while the terminology employed is similar, this project does not assert that Lynch's classifications are analogous to those used in network science. Rather, the use of similar terminology is intended to provide a familiar starting point from which designers might approach the study of networks, and which suggests the pertinence of network science to landscape architecture.*

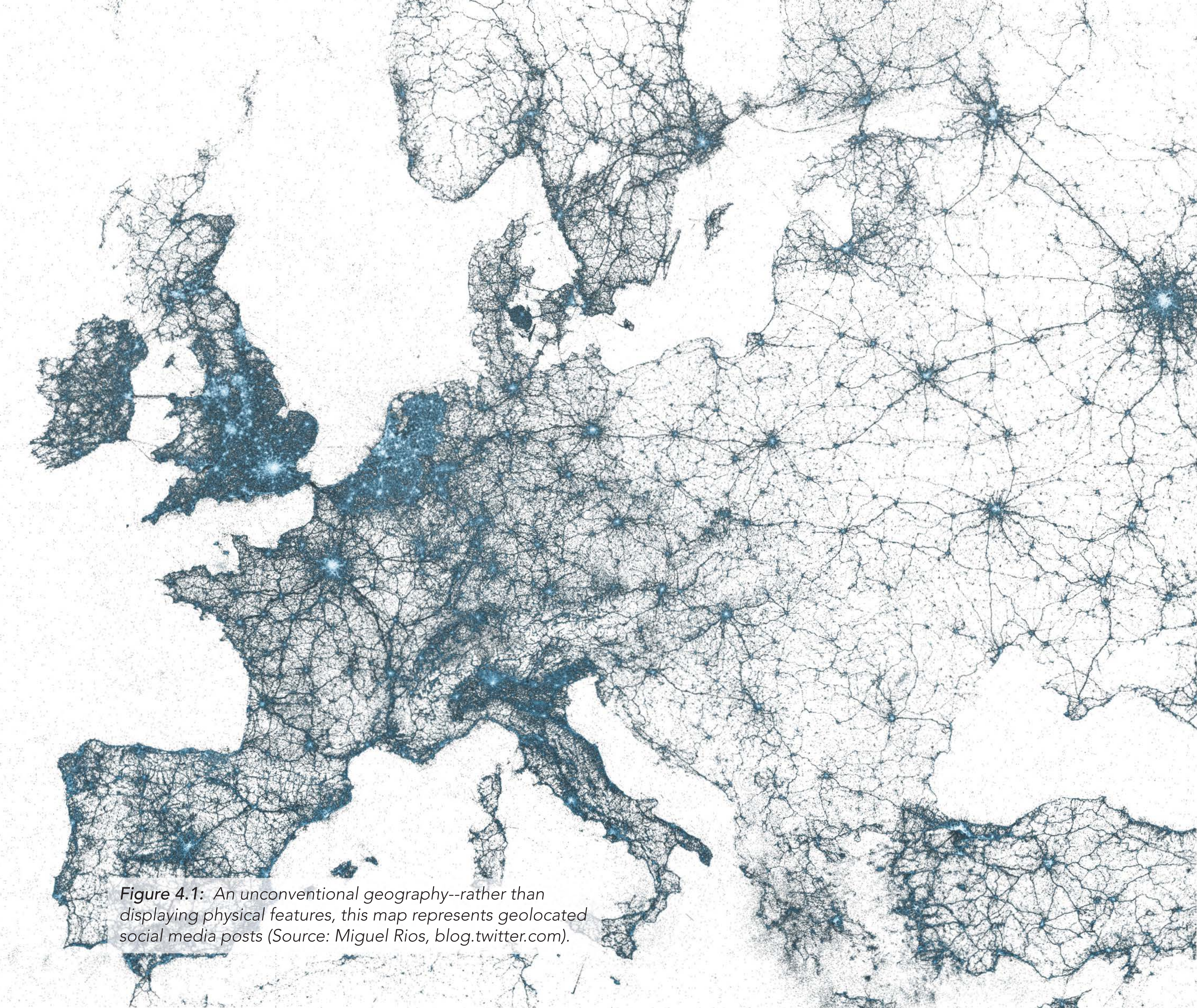


*Figure 4.1:* An unconventional geography--rather than displaying physical features, this map represents geolocated social media posts (Source: Miguel Rios, blog.twitter.com).

# 4. CONFIRMATION *methodology*

## PROJECT STRUCTURE

The preceding chapters have established the need for novel graphic strategies of landscape representation and proposed data visualization strategies for depicting networks as a possibility worthy of exploration (**Figure 4.1**). This project is structured as a classical argument, which includes the following five sections: introduction, narration, confirmation, refutation, and summation. The methodology described throughout this section is conducted to provide a robust and defensible confirmation to the project's thesis. This thesis, which is described in-depth in the introduction, may be concisely summarized as follows: "Despite the availability of techniques for doing so, landscape architects do not typically represent the complex and intangible networks within the landscapes they design, focusing instead on depictions of spatially explicit physical forms." The implications of this thesis are profound. If we accept Catherine Dee's claim that our representations have direct bearing on the way we conceive and create landscapes, then the failure to represent the networked nature of land systems suggests that our designs fall short of fully comprehending the holistic nature of landscape (Dee 2004). This implication and related considerations are discussed in detail in the argument's summation.

For clarity, throughout this document the overarching narrative argument is referred to as the "project," while the study conducted as part of the argument's confirmation is called the "methodology." This section focuses on the methodology itself and the procedures used to conduct it. The role of this methodology within the larger study is further contextualized in Chapter 6.

## METHODOLOGY: OVERVIEW

The intent of the methodology was to reinforce the narrative argument of the project (**Figure 4.2**). The methodology was designed to evaluate the degree to which landscape architecture has embraced strategies for depicting landscape networks. It looked to the current state of nationally recognized professional work in landscape architecture as a gauge for determining the relative presence of network representation within the field, which could provide more general evidence for the depiction of intangible landscape characteristics.

The methodology was guided by the following research question, and the two sub-questions that nest

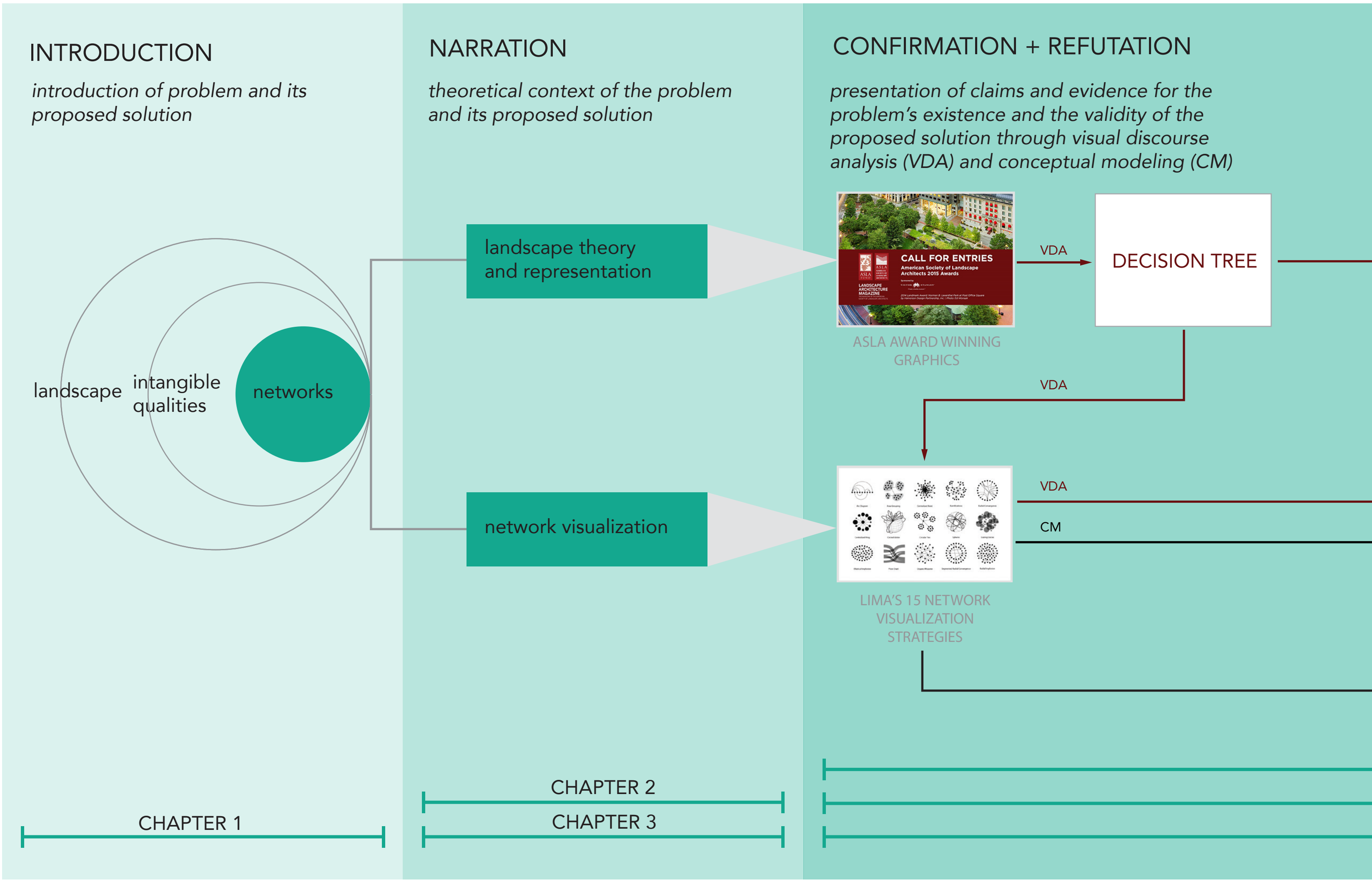
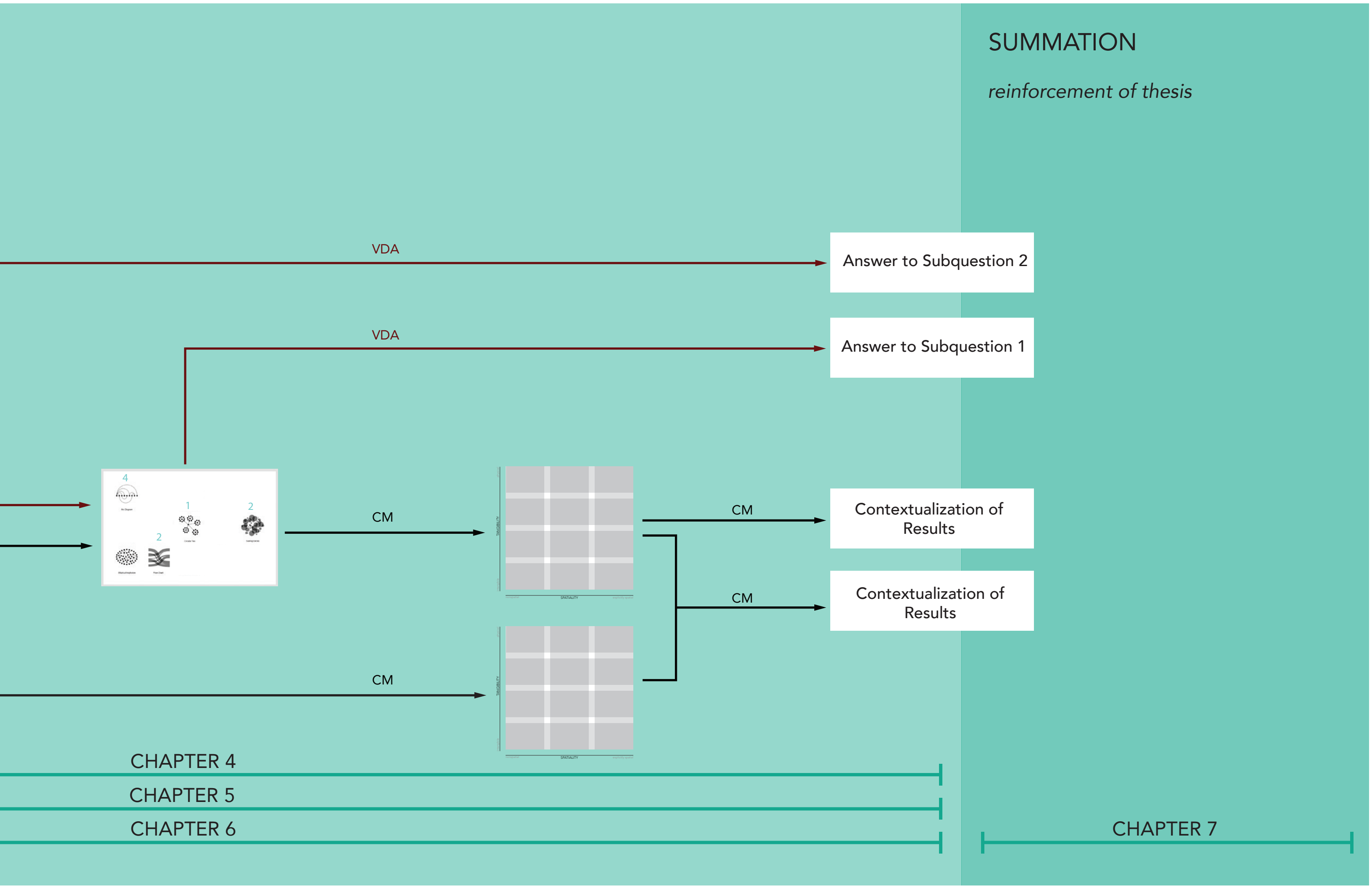



*Figure 4.2:* *Diagrammatic representation of the project structure and methodology*


SUMMATION
reinforcement of thesis
VDA
Answer to Subquestion 2
VDA
Answer to Subquestion 1
CM
CM
Contextualization of Results
CM
Contextualization of Results
CM
CHAPTER 4
CHAPTER 5
CHAPTER 6
CHAPTER 7

beneath it:

*Research Question*
*"To what degree are landscape architects graphically representing the networks present within the landscapes they study and design?"*

*Sub-question 1*
*"To what degree are landscape architects utilizing common conventions for network visualization from outside of the field to communicate or investigate landscape?"*

*Sub-question 2*
*"Are there any common strategies used by landscape architects for representing networks that are not documented in visualization literature outside of the field?"*

These questions were narrowly targeted to the use of network visualizations within the field of landscape architecture, however the findings may have broader implications for representation of complex and intangible systems within the field.

The methodology was structured around two major components, the **visual discourse analysis** and the **conceptual model development**. The visual discourse analysis was structured to specifically address the research question and the two sub-questions through a structured analytical lens. In the classical argument structure previously outlined, it might be described as providing the necessary information to build claims within the confirmation stage.

The term "visual discourse analysis" is original to this project. It is derived from the description of discourse analysis given in Deming and Swaffield's text *Landscape Architecture Research* but is modified to refer to source material that is graphic rather than text-based (Deming and Swaffield 2011).[1] Focused on interpreting how meaning is expressed, it is inherently a "constructivist" approach. It is particularly suitable for the current project because of its focus on understanding the practical and theoretical implications of a pattern of discourse (in this case visual). While visual discourse analysis was the overaching research strategy employed in the methodology, this study also draws upon aspects of other research strategies, most notably classification strategies including typology and literature review (Deming and Swaffield 2011).

The visual discourse analysis was designed to achieve the following:

- *Answer the research question and subquestions*

- *Produce a network visualization taxonomy specific to current practice in landscape architecture to reveal preferences and gaps in landscape architectural network visualization strategies*

The second component of the methodology, the development of a conceptual model, was intended to offer a framework for understanding the results of the visual discourse analysis. This model is what Deming and Swaffield consider a "logical system," which "attempt[s] to make sense of phenomena and ideas and to place them within a coherent system or order" (Deming and Swaffield 2011). In keeping with the classical argument structure, this stage may be seen as building "claims" or logical support for the project thesis. The conceptual model development was intended to achieve the following:

- *Situate the results of the visual discourse analysis in relation to network visualization outside the field of landscape architecture*

- *Situate the practice of network visualization in relation to other forms of representation*

## VISUAL DISCOURSE ANALYSIS

### *Source material selection*

The methodology began with a visual survey in which a selected body of landscape architectural imagery was evaluated for network depictions. Award-winning projects from the American Society of Landscape Architects (ASLA) national professional


*Figure 4.3: American Society of Landscape Architects competition call for entries.*

awards competition were chosen as the source material for the investigation based on their alignment with the following qualifications: **1)** minimization of project bias, **2)** a robust collection of works, **3)** recognition of quality and standing within the field and **4)** ready and equitable access to all projects. Once selected, this source material was more narrowly defined to include all projects to receive national ASLA professional Awards of Excellence and Honor between the years of 2005 and 2015 in the General, Residential, Analysis & Planning, Communications, Research, and Landmark categories (Figure 4.3). This body of work meets the source material selection criteria in the following ways:

**1)** Bias in selecting works for review was minimized by choosing a set of works curated for their excellence rather than selecting projects completed by a specific firm, or those in a specific location or narrow timeframe. All award-winning projects for the given timeframe were reviewed equally, eliminating any bias that could arise in selecting individual projects for review. Additionally, the inclusion of Research, Communications, and Analysis & Planning categories helped to reduce a bias towards constructed works due to these categories' focus on academic and theoretical works which may display different trends in representation.

Bias may also arise within the awards themselves, however the current project minimizes this effect by selecting a relatively wide timeframe so that industry trends and juror preferences are less relevant. More pervasive and consistent biases may also exist within the ASLA awards, however such biases are part of the expected findings of the project and, as such, are not intended to be minimized within the study. The pervasive nature of ASLA in the field of landscape architecture suggests that any underlying and consistent biases in the awards are likely broadly indicative of the field in general and are thus not only acceptable but appropriate given the current study (see Chapter 6 for further discussion of source material biases).

2) The ASLA awards provide multiple categories from which to draw source materials. Additionally, the availability of many years' worth of archived projects make a robust investigation feasbile.

3) As nationally awarded works by the field's American professional society, it is fair to assume that these projects are well-regarded and represent contemporary views in the field.

4) The ready availability of full submission text and imagery online makes equitable and thorough analysis feasible.

It should be noted that while most, if not all, projects consist of a far greater library of imagery than was submitted to the ASLA awards, it is outside of the scope of this project to evaluate such graphics. Such evaluation would not only be immensely time consuming and inconsistent between projects depending on the availability of source graphics, it would also be unnecessary for the current project. While it is plausible that ignoring this imagery could result in overlooking relevant graphics, the fact that such graphics are not included in the awards submissions is indicative of their standing within the field.



### *Analysis*

The visual discourse analysis was intended to evaluate how frequently contemporary landscape representations depict landscapes as networks either through the strategies outlined by Lima, or through unique means not represented within Lima's framework. Using the ASLA award winning projects from selected categories and years as a representative sample of contemporary landscape representation, graphics were examined for the presence of network depictions. To rigorously evaluate graphics based on this criterion, a comprehensive decision tree was made, increasing the efficiency, consistency, and rigor of evaluation (Figure 4.4).

Evaluation of a graphic using the decision tree

*Figure 4.4: Visualization decision tree used to evaluate award-winning ASLA graphics*

# VISUAL DISCOURSE ANALYSIS

**Body of work under consideration:**

ASLA national professional awards of Excellence and Honor; General, Residential, Analysis & Planning, Communications, Research, and Landmark categories; 2005-2015

**Definition:**

A network is a set of items, which we will call vertices or sometimes nodes, with connections between them, called edges (from Newman 2003).

**Lima's 15 strategies are, as follows:**

arc diagram
area grouping
centralized burst
centralized ring
circled globe
circular ties
elliptical implosion
flow chart
organic rhizome
radial convergence
radial implosion
ramification
scaling circles
segmented radial convergence
sphere

**1. Does the graphic appear to visually depict one of Manuel Lima's 15 strategies?**

a. If yes, answer the following questions:
  i. identify project
  ii. which strategy is it using?
  iii. is it representing a network?
    -If yes, what network?
    -If no, what is it representing?
  iv. what are the "nodes" and what are the "edges"?
  v. where is the information derived from?
  vi. what role does the graphic serve? (didactic, eidetic, etc.)
  vii. is this a stand-alone strategy or is it integrated with other graphics?
b. If no, proceed to 2

**2. Is the image a photograph, projection, perspectival, or textual representation, without visible integration with another representational strategy?**

a. If yes, discard image from study
b. If no, proceed to 3

**3. Does the graphic depict a network using a strategy not classified by Lima?**

a.If yes, answer the following questions:
  i. identify project (in spreadsheet)
  ii. what network is being represented?
  iii. describe the strategy
b. If no, proceed to 4

**4. Is there anything else in the graphic that might allude to a network?**

a. If yes, answer the following questions:
  i. identify project
  ii. what network is suggested?
  iii. what clues regarding the network's presence are visible?
b. If no, proceed to 5

**5. Is the project depicting an intangible characteristic?**

a. If yes, answer the following questions:
  i. identify project
  ii. what is the graphic depicting?
  iii. does the graphic use a standard statistical/ mathematical model (pie chart, bar graph, etc.)?
    -if yes, what?
    -if no, describe the strategy
b. if no, proceed to 6

**6. Answer the following questions about the graphic:**

a.identify project
b.what is the graphic representing?
c.does the graphic use a standard statistical/ mathematical model (pie chart, bar graph, etc.)?
  -if yes, what?
  -if no, describe strategy

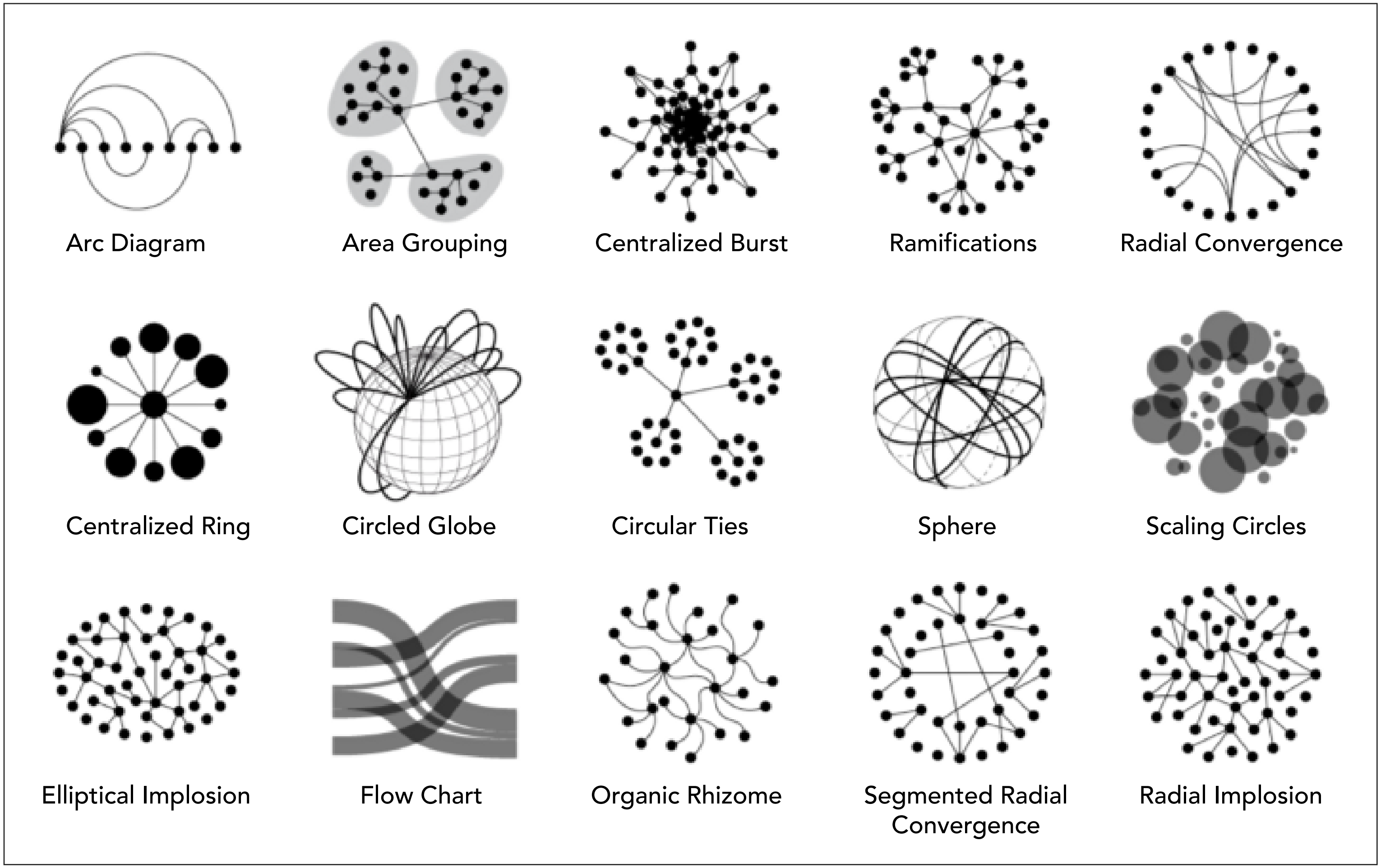



***Figure 4.5:*** *Lima's taxonomy of 15 network visualization strategies (Source: Lima 2011).*

was conducted in the following steps. All images were initially visually evaluated against Lima's 15 network visualization strategies (**Figure 4.5**). This step was specifically intended to address the methodology's first sub-question. Because these strategies represent physical layouts for depicting nodes and edges, the important part of this stage of analysis was the appearance of the graphics, not the content. If an image did use a form consistent with one of Lima's categories, it was recorded and analyzed in greater detail using the questions listed in the decision tree (**Figure 4.4**, step 1). These questions range from objective ("which strategy is it using?") to somewhat subjective or speculative (such as "what role does the graphic serve?") but all are phrased to be answerable in a single sentence from a visual inspection and reading of the image caption. Of note in this section is the question, "Is it [the image under consideration] representing a network?" This question was generated in anticipation of the possibility that a graphic might use a form consistent with one of Lima's strategies to depict something other than what the project defines as a network.

For graphics that did not visually depict a strategy from Lima's taxonomy, the image was screened for basic graphic relevance to the project (**Figure 4.4**, step 2). If it was a photograph or orthographic projection, it was discarded from the study, unless it was visibly integrated with other representational strategies. Such other representational strategies were required to be novel in their own right; for example, an annotated plan with photo callouts would not meet the criteria since neither of the integrated strategies were a non-projection-based image. Generally speaking, unless an image conveyed more than scaled and/or annotated spatial layout information, for the purposes of the current project it was eliminated from further consideration. This step was considered both necessary for project feasibility and appropriate to the project's focus on intangible and non-spatial representations.

Images that did not depict one of Lima's graphic strategies but that passed the graphic relevance screening in step 2 were passed on to step 3. This step was directed at the second sub-question which evaluated whether a network was being depicted in a way that did not conform to any of Lima's strategies. Due to the unpredictable nature of the results, the questions for this stage were more open-ended and relied more heavily on description than did the questions in the first step (**Figure 4.4**, step 3).

Images that did not depict a network in step 3 were passed on to step 4 (**Figure 4.4**, step 4). This step functioned as a final filter to assure that biases in wording or structure of the analysis did not eliminate valid imagery. It was anticipated that this step would elicit very few results, but it was included to assure that no network-related references were overlooked. While such clues could take any form, it was anticipated that such indicators would be seen in textual annotations since the first two steps should have picked up the vast majority of graphic network depictions.

It should be noted that the first three steps were sufficient to answer the researchable question and sub-questions and that from step 4 onward all information gathered was purely intended for discussion. It should also be noted that the set of graphics found to indirectly reference or depict a network may not be comprehensive, as some graphics that meet this criteria may have been eliminated during the initial screening step (such as if a plan had textual annotations that discussed a network). This is outside the scope of the current project, but should be considered if results of this works are used to inform future studies.

Though outside the scope of the methodology's research questions, the broader discussion engaged by the project speaks to the representation of intangible landscape elements and the use of non-spatially explicit imagery for depictions of landscape. Graphics that were flagged as non-photographic, non-orthographic imagery were recorded in steps 5 and 6 of the decision tree (**Figure 4.4**, steps 5 and 6). Because these graphics were already flagged by the methodology, recording the graphic type and the aspect of landscape they were used to represent provided significant information for discussion with minimal additional methodological procedure. As with step 4, these responses were not directly related to answering the project's research questions, but contribute valuably to the potential discussion of results.

### *Classification and compilation of results*

Results from the first phase of the methodology take two forms, 1) written responses to the research question and its constituent sub-questions, and 2) a preliminary Network Visualization Taxonomy for Landscape Architecture modified from Lima's and based on the conducted analysis. In addition to these finished products, the compiled data from the visual discourse analysis was used to inform and direct the development of the conceptual model.

## CONCEPTUAL MODEL DEVELOPMENT

### *Design*

The conceptual model development, in keeping with the classical argument format of the project, helps to generate claims that reinforce the thesis. The conceptual model is based on the key landscape graphic characteristics of tangibility and spatiality. These characteristics emerged within the visual discourse analysis as two major distinguishing factors in the graphic strategies used to depict landscapes. The basis for the conceptual model is a standard biaxial scatter plot that allows visualizations to be situated within the field based upon these two characteristics.

Tangibility, here defined as the quality of having a physical existence, refers to the kind of data or information being conveyed in a graphic. Images may convey tangible features of landscape (materials, structures, plants, etc.) intangible features (moods, historical influences, nutrient cycling, etc.) or features that have both tangible and intangible characteristics (circulation, bloom time, etc.). Network nodes, edges, and the space in which they occur may each be more or less tangible; for this reason tangibility is best discussed as a spectrum. Within this project, these three variables of nodes, edges, and space were considered together, creating the following four degrees of tangibility: mostly tangible (3 tangible variables), somewhat tangible (2 tangible variables and 1 intangible variable), somewhat intangible (1 tangible variable, 2 intangible variables), and mostly intangible (3 intangible variables). For example, people are tangible, but chat messages are intangible and occur in intangible cyberspace. Thus, based on the classification scheme, online chat messages represent a "somewhat intangible" network.

Spatiality refers to the way space in the graphic is used in relation to external space. Graphic spatiality may reference external space (here referred to as "explicit"), may be a scalable indicator of another factor (here referred to as "internal"), or may be inconsequential to the graphic's meaning (here referred to as "nonspatial"). A map, for example, is explicitly spatial, with distances and sizes in the graphic directly referencing distances and sizes in the real world. A pie chart is internally spatial; the relative size of segments conveys meaning, but does not correspond to external space. A family

# CONCEPTUAL MODEL

**Bodies of work under consideration:**

1) Set of 90 graphics from *Visual Complexity*, selected by Lima as representative of the 15 network visualization strategies

2) 16 ASLA graphics found through visual discourse analysis to utilize one of Lima's 15 network visualization strategies

**Spatiality:**
the way space in the graphic relates to external space

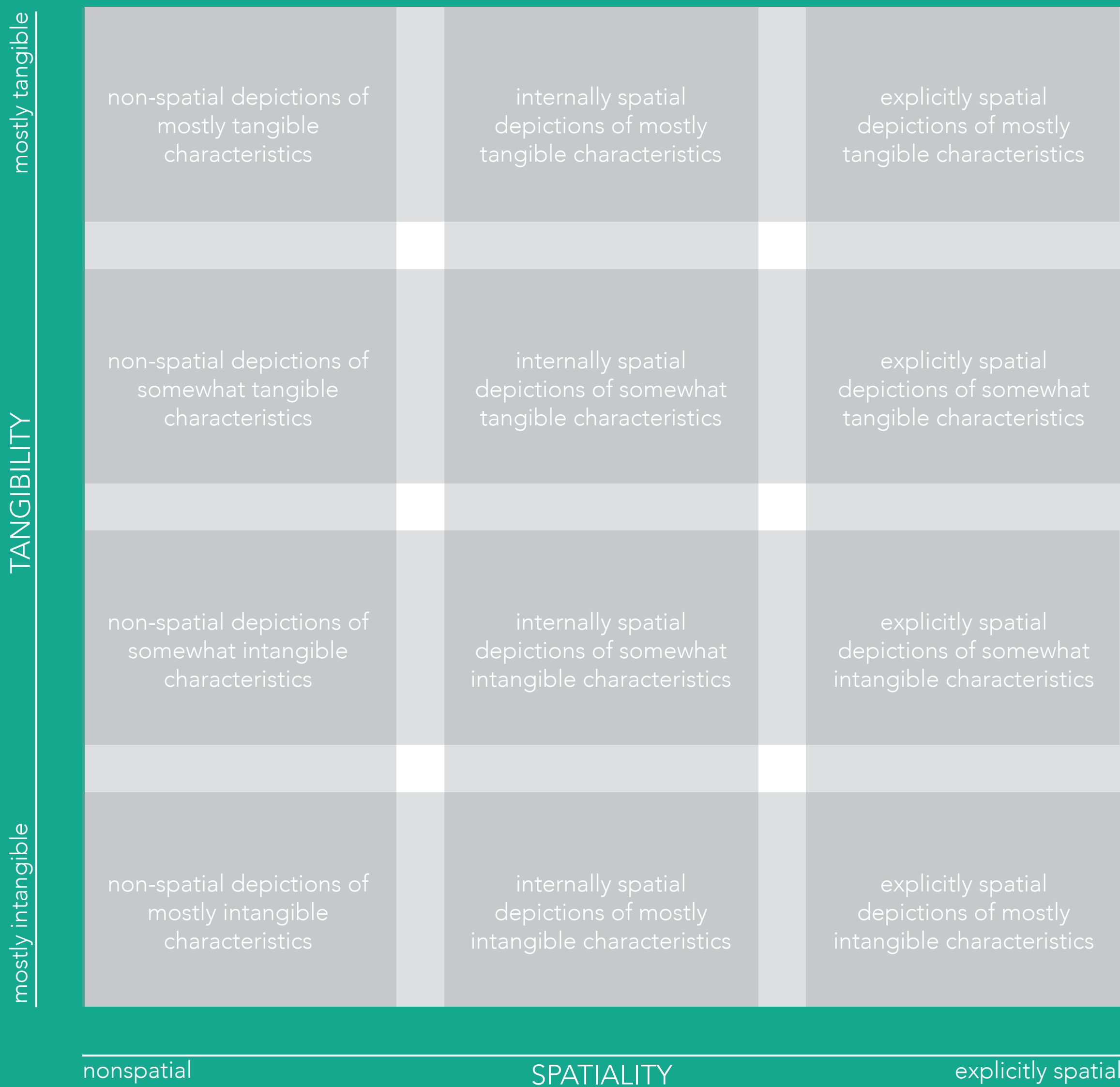
**explicit:** specifically references external space
**internal:** scalable indicator of nonspatial info
**nonspatial:** inconsequential to meaning

**Tangibility:**
the quality of having a physical existence, referring to the kind of information being conveyed

mostly tangible: 3 tangible variables
somewhat tangible: 2 tangible variables
somewhat intangible: 2 intangible variables
mostly intangible: 3 intangible variables



***Figure 4.6:*** *The conceptual model plots graphics based on the characteristics of tangibility and spatiality.*


mostly tangible
TANGIBILITY
mostly intangible
non-spatial depictions of mostly tangible characteristics
internally spatial depictions of mostly tangible characteristics
explicitly spatial depictions of mostly tangible characteristics
non-spatial depictions of somewhat tangible characteristics
internally spatial depictions of somewhat tangible characteristics
explicitly spatial depictions of somewhat tangible characteristics
non-spatial depictions of somewhat intangible characteristics
internally spatial depictions of somewhat intangible characteristics
explicitly spatial depictions of somewhat intangible characteristics
non-spatial depictions of mostly intangible characteristics
internally spatial depictions of mostly intangible characteristics
explicitly spatial depictions of mostly intangible characteristics
nonspatial
SPATIALITY
explicitly spatial

tree is an example of a typically nonspatial graphic technique. The lines connecting family members are of crucial importance but their orientation, length, and arrangement, as well as the size of the text and symbols used to denote individuals, is irrelevant to the meaning of the graphic (though it can certainly affect legibility). The conceptual model plots graphics over these 3 degrees of spatiality and 4 degrees of tangibility, producing a total of twelve possible combinations (**Figure 4.6**). This model is not specific to graphic type and can be used to classify and categorize any image. By plotting these characteristics spatially, the conceptual model is designed to definitively reveal graphic trends in relation to these two critical variables.


***Figure 4.7:*** *A spread from Lima's collection of imagery shows several examples of the elliptical implosion strategy (Source: Lima 2011).*

### *Application*

The conceptual model was applied to two data sets, a library of images classified by Lima within his taxonomy, and the imagery collected in the first step of the visual discourse analysis. Each of these data sets was plotted within the model separately, allowing for comparison between them. Lima's graphics provide a general context for visualization strategies and also serve as a source of comparison for the results of the visual discourse analysis. The results of the visual discourse analysis are contextualized by the model and display landscape architecture-specific trends in network visualization.

Lima's catalogue of visualization strategies found in *Visual Complexity* was used as source material for the analysis. Each of Lima's 15 strategies was represented by at least 4 visualizations for a total of 90 unique visualizations (**Figure 4.7**). Each visualization was plotted within the model based on the tangibility embodied and spatiality employed. This classification was conducted to show trends and preferences in network visualization across fields. It can serve both as an indicator of what network visualizations tend to be used to represent as well as the difference in usage between strategies. This is valuable for a greater understanding of the functionality of network visualization in general but within the context of this project it is especially valuable for providing a source of comparison for the trends seen within landscape architectural graphics.

The network visualizations found in the ASLA awards were also plotted within the model.[2] On its own, these results provide a snapshot of the preferences and trends in landscape architectural network visualization. This classification was then compared to the first plot featuring Lima's strategies. When compared to the works of Lima it provides a valuable juxtaposition between the use of network visualization in landscape architecture and in other fields.

## METHODOLOGICAL OUTCOMES

### *Purpose of Findings*

The methodology was conducted to build support for the project's argument, that landscape architects focus more on physical form than on intangible landscape qualities such as connection in their visual representations. The methodological results serve as one piece of data to aid in building this argument, not as a confirmation or rejection of this premise outright.

The results derived from the visual discourse analysis demonstrate the frequency with which landscape architects depict the landscapes they design and study as networks. Based on Catherine Dee's assertion that our ways of representing influence the way we think about and create landscape this, in turn, may indicate the degree to which landscapes are actually comprehended and designed as networks by landscape professionals and academics (Dee 2004). More broadly, when combined with the conceptual model, this may serve as an indicator of the field's representational biases, and may speak to the graphic treatment of intangible landscape qualities. This could also help to illuminate the degree of connection between theoretical concepts and actionable understanding within the field. Importantly, this project is intended to set the stage for future investigations into biases in landscape representation as well as the relationship of landscape architecture to cutting edge science and new media.

It should be noted that while the narrative of the project is based on the premise that landscape architects rarely depict intangible aspects of landscape systems such as network connections, this is not a given outcome of the methodology. While it would be highly unexpected, results that indicate the frequent use of landscape network visualizations within the field would provide an equally valid, though different, outcome worthy of discussion. Such an outcome would suggest that the breakdown lies not between conceptualization of landscapes as networks and their representation, but between representation in practice and the codified traditions of our field.



***"The way landscape architects make images influences both what and how places are conceived and made."***
***-Catherine Dee***

## Endnotes

[1] *Deming and Swaffield provide the following description for discourse analysis: "Discourse analysis (Potter and Wetherell 1994; Potter 2004; Paltridge 2007) is focused upon interpreting the ways that meaning is expressed through word and text. Its purpose is to seek out and better understanding (sic) the content and meaning of discourses within a community or in some wider part of society. . .Discourse analysis starts from the premise that our knowledge and experience of landscape and landscape practice is "constructed" by the way we talk and write about it (Greider and Gardovitch 1994). From this it follows that there are distinctive patterns of discourse—that is, different ways of talking and writing. There are also different fields of discourse—sets of interrelated ways of talking and writing (such as those within the discipline of landscape architecture itself). If the patterns and fields can be identified and better understood, it is argued, they can provide insight into many of the practical issues we face, as well as into the assumptions and values that shape our responses."*

[2] *One of these 16 visualizations utilized a blend of two strategies. Each*

*each of these two strategies were plotted separately, resulting in 17 total plot points.*

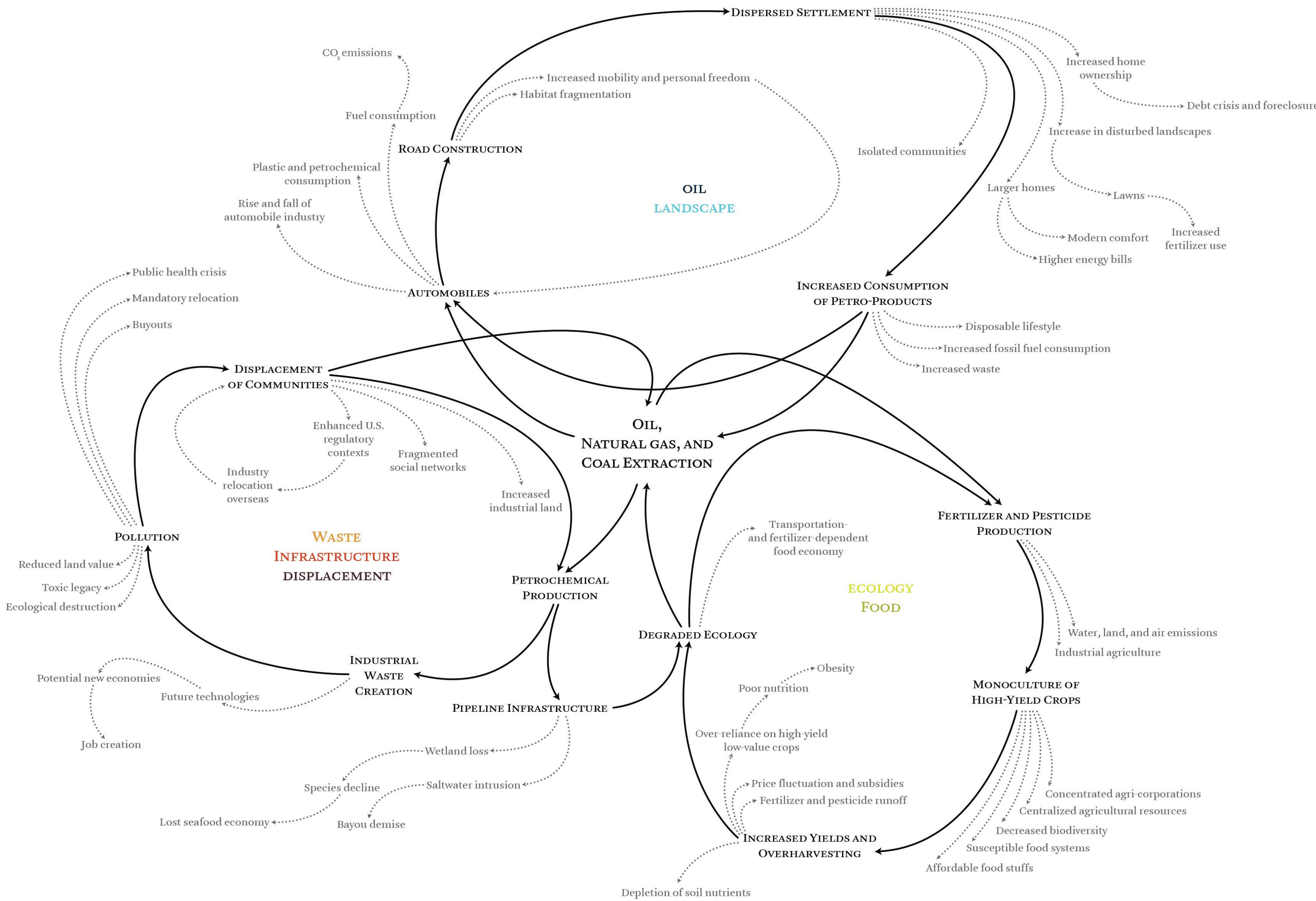



*Figure 5.1:* One of only 25 total graphics found to reference a network in the ASLA awards (Source: Kate Orff and Richard Misrach).

# 5. CONFIRMATION *presentation of results*

## RESULTS IN CONTEXT: THE ARGUMENT

While there has been significant call within landscape architectural theory for more diverse approaches to representation, the evidence for the field's reliance on limited and conventional graphics is generally anecdotal. The visual discourse analysis and conceptual model development conducted within this project contribute a rigorous examination of graphic practices within the field and provide solid evidence in favor of such anecdotal speculations. Within the project's argumentation structure, the results derived from conducting the project methodology help to provide a robust and rigorous confirmation for the project's argument.

Through a comprehensive examination of the graphics used in award-winning landscape architectural projects over the past decade, the project builds a confirmation of its argument, that landscape architectural graphics overwhelmingly preference the depiction of physical space and tangible characteristics over other landscape qualities. Specifically, the examination confirms that strategies of network visualization common across diverse disciplines are a useful way to depict non-spatial and intangible phenomena, but are nearly absent within landscape architecture (**Figure 5.1**).

## RESULTS: VISUAL DISCOURSE ANALYSIS

### *Overview*

As outlined in Chapter 4, the visual discourse analysis was designed to specifically address the research question, "To what degree are landscape architects graphically representing the networks present within the landscapes they study and design?" through a structured analytical lens. This question also contained two subquestions, 1) "To what degree are landscape architects utilizing common conventions for network visualization from outside of the field to communicate or investigate landscape?" and 2) "Are there any common strategies used by landscape architects for representing networks that are not documented in visualization literature outside of the field?" Using a comprehensive decision tree (see **Figure 4.4**) to consistently and rigorously evaluate images, the methodology examined the graphic strategies employed in ASLA award winning projects. The results of the visual discourse analysis include the following:

- *Answers to the research question and*

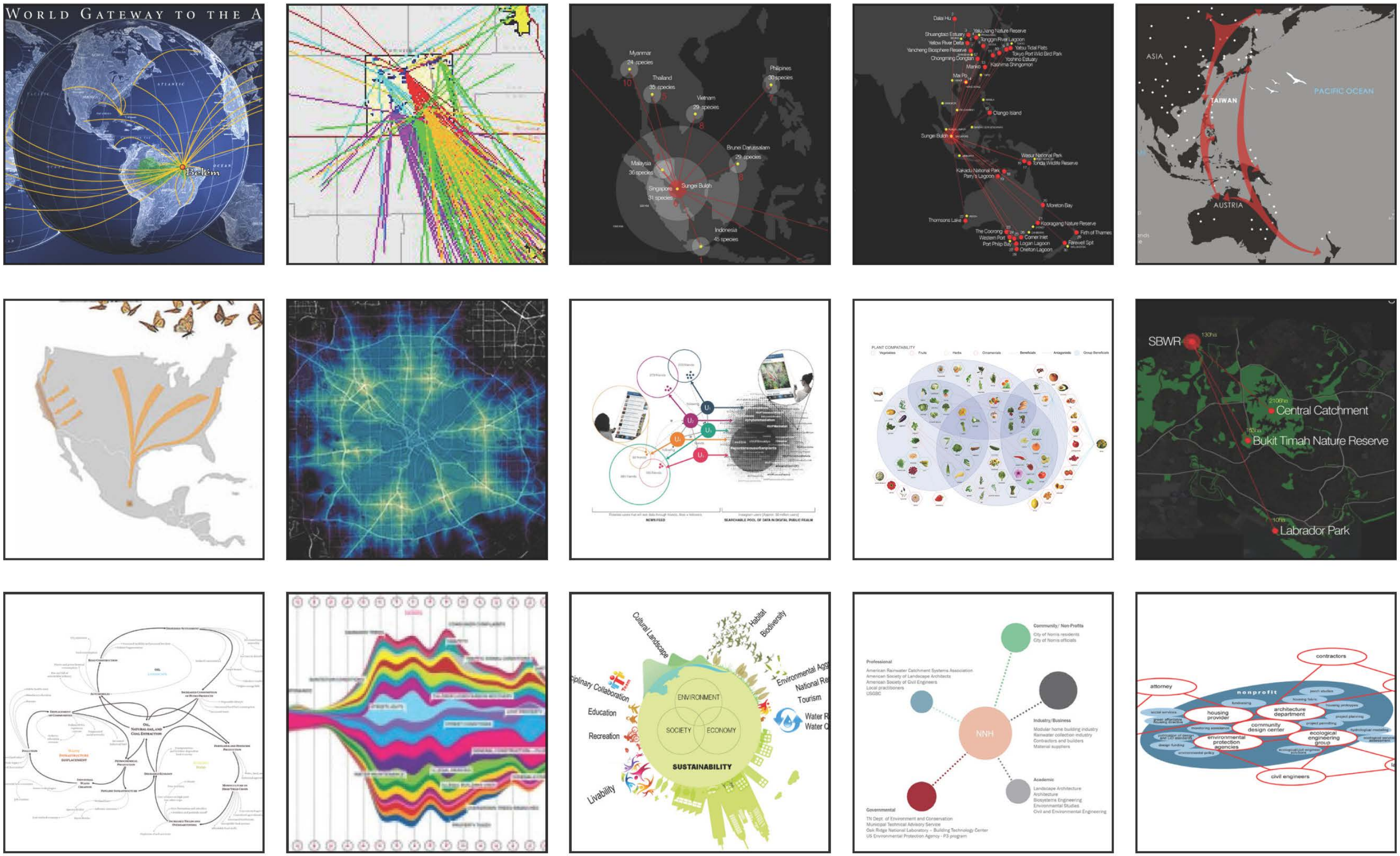



*Figure 5.2:* *Fifteen graphics using one of Manuel Lima's visualization strategies were found within ASLA awards (Sources:* ***Top Row:*** *Morris Architects; Paul H. Gobster and Robert G. Haight; Lim Chu Kang; Lim Chu Kang; Lim Chu Kang;* ***Middle Row:*** *Kathleen John-Alder; Mia Lehrer + Associates; Future Green Studio; Visual Logic; Lim Chu Kang;* ***Bottom Row:*** *Richard Misrach and Kate Orff; Sarah Peck; Beijing Tsinghua Urban Planning & Design Institute; University of Tennessee College of Architecture and Design; University of Arkansas Community Design Center).*

*subquestions*

- *A network visualization taxonomy specific to current practice in landscape architecture to reveal preferences and gaps in landscape architectural network visualization strategies*

In addition to explicitly addressing the methodology's research questions regarding network visualization specifically, the examination also produced significant data worthy of discussion regarding the field's general graphic practices in terms of both graphic strategies and graphic content.

### *Sub-question 1: To what degree are landscape architects utilizing common conventions for network visualization from outside of the field to communicate their work?*

Of the 406 projects reviewed, only 13 projects utilized graphic conventions that could be categorized within Lima's framework, producing a total of 16 applicable graphics (**Figure 5.2**). These graphics will be referred to as "classic visualizations" for the duration of the project. Of these 16 graphics, 14 depicted concepts or systems that could be considered networks, while two of them utilized graphic conventions reminiscent of Lima's strategies but applied them to other phenomena. Additionally, of the 14 graphics depicting networks, eight of these were spatially or physically explicit while six were non-spatially explicit representations (**Appendix A**).

Of the network strategies utilized, the circled globe was by far the most popular, accounting for eight of the 16 visualizations. This is the only explicitly spatial strategy included in Lima's framework although it can be used to depict non-tangible connections in addition to explicitly physical ones. Of these graphics, several were modified versions that did not show full globes but were more limited in extent. In half of these cases the strategy was used to represent physical phenomena or movement rather than non-tangible aspects.

The source of the data used to generate the visualization is not specified in 10 of the 16 graphics. Furthermore some are clearly not data-derived at all, such as the Beijing Tsinghua Urban Planning & Design Institute's graphic depicting project goals (**Figure 5.3**). This is a marked departure from the majority of the graphics catalogued by Lima, which often (though not always) draw on sizable and well-documented datasets as source material.

It was noteworthy that both nodes and edges were not explicitly present in all graphics. Even in images that did graphically represent both nodes and edges, the relevance of one or both was not always specified. For example, the global visualization found in Morris Architects' 2006 project Parque Amazonia is perhaps the most obvious example of Lima's circled globe strategy found within the ASLA awards, but the relevance of the edges, depicted as arcing lines connecting cities, is unclear (**Figure 5.4**). Whether physical, economic, social,

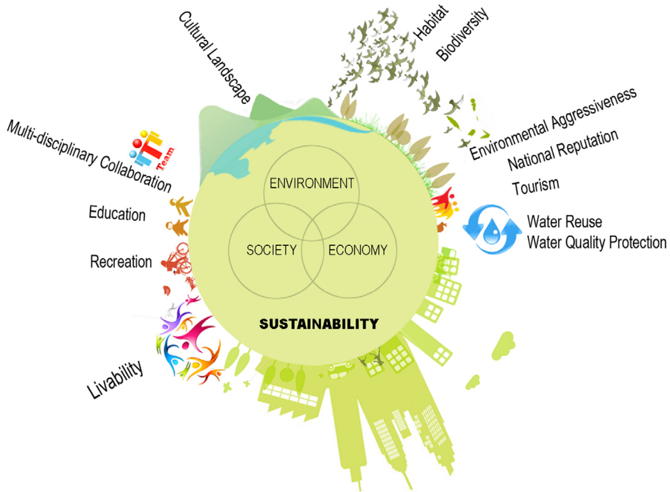




*Figure 5.3 (above): It is unclear if this project goals visualization is based on actual data (Source: Beijing Tsinghua Urban Planning & Design Institute).*
*Figure 5.4 (below): Reminiscent of Lima's circled globe, this graphic lacks discernible meaning (Source: Morris Architects).*
*Figure 5.5 (right): Seven graphics use strategies outside Lima's taxonomy to visualize networks (Sources: See footnotes).*[1]

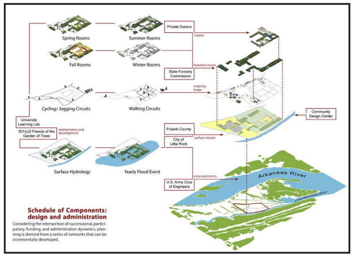
or theoretical connections, neither the caption nor the graphic itself reveal.

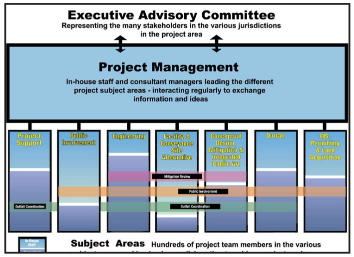
It is further notable that the 16 graphics were not evenly distributed across awards categories. While six categories were examined, "classic" visualizations only appeared in three of these categories, Research: Communications, and Analysis and Planning. Eight of the graphics were found in the Analysis and Planning category, a trend which was mirrored more broadly in the full set of graphics to make it past the initial screening step.

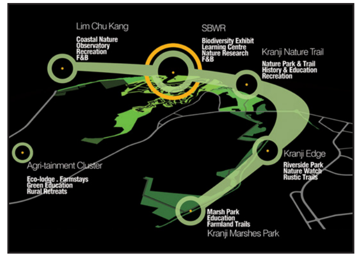
These results suggest that landscape architects rarely utilize common conventions for depicting networks when representing landscape. When they do so, they tend to preference spatially explicit strategies over those that are not spatially explicit. Furthermore, such graphics are not typically used to develop or communicate built professional projects but tend to be used in academic, theoretical, and analytical works.

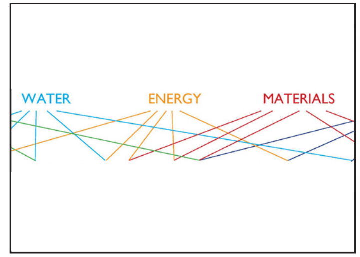
### *Sub-question 2: Are there any common strategies used by landscape architects for representing networks that are not documented in visualization literature outside of the field?*

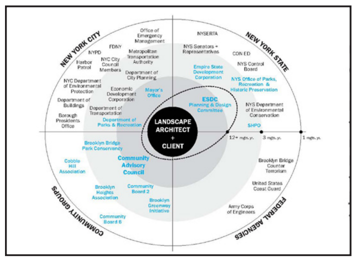
In addition to the 16 "classic" visualizations, another 7 graphics depicted something that could be perceived as a network using strategies that differed from those described by Lima (**Figure 5.5**). These graphics will be referred to as "novel visualizations"

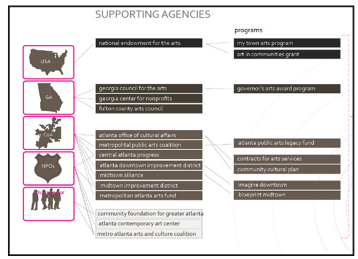











for the duration of the project. While these techniques varied significantly, a flowchart-like structure was the most common, seen in 3 of the projects. Even so, the approach to such flowcharts differed dramatically and it would be hard to consider these graphics to use a common strategy (Appendix B).

The small number of projects in this category and their obvious graphic differences imply that landscape architects have not developed their own strategies for depicting networks outside of the common conventions used outside of the field. As with the "classic" visualizations, "novel" visualizations were not evenly distributed across award categories. Analysis and Planning was again the best-represented category, featuring 6 of the 7 projects. The final project was found in the research category, which is also consistent with the "classic" visualization results.

***Research Question: To what degree are landscape architects graphically representing the networks present within the landscapes they study and design?***

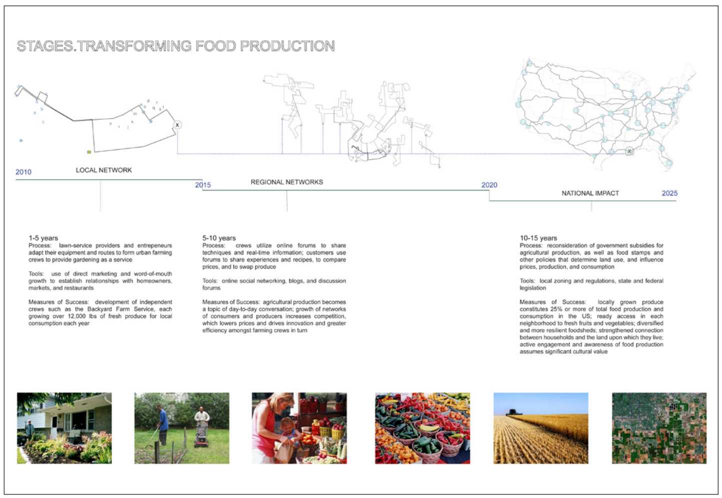
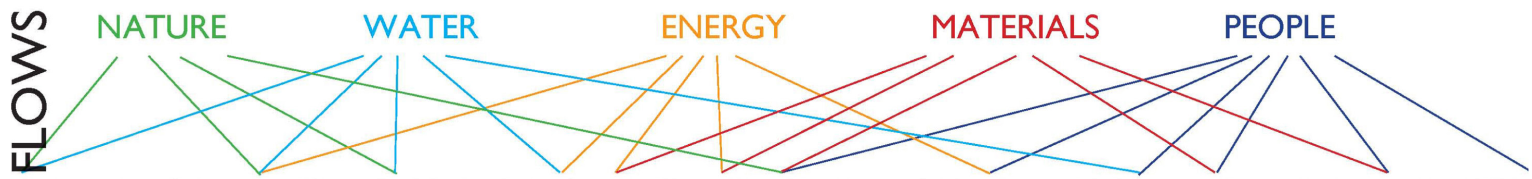



***Figure 5.6 (right):*** *This graphic superficially represents a network but contains no actual information (Source: Ken Smith Workshop West and Mia Lehrer + Associates).*
***Figure 5.7 (above):*** *Captions in this annotated timeline reference networks repeatedly (Source: Visual Logic).*

While the scope of this study is restricted to ASLA award-winning projects within the past decade, it is reasonable to conclude from the results of this study that network visualization does not occupy a prominent position within the field of landscape architecture. 406 total projects were examined in their entirety, with each project including up to 15 images.2 Of these approximately 5,000 distinct graphics examined, only 23 graphically depicted or textually referenced networks of any kind. Furthermore, of those 23 graphics, 10 of them were spatially explicit, suggesting minimal departure from landscape architectural conventions.

A common trend that emerged in both “classic” and “novel” visualizations was a superficial adherence to network depiction trends without explicit meaning behind the graphic convention. For example, the design for the Orange County Great Park by Ken Smith Workshop West and Mia Lehrer + Associates, includes a network depiction entitled “Flows” (**Figure 5.6**). This graphic initially appears as a straightforward depiction of a simple network with explicit depictions of nodes (text) and edges (colored lines). A closer inspection, however, gives no clues as to the quality of connection represented by the edges. This situation is further confused by the connection of edges to other edges. Additionally, these edges connect each node to every other node without distinction, sometimes twice. Through a superficial application of graphic conventions for showing nodes and edges, the “Flows” diagram



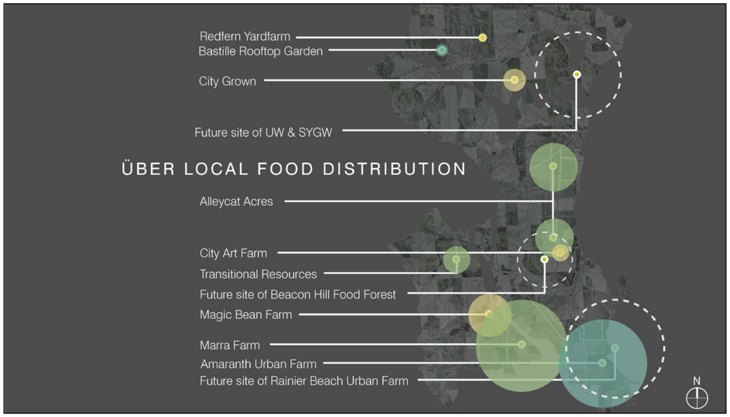

is an example of a formal interpretation of network visualization that fails to embody the data-richness of the strategy's source.

Only two projects were found to reference a network without attempting to depict it (**Appendix C**). The first is from Visual Logic's project "Backyard Farm Service: A Business Plan for Localizing Food Production" (**Figure 5.7**). This graphic employs a timeline structure with diagrammatic plans illustrating phases in time. On its own, such a graphic would not suggest a network, however image captions repeatedly acknowledge the presence of networks.

The second of these graphics was found in Berger's Partnership's 2012 research project "Productive Neighborhoods: A Case Study Based Exploration of Seattle Urban Agriculture Projects" (**Figure 5.8**). Scaled and colored circles within the graphic suggest that some nonspatial information is being conveyed by the graphic, but it would not be picked up by the decision tree until step five without the caption's specific reference to a network. Such a graphic highlights the misalignment in theoretical understanding and physical depiction that permeates the relationship between landscape architecture and networks.

There are striking similarities between this graphic and those from "The Sungei Buloh Wetland Reserve Master Plan" by Lim Chu Kang, which was flagged in step 1 (**Figure 5.9**). In both cases, physical locations are depicted with the use of geo-located circles. In "Productive Neighborhoods", Berger Partnership draws on Lima's "scaling circles" strategy though it is unclear whether this is purely a visual choice or whether it embodies data. Lim Chu Kang's graphic, seemingly less dependent upon scale, blends characteristics of Lima's "centralized ring" strategy which functions around a central hub with the "circled globe" strategy for showing geographic connections. While the Berger Partnership graphic does not depict the connections shown by Lim Chu Kang, the edges in the Sungei Buloh graphic have little explicit meaning, suggesting that, despite apparent differences, these graphics function similarly.

Taken together, the survey of both "classic" and "novel" network visualizations in landscape architecture suggests that landscapes are rarely depicted as networks of connections. The presence of several network



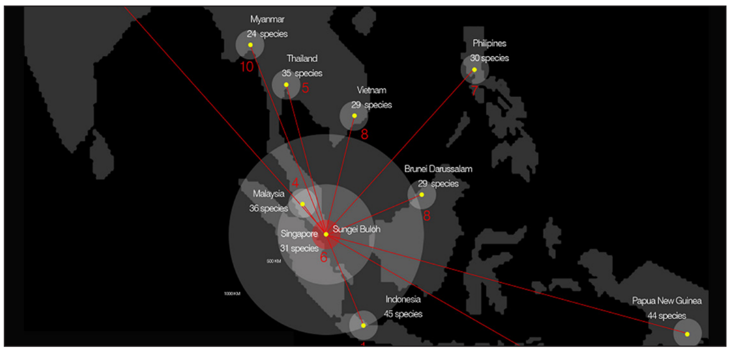




***Figure 5.8 (above):*** *Though explicitly referencing a network in the caption and using graphic conventions reminiscent of Lima's "scaling circles" strategy, this graphic contains no depiction of connections (Source: Berger Partnership).*
***Figure 5.9 (below):*** *Unlike Figure 5.8, this graphic depicts edges, though their characteristics are not elaborated upon (Source: Lim Chu Kang).*

depicting graphics do, however, suggest that these strategies are not wholly misaligned with the field, but rather that they have not been embraced as a common part of landscape architectural practice.

## *Landscape Architectural Network Visualization Taxonomy*

Manuel Lima has generated a preliminary taxonomy for the current state of network visualizations broadly across fields. As described by Lima, "this embryonic and evolving taxonomy provides a portrait of the current state of the practice and reveals the initial building blocks shaping a new visual language" (Lima 2011). Lima's taxonomy was modified based on the results of the visual discourse analysis to reflect the current state of network visualization within landscape architecture specifically (**Figure 5.10**). This taxonomy is intended to be descriptive of current practice and is not intended to be proscriptive of specific future directions.

Of the 15 strategies within Lima's taxonomy, eight were found within the surveyed landscape architectural works. The circled globe accounted for half of all such visualizations, and no other strategy was found more than twice. This taxonomic representation highlights the significant gaps in landscape network visualization when compared with the broader array of strategies utilized outside the field. It also displays the unevenness of usage among even those strategies adopted by the field. The limited number and disparate nature

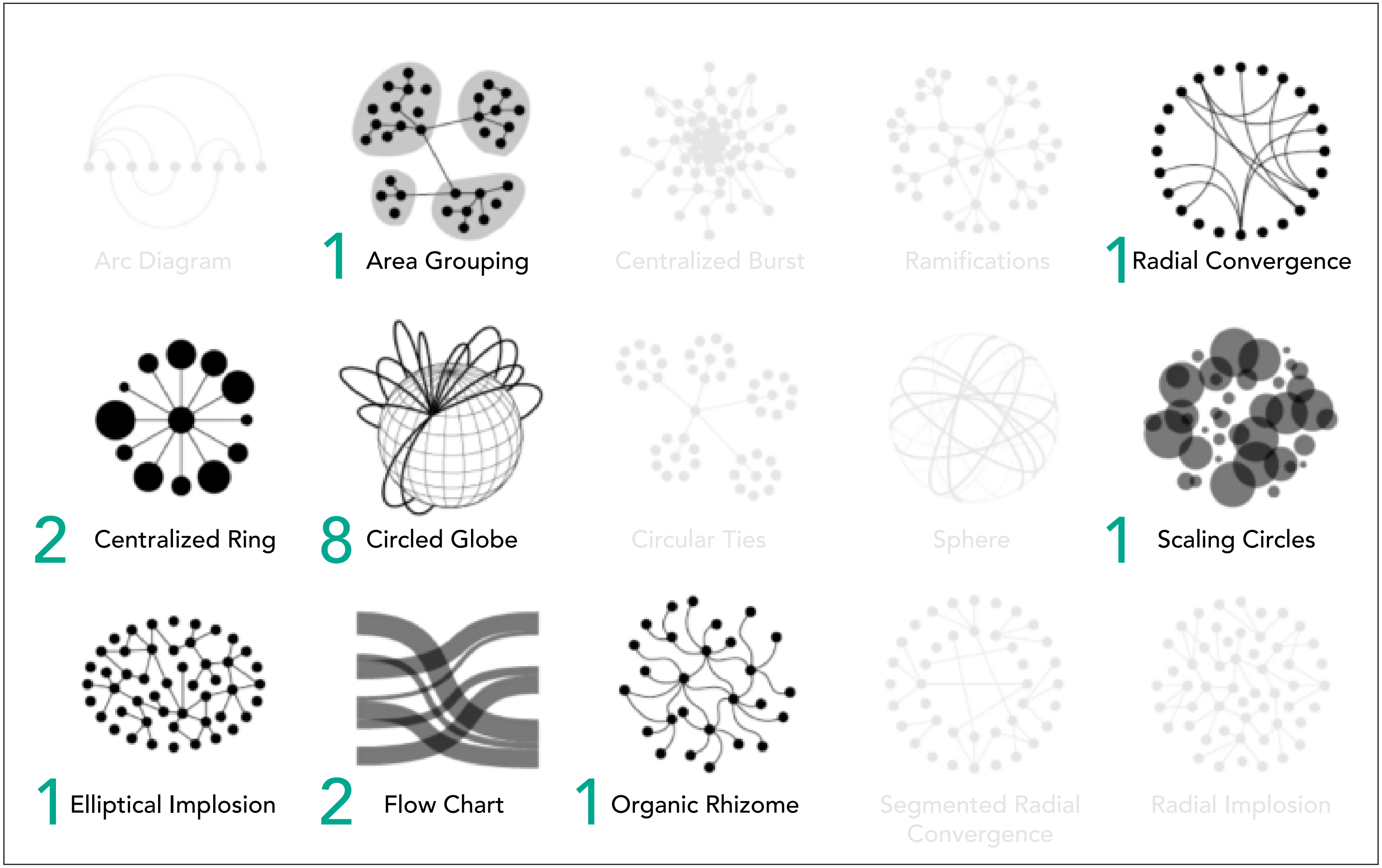



*Figure 5.10: Lima's taxonomy was revised based on the visual discourse analysis to represent the current state of network visualization in landscape architecture.*

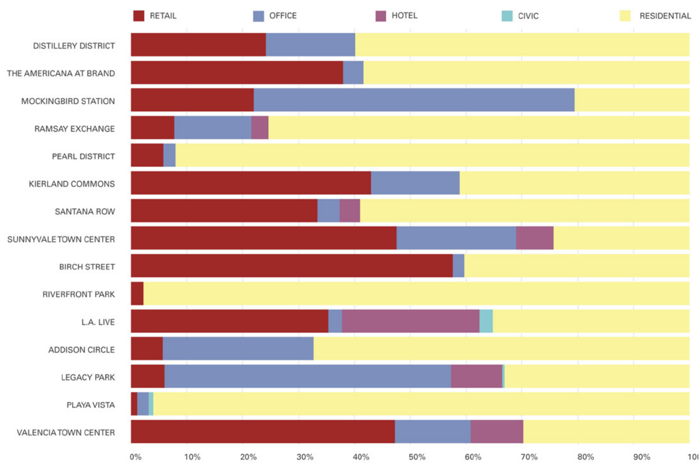



***Figure 5.11 (right):*** *This section transcends tangible concerns by depicting mood and experience (Source: West 8 Urban Design & Landscape Architecture, P.C.).*
***Figure 5.12 (above):*** *Many graphics used statistical conventions (Source: RTKL Associates Inc.).*

of "novel" visualization strategies make the addition of any landscape-specific strategies to the taxonomy impractical.

## *Additional Data*

While an in-depth analysis of graphics that did not depict or reference networks was outside of the scope of inquiry, the methodology resulted in a significant library of imagery that depicted intangible qualities, employed non-spatial tactics, or, in some cases did both. These images were recorded and described in steps 5 and 6 of the decision tree (**Appendix D and E**).

These results provide general insights into graphic trends and conventions and provide further background for discussing results. Seventy-five graphics were found to depict intangible landscape characteristics. Of these, 59 used conventions from statistics or the natural sciences including: bar graphs, line graphs, flow charts, pie charts, scatter plots, timelines, wind roses and solar path diagrams. Twenty-four graphics used non-mathematical/scientific strategies for doing so.[3] While many of the intangible elements portrayed were biophysical in nature, some of these graphics also attempted to capture elements of site experience, social systems, and time (**Figure 5.11**). The breadth of intangible characteristics portrayed, even in a small sample size, suggests that such graphics could be a worthy subject of future investigation.

The final step in the decision tree recorded


graphics that were retained for the study because they were not projection-based, but were not found in earlier steps to depict networks or intangible characteristics. This body of work included 96 graphics. Of these graphics, 88 were found to utilize conventional statistical or scientific strategies described above (**Figure 5.12**). 23 used other graphic strategies, most commonly non-spatial infographic depictions.[4]

These results are useful in providing more general information regarding non-network-specific graphics. While these results fall outside the methodological inquiry into networks, they are relevant for the broader argument of the project. Such information is intended as supporting evidence of the more rigorous investigation but does not itself constitute defensible claims as it has not been thoroughly analyzed. This data may be a fruitful source of further information and is intended to support and inspire future investigations.

## RESULTS: CONCEPTUAL MODELING

The second part of the methodology, the development of the conceptual model, was aimed at contextualizing the results of the visual discourse analysis in the broader context of graphic representation and network visualization. The creation of this model provides both a lens to understand the roles of individual landscape architectural graphics, as well as a defensible structure for highlighting specific gaps in landscape representation.

The conceptual model was developed based on the two key parameters of data tangibility and graphic spatiality. Landscape architectural graphic

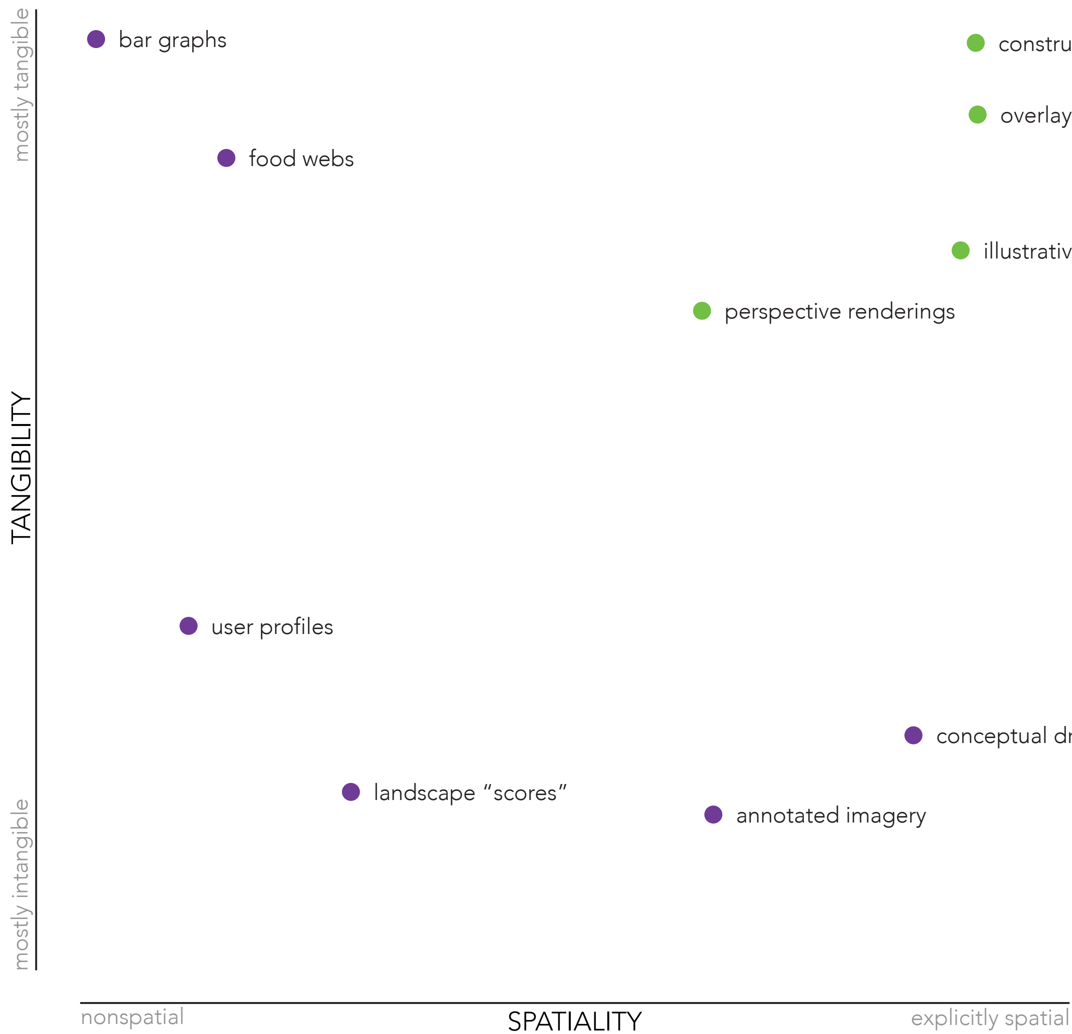



*Figure 5.13: Landscape architectural graphics tend to focus on depicting tangible characteristics in spatially explicit ways (common conventions are shown in green, other strategies found within the field are depicted in purple).*

standards tend to preference tangible qualities and spatially explicit depictions over non-spatial and intangible qualities and representations. Conventions such as perspective renderings, overlay mapping, and construction documentation all fall within this category (**Figure 5.13**). While it has been an assumption of the project that Lima's graphic strategies depart from the familiar graphic conventions of landscape architecture, the conceptual model was developed in part to help explain the qualities of this departure.

### *Application: Lima's Taxonomy*

Ninety graphics representing all 15 of Lima's classified network visualization strategies were mapped within the conceptual model. Each visualization was plotted based on its spatiality and tangibility (**Figure 5.14**). Colors correspond with particular visualization strategies and circle size indicates the proportional number of visualizations.

As the conceptual model displays, the network visualization strategies classified by Lima appear especially applicable to representing intangible information in ways that are not explicitly spatial.[5] Non-spatial and internally spatial graphics are much more common among these visualizations than are explicitly spatial strategies. Both intangible and tangible data are represented relatively equally, though there is a clear bias towards using spatially explicit methods for representing tangible qualities.

It is notable that certain strategies seem to be more well-suited to certain degrees of tangibility and spatiality. The segmented radial convergence seems almost inherently non-spatial and is much more strongly correlated with intangible data. The circled globe on the other hand is typically explicitly spatial and is most frequently used to depict physical characteristics. The distribution of examples throughout all portions of the plot indicates the diverse applications of network visualization and clearly displays that such strategies are broadly and consistently applicable to non-spatial and intangible information.

It should be noted that the 90 visualizations were chosen by Lima for their quality as examples of graphic strategies and range across topics and disciplines. Thus, internal bias in regards to spatiality and tangibility is unlikely to be present. Should bias exist, its effect would be to over or under-represent the relative prevalence of certain spatiality/tangibility combinations. Even if this were the case, it would not diminish the most crucial contribution of the model, the visual confirmation that network visualization can be, and is, used to depict intangible qualities non-spatially.

### *Application: ASLA results*

To contextualize the results of the visual discourse analysis, the 16 "classic" network visualizations found within the ASLA award-winning projects were plotted within the conceptual model framework (**Figure**


*Figure 5.14: 90 examples spanning Lima's 15 network visualization strategies were plotted by spatiality and tangibility. Color corresponds with particular visualization strategies and circle size indicates the proportional number of visualizations.*

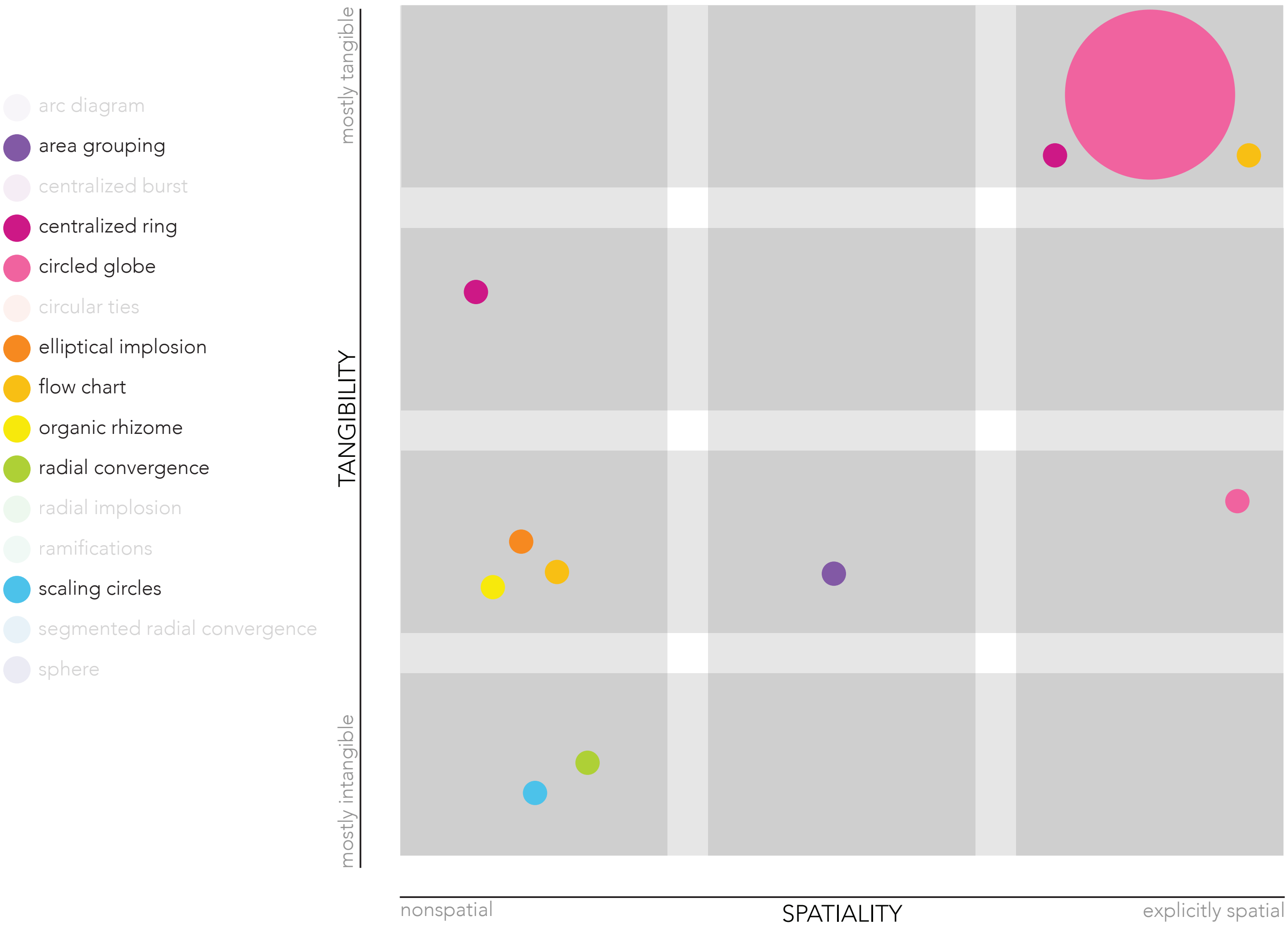



*Figure 5.15: "Classic" visualizations from the ASLA visual discourse analysis were plotted by tangibility and spatiality. Color corresponds with particular visualization strategies and circle size indicates the proportional number of visualizations.*

5.15). Though not universally true, the majority of visualizations were both explicitly spatial and physically tangible. Five visualizations utilized non-spatial strategies to depict intangible phenomena, indicating that, while not common, such strategies have potential use within the field. It is notable that in no cases were spatially explicit graphics used to represent intangible phenomena; similarly, tangible information was not depicted non-spatially.

Although the ASLA sample size was more limited, its distribution differed substantially from the distribution seen for Lima's selected visualizations (**Figure 5.14**). While the distribution across the plot was quite different, it is notable that individual strategies still occupied the same relative placement. Thus, the "circled globe" was most frequently used to spatially depict tangible data, both in Lima's visualizations and the ASLA awards.

The presence of a limited number of non-spatial and intangible graphics suggests that such representations are potentially applicable and appropriate for use within the field despite their current infrequent use.

## LIMITATIONS OF RESULTS

In answering the research question, "To what degree are landscape architects graphically representing the networks present within the landscapes they study and design?", this study has selected one representative sample for investigation. The results from the ASLA awards visual discourse analysis offer an answer to this question, but cannot confirm or refute the question with complete certainty. While these results cannot be guaranteed to be representative of the entire field, the strength of the selected sample (as outlined in Chapter 4) suggests a high level of validity for the results. Additionally, while we may not necessarily assume that the trends observed within the project are representative of the field as a whole, the comprehensive nature of the visual discourse analysis unquestionably reveals the representational biases held by the ASLA awards, which, as a leading institution within the field, is noteworthy in and of itself. In keeping with the classical argument format of the paper, such limitations provide the basis for refutation and discussion.

In all analysis, it should be noted that, while every effort was made to be both rigorous and consistent and to minimize researcher bias, visual discourse is inherently somewhat subjective. Additionally, the systems, concepts, and strategies being depicted are not necessarily clearly delineated or straightforward. For example, a logical and reasoned case can be made for characteristics such as soil pH to be considered intangible aspects of the landscape rather than physical (as characterized by the project) because they are not perceptible to a human on site. A similar case could be made that social networks are physical because they involve people who are decidedly tangible. The project maintains strict internal consistency and meticulous record keeping for any instances in which such judgment calls must be made. Ultimately, such nuances have little significance to the results and implications of the project because the frequency of network representation is so low, regardless of such specifications. Furthermore, while characteristics classified as tangible and those classified as intangible are both occasionally represented, in both cases the graphic methodologies used to do so are overwhelmingly conventional in nature relying predominately on traditional statistical graphing strategies and flow charts for well over two-thirds of the graphics. Thus, while internal consistency was crucial for conducting a reputable and defensible study, such aspects of the methodology have little bearing on the results.

Finally, it is important to note that while the conceptual model and visual discourse analysis provide a description of what is occurring, they are not intended to explain why or how it is occurring. That is, while it is apparent from the results that ASLA award-winning projects do not commonly use network visualizations, the reason why is not discrenible from the current study. Chapter 6 examines possible explanations for these results and is intended to spark a broader discussion of their impolications. Given this, the goal of the project argument is to provide evidence of a problem and a discussion of possible causes. It is outside of the scope of this study to prove or pinpoint the exact source of the problem, but it is hoped that the foundation laid by this project may set the stage for such future results.

## THESIS CONFIRMATION

In the introduction, this project put forth the thesis that landscape graphics do not adequately emphasize connection and networks, potentially resulting in built works that are insensitive to the diverse social and ecological connections that exist within the landscape. The visual discourse analysis and the construction of a conceptual model offer evidence in confirmation of this thesis. The depiction of networks, both through accepted visualization conventions and through strategies unique to landscape architecture, is rare. Though these depictions do occur, it is clear that their frequency and variety is limited when compared to the diversity of strategies developed across disciplines. These results suggest that network visualization is underutilized within the field of landscape architecture. More broadly, this implies a general lack of graphic conventions for depicting non-spatial and intangible landscape qualities. While networks are only one intangible quality of landscape, they are well studied and graphic strategies for their depiction already exist. Thus, their depiction in landscape architecture may reasonably be expected to equal or surpass that of other, less well-documented intangible phenomena. In the following chapter we will consider reasons landscape architects do not typically depict landscape systems as networks, ideas for doing so, and the broader implications for the field of embracing intangibility within landscape graphics.

## Endnotes

[1] *Sources:* Top Row: *University of Arkansas Community Design Center; King County Department of Natural Resources and Parks-Wastewater Treatment Division, CH2M Hill, Environmental Science Associates; Lim Chu Kang; Ken Smith Workshop West, Mia Lehrer + Associates;* Bottom Row: *Kathleen John-Alder; MVVA; SWA Group.*

[2] *Submission guidelines require the inclusion of between 5 and 15 images, with the majority of projects including between 10 and 15. In rare cases up to 22 images were included; it was not specified why this exception to submission guidelines occurred. The number of images examined is not purely indicated by the number of submissions since, especially in the case of the Analysis and Planning category, submitted images were often composite layouts; images in such layouts were each considered individually.*

[3] *Some graphics featured more than one strategy, resulting in 83 total strategies employed, though the total number of graphics was only 79.*

[4] *As above, because many of these graphics featured more than one strategy, the total number of strategies exceeds the number of graphics.*

[5] *In this case, spatiality refers to the alignment of space between the graphic and the external world. Thus, an explicitly spatial graphic references physical space directly. The midpoint of the spatiality spectrum represents graphics for which aspects of space are crucial to legibility and meaning but which have no direct connection to external spatial relationships. Non-spatial graphics are those for which spatial relationships within the graphic are irrelevant to the meaning of the graphic.*

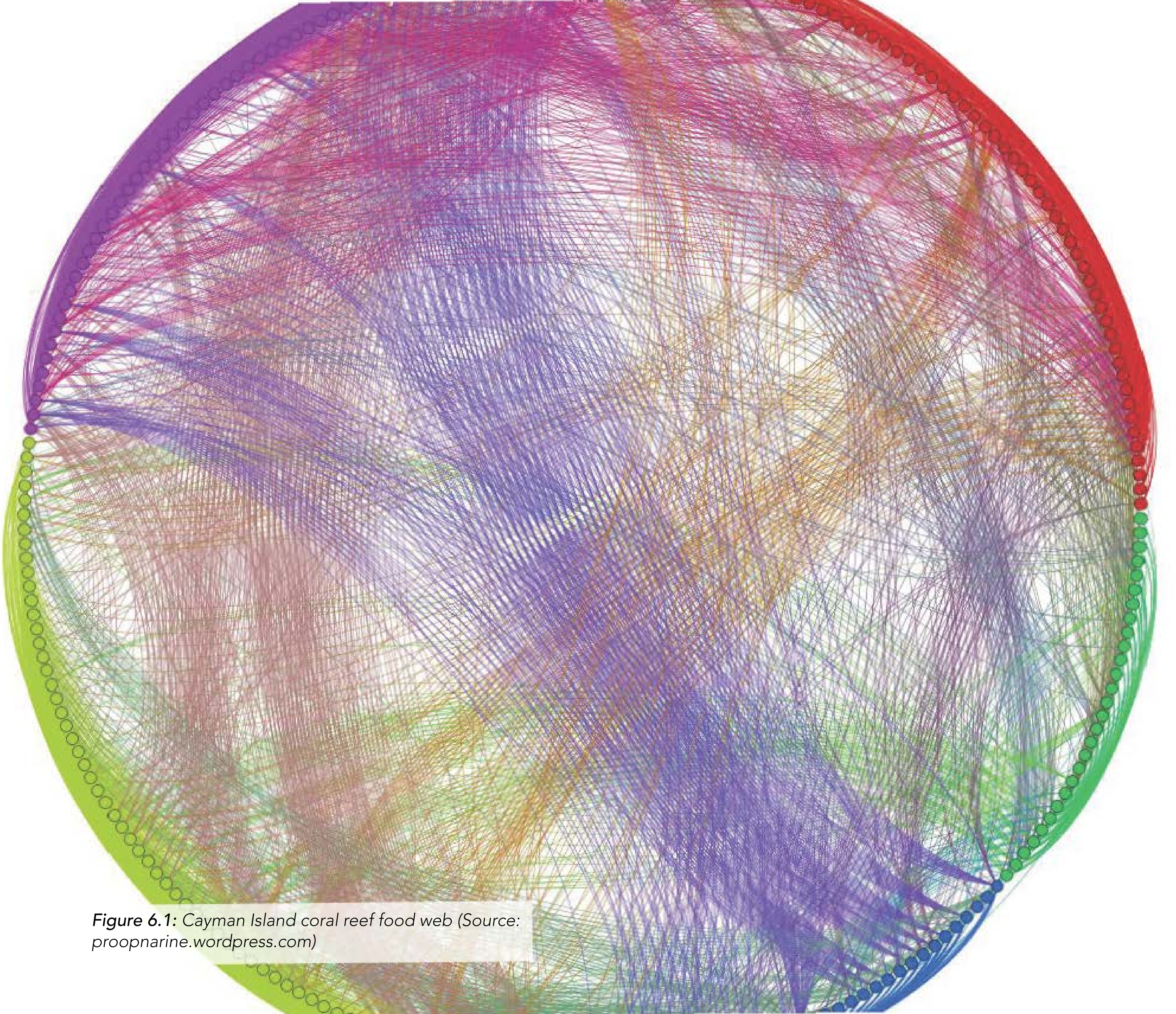


*Figure 6.1:* *Cayman Island coral reef food web (Source: proopnarine.wordpress.com)*

# 6. CONFIRMATION+REFUTATION *discussion*



## RESULTS IN CONTEXT

From the outset, this project has made the argument that the field of landscape architecture rarely graphically depicts the diverse networks present within landscapes. The results of the visual discourse analysis provide strong support for this thesis. These results demonstrate that landscape architects rarely make use of recognized graphic strategies for depicting networks. Furthermore, these results indicate that landscape architecture has not developed original graphic strategies for depicting networks.

When combined with the conceptual model development, the results also support the project's assertion that this is a symptom of a graphic bias within the field. The classification of network graphics within the conceptual model confirms a consistent preference for graphics that depict physical characteristics in spatially explicit ways. Though the conceptual model also reveals the appropriateness of network visualization strategies for depicting intangible characteristics in non-spatial ways, the usage of such graphics within landscape architecture does not follow this trend. Even in rare cases when networks are depicted graphically, the results show a strong preference for graphics that are similarly tangible and spatial to other landscape conventions.

The minimal use of network visualizations, and indeed non-spatial/intangible landscape graphics of all kinds, within landscape architecture is likely attributable to many factors. In addition to the theoretical and historical underpinnings of landscape representation discussed in Chapter 2, there may be **characteristics of landscape networks themselves** that make their depiction more challenging or simply different than in other fields. **Preferences, expectations, and conventions within the field** may be self-reinforcing for a variety of reasons, for practitioners and academics alike; limitations in data-collection abilities, technological prowess, and even conceptual exposure may exacerbate this. As with all projects, there are **potential biases embedded within the selection of source material**, though the results are conclusive enough to make such bias largely inconsequential to the outcomes. While such factors are undoubtedly complex and interconnected it is nevertheless possible to speak to general trends that may contribute to the current state of visualization in landscape architecture.

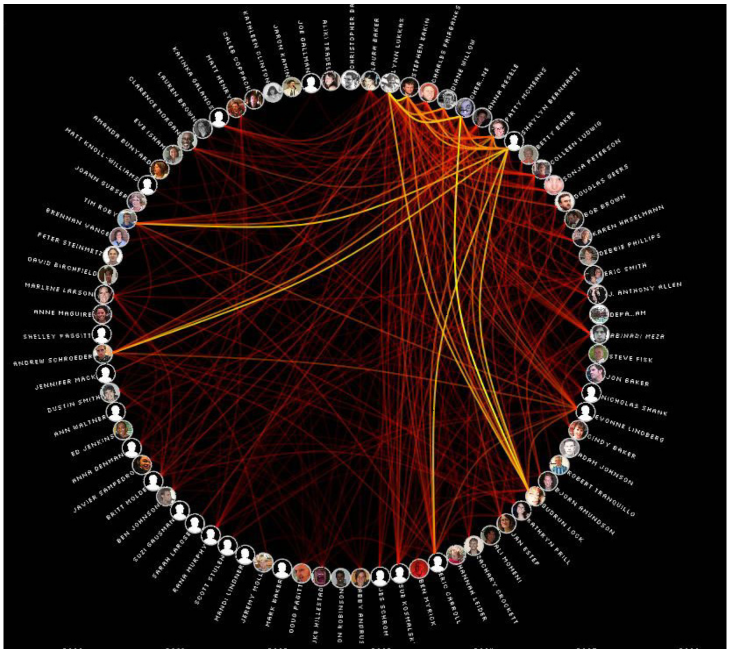


*Figure 6.2: A visualization of email message exchanges between the members of a single user's address book; this graphic is able to utilize a fine grained level of detail by restricting the scope of the graphic (Source: www.christopherbaker.net).*

## LANDSCAPE CHARACTERISTICS

### *Landscape as Networks*

Even if we agree upon a relatively narrow and straightforward definition of landscape, a task that is no small matter itself, the complexity of such systems is still significant (**Figure 6.1**). It is perhaps less appropriate to describe landscapes as networks than to describe them as networks of networks. As such, visualizations must necessarily select a single characteristic of landscape to depict, or depict the entire network on a higher, more general, level. Most of the networks depicted through the straightforward visualization strategies discussed by Lima are narrow in scope and specific to a single network. Such strategies may seem less accessible to designers who are considering multiple complex networks and their interactions. As noted in Chapter 3, humans have powerful visual processing abilities that allow for the detection of trends, patterns, and anomalies in graphics that might be imperceptible when presented in other forms (Ervin 2005); the main goal of data visualization is to harness this ability. For those in the field of landscape architecture, the complexity of landscape networks may rightfully appear at odds with the ostensible graphic clarity that can be achieved through such graphic strategies.

While such skepticism is not unwarranted, it should not be viewed as a reason to dismiss such graphic strategies entirely. Landscapes are indeed more complex than the emails sent by a single individual, as visualized in **Figure 6.2**, but this comparison is hardly relevant. Most datasets exist within broader contexts and on larger scales than those depicted within a given visualization, and it is the task of the designer to select the scale and level of detail that is appropriate for the situation. In the case of **Figure 6.2**, the graphic does not attempt to depict worldwide digital communications between all users, which would be practically impossible and graphically indecipherable. Similarly, **Figure 6.3** actually does depict the full breadth of information exchange between New York and the world, but does so at the expense of the granularity seen in **Figure 6.2**.

Studies on data visualization have shown that certain visualization techniques are particularly suited to particular kinds of data and scales of complexity (Quispel and Maes 2008). Network visualization strategies must be applied with care and thoughtfulness for the purpose of individual graphics in landscape architecture as much as in other fields but this does not diminish their relevance or utility to the field in general.

### *Landscapes as Data*

The challenges associated with the collection, access, storage, and analysis of landscape data are another possible explanation for limited network visualization within the field. Data can be generated from diverse sources but most involve some form of monitoring or data collection, which can be resource intensive. While the proposal of solutions to this challenge is outside of the scope of this project, the discussion of its ramifications is worthy of some attention.

It is true that most landscape professionals and even academics have limited time and funding to collect and analyze landscape data. Given such limitations it is unsurprising that the visualization of abstract and intangible landscape phenomena that are best represented though aggregated data sets are underutilized in the field. While there is an element of validity to this argument, it is clearly not the only cause of the problem. Landscape data is frequently available, either collected passively, gathered for unrelated projects, or specifically collected for given studies. GIS datasets covering an enormous range of topics and spanning much of the globe are presently available and more are being generated all the time. Such data collection and availability suggests that both the capabilities and the resources are theoretically present for data collection when necessary. This suggests that while limited resources may help account for limitations in landscape visualizations presently, it is not a factor that presents an inherent limitation.

## BIAS IN THE FIELD

### *The Preference for Presentation*

As illuminated by James Corner, Catherine Dee, and others, landscape architecture is prone to preferencing presentation graphics over exploratory

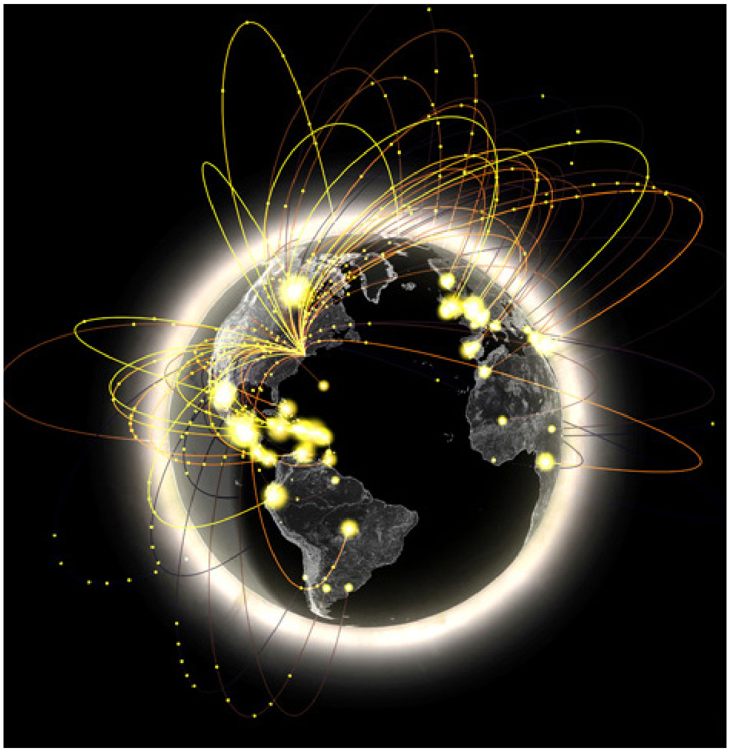


*Figure 6.3: In contrast to Figure 6.2, the scope of this visualization is huge; it is able to show this scale by minimizing the amount of detail provided (Source: New York Talk Exchange).*

graphics. This is seen in the ASLA awards by the strong emphasis on photographs of built works and site plans. These graphic strategies are quite appropriate and well-suited for the presentation of designs, especially in regards to tangible, spatial components. They are less ideally suited to exploratory functions and the representation of intangible and non-spatial aspects, which may facilitate greater understanding for the designer as well as the viewer.

In the case of awards submissions, the projects submitted are complete or nearly complete and the goal of the entrants is to communicate these projects to judges. It is, therefore not surprising that the majority of images submitted tend to focus on the presentation function of graphics over the exploratory function. There is no reason why process work cannot or should not be included within awards submissions, but it is also not surprising that, with a limited number of images at their disposal, designers tend to submit graphics that most effectively present their projects to the judges, over those that were most useful for their own personal discovery.

Data visualization may theoretically serve both exploratory and presentation functions (Unwin et al 2008). However, the effectiveness of such graphics at presenting a project may be somewhat diminished by their novelty within the landscape architectural context. Their unconventional nature means that their legibility to viewers (and in the case of the ASLA awards, judges) may be diminished, or at the very least made more challenging. In contrast to other outlets, it may be less likely for designers to risk the inclusion of a confusing or complex graphic in a competition, where every image counts and viewer confusion might cost them an award. Photographs, plans, and other accepted graphic conventions represent the “expected” forms of presentation within the field and other graphic strategies may appear as “studies,” “analyses,” or “investigations” in service of final formal decisions, rather than products themselves. Thus, while network visualizations can feasibly function for presentation, it is possible that they are perceived as serving a more exploratory function by the field due to their lack of familiarity. This perception of their exploratory function, when paired with a strong desire for clear and straightforward communication of projects to judges, seems likely to contribute to the results of the visual discourse analysis.

### *Graphic Convention Feedback Loop*

The conceptual model reveals that landscape architecture most frequently employs network visualizations for spatially explicit depictions of tangible landscape characteristics. This is the same role served by most conventional landscape graphics. This redundancy is not entirely surprising—it is logical that the characteristics of landscape deemed worthy of developing standards around are also the ones that are most apparent to designers when using other graphic strategies. On the other hand, the greatest benefit of novel graphic strategies is arguably not to reproduce the functions and roles already filled by conventions, but to fill previously unexplored functions.

This valuable use of network graphics may go unrecognized, since it is not the usage that is typically seen in implementation. When network visualizations are used, they are, in many ways, redundant to other conventions and therefore are not seen as particularly useful. Thus, they are not explored more deeply, limiting their use to the most obvious cases, the very cases in which they are redundant. This, the use of network visualizations to fill the same roles as other landscape conventions may create a self-reinforcing feedback loop, which leads to the under-appreciation of network visualizations in general.



## SOURCE MATERIAL BIAS

The use of the ASLA award-winning projects, like any other curated body of works, presents a particular bias for the project. The ubiquity and prevalence of the ASLA within both the professional and academic realms of the field make its values and biases largely, though certainly not wholly, indicative of the field. ASLA is, in many ways, synonymous with the field of landscape architecture in North America, and thus the biases it embodies were accepted as a valid part of the project. This is not to imply that all valid and important works in the field are recognized by ASLA, but merely that this body of works is the closest accessible sample we currently have to a representative body of excellent works of landscape architectural design and research.

The use of award-winning projects undoubtedly places a higher degree of relevance and importance upon seemingly innocuous awards submission criteria than might otherwise be the case, potentially accounting for the results seen. ASLA submission criteria do vary slightly between categories but the greatest variation actually occurs from year to year (**Figure 6.4**). These differences are less informative for the current project, as network visualizations seem correlated to particular categories rather than specific years.

While minimal guidance is provided on the content of imagery across all categories and years, as can be seen in **Figure 6.3**, there are nevertheless several subtle differences that may influence the content of submissions. First, between 2007 and 2014, some categories requested “images” while others requested “drawings and/or photographs.” In all years, General, Residential, and Landmark categories requested “drawings and/or photographs” and Research and Communications categories requested “images” (clarified to include items such as graphs, drawings, or photos). This division aligns well with the results, with few network visualizations occurring in the categories that consistently request “drawings and/or photographs” and more occurring in those that request “images.” The Analysis and Planning category conflicts with this finding however. In 2007, the first year this language was employed, submission criteria requested “images.” This was modified in following years to request “drawings and/or photographs,” yet the Analysis and Planning category produced the majority of network visualizations (as well as the majority of images to make it past the initial decision tree screening step). It is possible that the 2007 criteria set a precedent that was stronger than the effect of later revisions in language, though this seems somewhat unlikely (it is also possible that criteria predating the study period had some effect on expectations for various categories). After 2012, however, the Analysis and Planning criteria were again differentiated from other categories. While still employing the “drawings and/or photographs” terminology, Analysis and Planning guidelines did not forbid the inclusion of montages and overlays as did the General, Residential, and Landmark categories, perhaps reinforcing the difference in expectations between categories.

Such linguistic differences seem small and it is extremely unlikely that such criteria can fully account for the results seen. However, the difference in language used to outline submission guidelines should not be fully discounted as a potential factor for setting up expectations and precedents within each category. This language not only dictates the kinds of submissions that are received, but is reflective of the ASLA’s perceptions of what is appropriate or necessary to communicate projects of various kinds. In addition to the potential effects of such language, it is fully possible, and probable, that criteria are tailored to elicit the most successful strategies employed by past submissions. Therefore, while one conclusion is that guidelines dictate submissions, it is equally plausible that the content of successful submissions informs the future structure of such guidelines. In either case, it seems relatively apparent that significantly different conventions between each category, whether derived from precedent or explicit guidelines, transcend the minimal criteria given by the ASLA.

It is, of course, impossible to overlook the fact that the judging itself may subconsciously preference projects that include a greater number of spatially explicit physical depictions. While this is not stated in the submissions criteria, and is likely not considered explicitly by judges, the lack of network visualizations in award-winning projects does not necessarily equate to a lack of network visualizations in the full body of submissions. It is entirely possible that a preference for excellence in construction and spatial depiction exceeds the appreciation for novel representation strategies to a great enough degree to largely eliminate them from the body of award-winning works. Again, while this is unlikely to fully account for the results, it should not be dismissed as a possible factor.

## SUMMARY

The above discussion attempts to provide

*Figure 6.4: ASLA award submission criteria, organized by year and category; differences between categories are highlighted.*

ASLA AWARDS SUBMISSION CRITERIA
*by year and category*

**2005**
Submit at least five, but no more than fifteen (GENERAL, ANALYSIS AND PLANNING) or ten (RESIDENTIAL, RESEARCH, COMMUNICATIONS, LANDMARK) total drawings and/or photographs. No collages or smaller format photos will be accepted.

**2006**
Submit at least five, but no more than fifteen (GENERAL, RESIDENTIAL, ANALYSIS AND PLANNING, LANDMARK) or ten (RESEARCH, COMMUNICATIONS) total drawings and/or photographs. No collages or smaller format photos will be accepted.

**2007**
GENERAL DESIGN, RESIDENTIAL, LANDMARK: Include at least five (5) but no more than fifteen (15) total **drawings and/or photographs** of the project.
ANALYSIS AND PLANNING: Images: Include at least five (5) but no more than fifteen (15) total **images** of the project.
RESEARCH, COMMUNICATIONS: Include at least five (5) but no more than fifteen (15) total **images, which may include graphs or statistical tables illustrating the project narrative**.

### 2008

GENERAL, RESIDENTIAL, ANALYSIS AND PLANNING, LANDMARK: **A simple site plan to give the jurors context of the entire project.** Include at least five (5) but no more than fifteen (15) total **drawings and/or photographs** of the project.
RESEARCH: Include at least five (5) but no more than fifteen (15) total **images (graphs, drawings, photographs)** to illustrate the research.
COMMUNICATIONS: Include at least five (5) but no more than fifteen (15) total **images (screen shots, excerpts, photographs, etc.)** to illustrate the submission.

### 2009-2012

GENERAL, RESIDENTIAL, ANALYSIS AND PLANNING, LANDMARK: **A simple site plan to give the jurors context of the entire project.** Include at least five (5) but no more than fifteen (15) total **drawings and/or photographs** of the project.
RESEARCH, COMMUNICATIONS: Include at least five (5) but no more than fifteen (15) total **images (graphs, drawings, photographs)** to illustrate the research.

### 2013-2014

GENERAL, RESIDENTIAL, LANDMARK: A simple site plan to give the jurors context of the entire project. Include at least five (5) but no more than fifteen (15) total **drawings and/or photographs** of the project. **Montages and/or overlays are not allowed.**
ANALYSIS AND PLANNING: Include at least five (5) but no more than fifteen (15) total **drawings and/or photographs** of the project.
COMMUNICATIONS, RESEARCH: Include at least five (5) but no more than fifteen (15) total **images (graphs, drawings, photographs)** to illustrate the project.

### 2015

GENERAL, RESIDENTIAL: Project images must be submitted in a single .PDF file not to exceed 10 MB and 15 pages. **Montages and/or overlays are not allowed. One image per page.**
ANALYSIS AND PLANNING, COMMUNICATIONS, RESEARCH, LANDMARK: Project images must be submitted in a single .PDF file not to exceed 10 MB and 15 pages.

some explanation for the demonstrated lack of network visualization within the field of landscape architecture. These explanations are certainly not exhaustive as the diverse motivations, conventions, and capabilities that interact to create the current context within the field are not straightforward. It is not the goal of this project to necessarily fully explain why the field has not yet embraced the potential for novel visualization strategies. Rather, this project hopes for a forward-moving approach that looks to future possibilities for improvement. It is hoped that this project may provide a motivation, inspiration, and first step towards greater diversity in landscape representation and greater implementation of network visualization strategies. The following section takes the first step in proving the feasibility, applicability, and diverse possibilities of such future graphic investigations.

## FUTURE DIRECTIONS

### *Visualizing Landscape Networks*

While the results of the methodology suggest a potential alignment between the strengths of network visualization techniques and the graphic needs of landscape architecture, this does not necessarily mean that such implementation is appropriate. The following examples demonstrate that network visualization is feasibly applicable to a range of landscape network types. These examples strive to depict the practical use of network visualization within landscape architecture as a means to transcend spatially explicit depictions of tangible landscape qualities. By extension, these graphics suggest the broader utility of data visualization as a means of both graphic presentation and exploration. These examples do not propose methods of data collection and acquisition or suggest that these techniques will be feasible in all situations. The focus, therefore, is not on the practicality of specific scenarios but rather upon the broad applicability of graphic methods to landscape concepts.

### *The Social Network of a Community Garden*

**Figure 6.5** hypothetically depicts the participation of community members in a local community garden. Circles represent individual users of the garden space. The size of these circles represents the relative frequency of visits to the garden and the color corresponds with the racial identity of the user. The distance of the circle from the central node signifies the relative distance from the user's home to the garden. Such graphics could be used to show social impacts of community gardens in several ways. The effect of proximity on the usage of outdoor space can be evaluated, as well as the prevalence of use among various racial groups. The graphic also makes possible a comparison of the relative weight of these factors. In a broader sense, it can be used to assess aspects of demographic justice in regards to garden placement and the role such spaces do or do not play in fostering diversity. It should be noted that such a strategy could function equally well using other demographic metrics, such as age, household income, or education level.

Data to create such graphics could be collected through self-reporting, surveys of users, or through the use of records already kept by the garden, or, most likely, a combination of these strategies. As previously mentioned, it is outside the scope of this project to examine data collection in detail but it is important to acknowledge its feasibility.

### *The Ecological Network of Patches and Corridors*

The hypothetical habitat patch network graphic displayed in **Figure 6.6** shows the degree and quality of connection between various habitat patches within a landscape matrix for a population of breeding birds. The size of each circle represents the number of breeding pairs within a given patch. Saturation indicates the quality of the habitat for the given species, based on aggregated landscape characteristics such as patch size, floristic diversity, matrix type, and nest site availability. Edges between patches represent physical connections between patches; the width of such corridors reflects quality, based on similar metrics to those used to determine patch quality (such as corridor width, matrix type, etc). The placement of the individual patches is conceived as representative of relative distances, not geographic layout, but could easily be modified to function in conjunction with external space.

This graphic provides a rudimentary starting point for a wealth of ecological representation possibilities, especially if such a graphic were interactive. For example, by allowing a researcher to visually create new connections or eliminate patches within the system, such a graphic could be used to experimentally test the benefits and drawbacks of various land use planning decisions. It should be noted that connection is neither positive nor negative in this case, as the graphic is not specific to a given context. For example, if a parasite is known to be present in a particular patch, connections with this patch might weaken the network as a whole, rather than strengthening it as one might expect. Additionally, such graphics are necessarily species specific, and any measure of "quality" is relative to specific needs of a population.

Both nodes and edges could be easily modified to show variables other than those currently depicted. For example, node size could show a characteristic of the population itself rather than habitat quality, or could be used to indicate a single variable, such as nest site availability. Similarly, edges don't necessarily have to show corridors, but could instead show genetic similarities between populations or other non-spatial factors. In all of these cases, data could be collected in field surveys or from GIS data sets. It is likely that in many cases such data already exists. As with all of the hypothetical visualizations in this section, the proposed use is specific for the sake of clarity but the same strategy could be used for a wide diversity of ecological patch and corridor networks.

### *The Conceptual Network of Landscape Perception*

Figure 6.7 hypothetically visualizes the common experiences of park users through an aggregation of the adjectives used in their geolocated social media photo captions. Individual users are shown in different colors around the middle ring. Adjectives are found around the outside ring. Colored lines connect users to the particular adjectives they employed in their image captions.

These words create a snapshot of the experiential and perceptual impact of a given landscape that can be viewed on several scales. Taken as a whole, the set of words creates a general perceptual description of the site. A closer examination may pull out more important trends, such as common pairs of words or certain words that occur significantly more frequently than others. Finally, an individual user examination might shed light on reasons for certain responses (such as "sunny" and "crowded" occurring in the same description). When paired with other possible information, such as dates and times, such descriptions could be especially fruitful.

Social media has provided enormously useful datasets for visualizations of many kinds. Because of its public and widespread nature, the use and collection of such information requires relatively few resources. Such information could also be gathered through more typical forms of post-occupancy evaluation, but the value of free and accessible information from Internet services should not be discounted within landscape architecture.

### *Implications*

The successful implementation of network visualization strategies within a landscape architectural context provides conclusive evidence that such visualizations are feasible within the field. This suggests that any failure to implement such strategies within the field is due not to a poor fit between landscape data and network graphics, but rather is due to other considerations. These may include entrenched tradition, insufficient exposure, a lack of technical prowess, and resource shortages. These graphics are designed to embody and communicate landscape information, transcending the hollow adherence to graphic trends seen in many of the ASLA visualizations (see Figure 5.6). These examples showcase the applicability of such strategies to the contexts and concerns of landscape architecture, and hopefully provide inspiration and direction for future explorations in landscape visualization.

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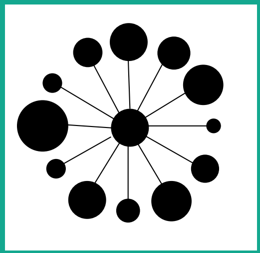
*Figure 6.5:* *A hypothetical "centralized ring" visualization depicts the use of a community garden space by diverse members of a community. Circles depict individual garden users.*

# THE SOCIAL NETWORK OF A COMMUNITY GARDEN

**Visualization Strategy:**

Centralized Ring

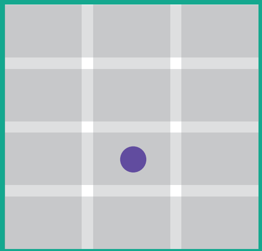


**Spatiality:**

Distances are important within the graphic but do not relate specifically to external reality so the graphic is considered "internally spatial."

**Tangibility:**

Users are humans and therefore tangible, but the crucial factor in this graphic is race (intangible). We are measuring their visits to the community garden, which is intangible (experience), but it does occur in real space (the garden), which is tangible. This yields a conceptual model placement of "somewhat intangible."



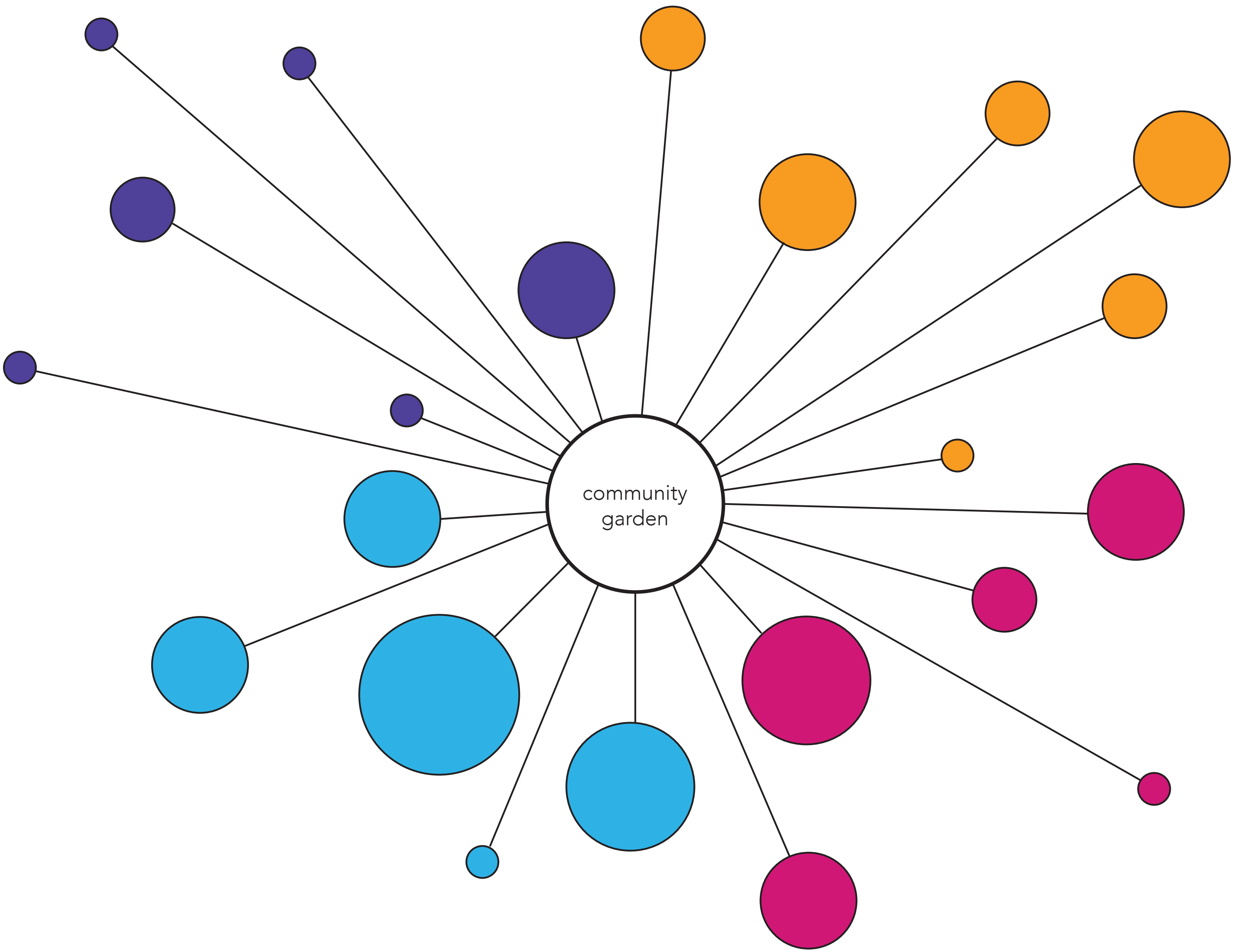

community
garden

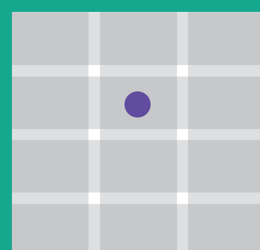
*Figure 6.6: A hypothetical "scaling circles" visualization depicts the importance of habitat patches and corridors for a particular species of breeding bird. Circles represent patches and lines represent connections between them.*

# THE ECOLOGICAL NETWORK OF PATCHES AND CORRIDORS

**Visualization Strategy:**
Scaling Circles

**Spatiality:**
Because scale and distance matter within the graphic but do not relate to the external world, it is considered "internally spatial."

**Tangibility:**
Patches and corridors are both tangible, as are the populations that use them, which might imply that the graphic is "mostly tangible." However, because the variable of quality is used in this case for both nodes and edges rather than specific physical features, this graphic is instead considered "somewhat tangible."



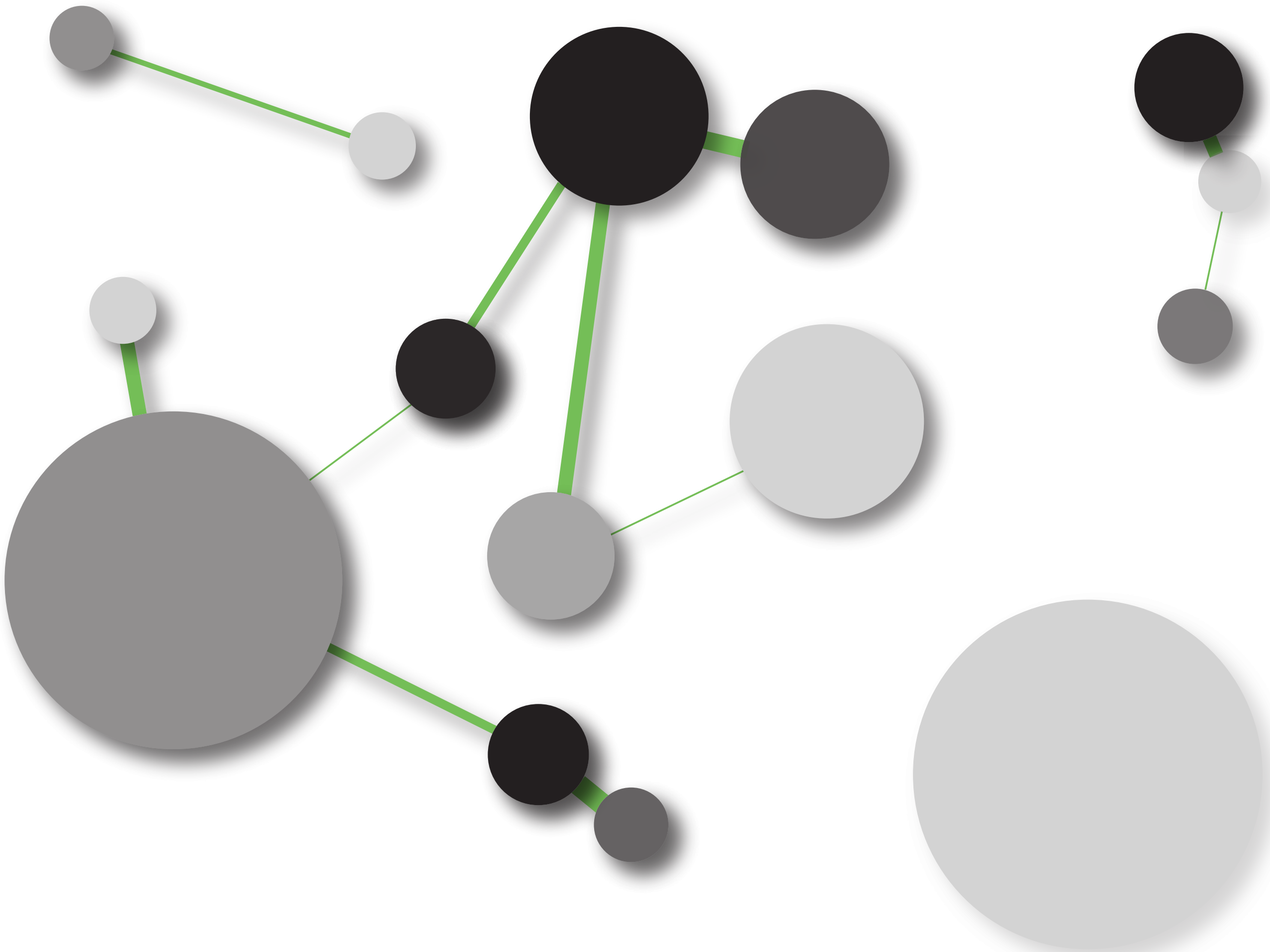
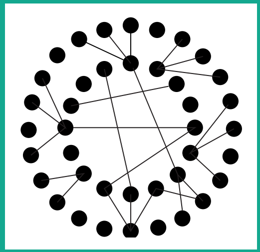


*Figure 6.7: A hypothetical graphic of user experiences of a specific landscape, constructed from adjectives used in geolocated social media photo captions. Lines connect users to the terms they use to describe the site.*

# THE CONCEPTUAL NETWORK OF LANDSCAPE PERCEPTION

**Visualization Strategy:**

Segmented Radial Convergence

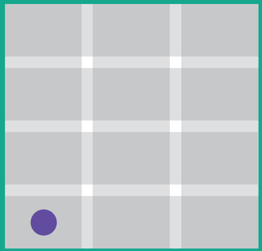


**Spatiality:**

The graphic is non-spatial in that locations and distances within the graphic are irrelevant to its interpretation.

**Tangibility:**

The graphic relies on the use of words (intangible) to create a written description in cyberspace (intangible) of common experiences (intangible), resulting in a mostly intangible graphic.



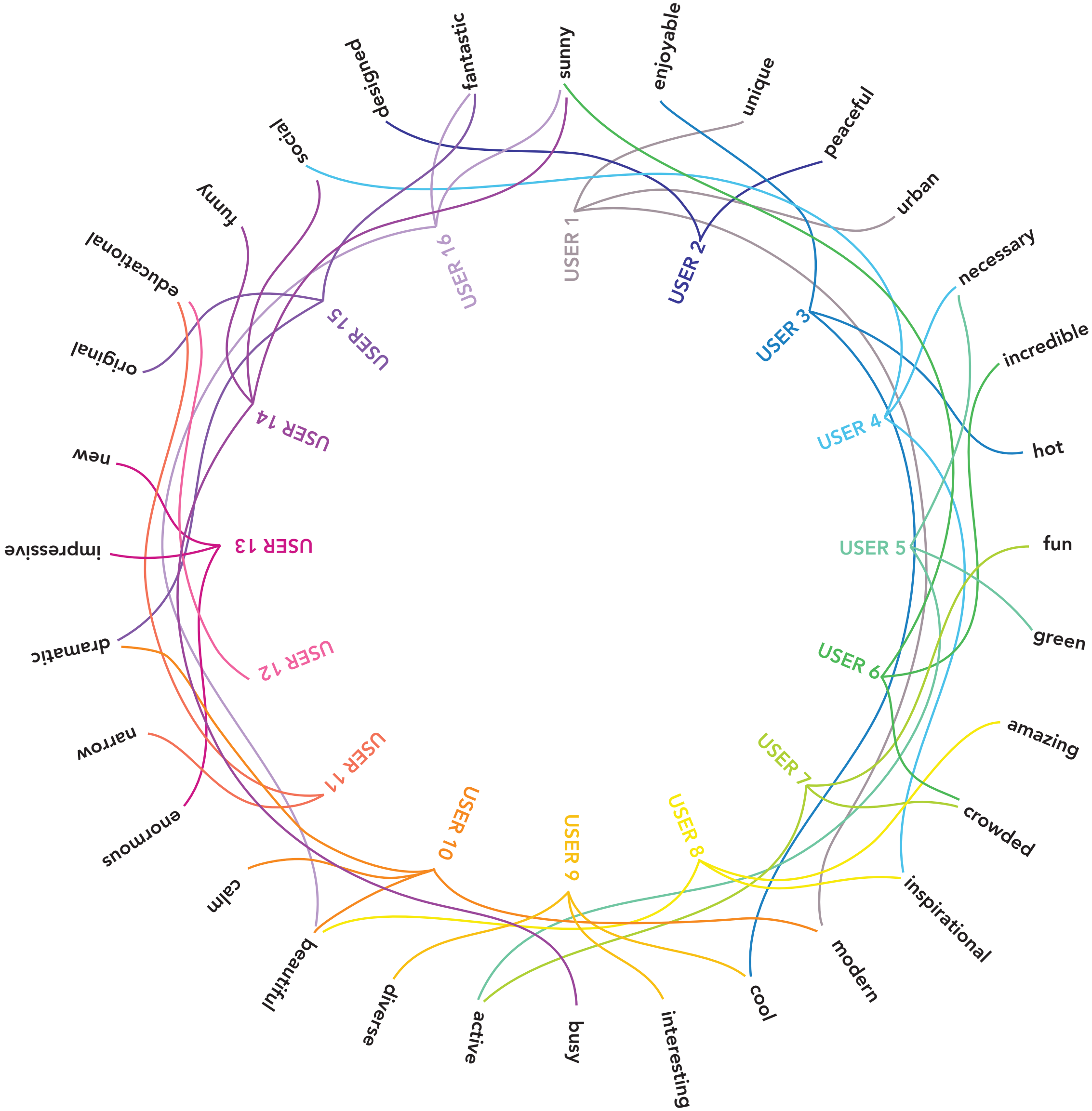

USER 1
USER 2
USER 3
USER 4
USER 5
USER 6
USER 7
USER 8
USER 9
USER 10
USER 11
USER 12
USER 13
USER 14
USER 15
USER 16
sunny
enjoyable
unique
peaceful
urban
necessary
incredible
hot
fun
green
amazing
crowded
inspirational
modern
cool
interesting
busy
active
diverse
beautiful
calm
enormous
narrow
dramatic
impressive
new
original
educational
funny
social
designed
fantastic

*Figure 7.1:* A photograph is unable to fully capture the complexity of this estuary - network visualization offers one possibility for doing so.

# 7. SUMMATION *the need for networks*

This project has argued from the outset that landscape architecture, as a field, preferences graphic strategies that depict tangible landscape qualities in spatially explicit ways. This bias has the potential to influence both the way we design and make landscapes and the way we perceive and conceive of the landscapes that surround us. Responding to the calls for greater diversity in representational strategies of James Corner, Catherine Dee, Cesar Torres, and others, this project has proposed interdisciplinary network visualization as a source of practical and conceptual inspiration for landscape architects seeking novel means of landscape representation (**Figure 7.1**).

The results of the project's analysis confirm that landscape architects have not yet embraced network visualization strategies common in other fields. This offers evidence in support of the project's thesis, that landscape architectural graphics are heavily reliant upon spatially explicit depictions of tangible landscape qualities. The project further confirms that network visualization is both theoretically and practically applicable to the complex and intangible landscape systems explored and created within landscape architecture.

This represents only one step towards a more holistic approach to landscape representation. The results, while definitive, offer only a single piece of evidence highlighting this conceptual gap in landscape visualization. Additional research and, most importantly, greater exploration and experimentation with graphic techniques is necessary to bring strategies for depicting the intangible landscape into focus.

If we are to design landscapes around more than physical form and aesthetic appearance, we must imbue not only our written theory but also our graphic depictions with such ideals. Landscape architects have the opportunity to design spaces that contribute to ecological resilience, social justice, and the embodied human experience, yet if we fail to conceive of the spaces we design in these terms we will continue to design in ways that are indifferent to or detrimental to these goals. When we draw we must go beyond a flat facsimile of what we wish to see in the landscape. We must instead consider the complexity of the landscape we hope to experience for, as Edward Tufte says, "all the interesting worlds that we seek to understand are inevitably and happily multivariate in nature."

# APPENDICES

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# APPENDIX A

*1. Does the graphic appear to visually depict one of Manuel Lima's 15 typologies? = yes*

| | i. Project Title | Category | Year | I.D. | ii. Which one? | iii. Is it representing a network? |
|---|---|---|---|---|---|---|
| 1a. | Parque Amazonia | Analysis and Planning | 2006 | 14 | circled globe | yes |
| 1b. | From Landscapes to Lots: Understanding and Managing Midwestern Landscape Change | Research | 2006 | 5 | circled globe (modified) | yes |
| 1c. | Porchscapes: An Affordable LEED Neighborhood Development | Analysis and Planning | 2008 | 3 | Elliptical Implosion | yes |
| 1d. | The Sungei Buloh Wetland Reserve Master Plan | Analysis and Planning | 2010 | 1 | circled globe (modified), Centralized ring | no |
| 1e. | The Sungei Buloh Wetland Reserve Master Plan | Analysis and Planning | 2010 | 2 | circled globe (modified) | yes |
| 1f. | The Sungei Buloh Wetland Reserve Master Plan | Analysis and Planning | 2010 | 3 | circled globe (modified) | yes |
| 1g. | An Emerging Natural Paradise-Aogu Wetland Forest Park Master Plan | Analysis and Planning | 2011 | 1 | circled globe | yes |

| a. What network? | b. What is it representing? | iv. What are the nodes and what are the edges? | v. Where is the info from? | vi. What role does the graphic serve? | vii. stand-alone or integrated? |
|---|---|---|---|---|---|
| connections between global cities | | nodes: cities, edges: unspecified-economic or physical links | economic feasibility study (presumably-not explicitly stated) | didactic/marketing | stand-alone |
| primary and secondary residences of homeowners | | nodes: homes owned by county residents, edges: lines between homes owned by same resident | Walworth County Case Study | presentation | integrated (with photos, annotations, and arrows) |
| project collaborators and tasks | | nodes: collaborators, tasks; edges: not specified-presumably collaborations between agencies | not specified | presentation | stand-alone |
| | number of mangrove species present in various SE Asian nations, with emphasis on Singapore | nodes: locations, edges: not specified, don't seem to embody any data (all connect back to focal nation, Singapore | [illegible] and C. Field (Eds.). "World Mangrove Atlas", The international Society for Mangrove Ecosystems (ISME), Okinawa, Japan, | didactic | stand-alone |
| East Asian Australasian Shorebird Site Network | | Nodes: shorebird sites, Edges: connections specifically to focal site (presumably to illustrate the site's centrality) | www.environment.gov.au | didactic | stand-alone |
| Singapore's nature reserves | | nodes: nature reserves edges: unspecified conncetions to focal reserve | not specified | didactic | stand-alone |
| bird migration routes | | nodes: wetlands (not specifically connected to edges), implicitly starting locations; edges: migration routes | image: National Sun Yat-sen University, Yannlin Photo, Forestry Bureau; data: not specified | didactic | stand-alone |

| | i. Project Title | Category | Year | I.D. | ii. Which one? | iii. Is it representing a network? |
|---|---|---|---|---|---|---|
| 1h. | Backyard Farm Service: A Business Plan for Localizing Food Production | Research | 2011 | 10 | Area Grouping | yes |
| 1i. | Core Area of Lotus Lake National Wetland Park Landscape Planning | Analysis and Planning | 2012 | 3 | Radial Convergence (partial) | no |
| 1j. | Landscape Urbanism Website and Journal | Communications | 2012 | 4 | Flow Chart | yes |
| 1k. | Petrochemical America | Communications | 2013 | 1 | Organic Rhizome | yes |
| 1l. | A New Norris House Landscape | Research | 2014 | 13 | Centralized Ring | yes |
| 1m. | Dallas Connected Cities | Analysis and Planning | 2015 | 4 | Flow Chart | yes |
| 1n. | Collective Visions: Exploring the Design Potential of Landscape History | Research | 2015 | 12 | circled globe | yes |
| 1o. | Spontaneous Urban Plants | Research | 2015 | 5 | Scaling circles | yes |
| 1p. | Backyard Farm Service: A Business Plan for Localizing Food Production | Research | 2001 | 2 | circled globe (modified) | yes |

| a. What network? | b. What is it representing? | iv. What are the nodes and what are the edges? | v. Where is the info from? | vi. What role does the graphic serve? | vii. stand-alone or integrated? |
|---|---|---|---|---|---|
| plant compatibility | | nodes:plant species, edges: beneficial or harmful interations | image: Visual Logic; data: not specified | didactic | stand-alone |
| | project goals | nodes: goals edges: not specifially present, though nodes are clustered under themes (environment, society, economy) | not specified | presentation /didactic | integrated (with venn diagram) |
| not specified (thumbnail excerpt from larger issue) | | not specified | not specified | presentation | integrated (with timeline) |
| petrochemistry | | nodes: causes and impacts of petrochemistry edges:direction of cause/impact | not specified | didactic | stand-alone |
| project team | | nodes: team members, edges: connection to project | not data-derived | didactic | stand-alone |
| traffic patterns on roadways | | nodes: not specifically present, edges: paths of travel | not specified | didactic/possibly eidetic | stand-alone |
| monarch migration | | nodes: start and end points of migration, edges: migration paths | not specified | didactic | stand-alone |
| social media interations | | nodes: users, hashtags, edges: interactions between users | not specified | didactic /presentation | integrated |
| food distribution | | distribution hubs | paths of distribution | didactic /presentation | stand-alone |

# APPENDIX B

*3. Does the graphic depict a network using a strategy not classified by Lima? = yes*



| | i. Project Title | Category | Year | I.D. | ii. What network? | iii. General formal description |
|---|---|---|---|---|---|---|
| 2a. | Clearings, Clusters, and Cloisters: A Garden of Trees for Two Rivers Park | Analysis and Planning | 2005 | 5 | design and administration of the project | Flowchart integrated with basic spatial graphics of park to show design stages |
| 2b. | Brightwater Siting Project | Analysis and Planning | 2005 | 2 | Project team organization | Flowchart |
| 2c. | Orange County Great Park Comprehensive Master Plan "A Vision for the Great Park of the 21st Century | Analysis and Planning | 2008 | 5 | flows of site elements (nature, water, energy, materials, people) related to sustainability | linear version of a Lima pattern. nodes: 5 site elements; edges: connections between them (ambiguous) |
| 2d. | Brooklyn Bridge Park | Analysis and Planning | 2009 | 5 | park constituency and infrastructural functions | bullseye diagram |
| 2e. | The Sungei Buloh Wetland Reserve Master Plan | Analysis and Planning | 2010 | 6 | habitat patches and corridors | stylized arc connecting nodes. nodes: "pockets of nature; edges:"corridors" |
| 2f. | Museum of Freeway Art (MoFA) - The Atlanta 1/75 - I/85 Connector Transformation | Analysis and Planning | 2013 | 9 | organizational structure | nodes: programs and agencies; edges: collaborations/oversight |
| 2g. | Collective Visions: Exploring the Design Potential of Landscape History | Research | 2015 | 8 | "threads of change" | nodes: historical images, edges: connections to theses (supposed) |

# APPENDIX C

*4. Is there anything else in the graphic that might allude to a network? = yes*

| | i. Project Title | Category | Year | I.D. | ii. What network? | iii. What clues are visible? |
|---|---|---|---|---|---|---|
| 3a. | Productive Neighborhoods: A Case Study Based Exploration of Seattle Urban Agriculture Projects | Research | 2012 | 5 | local urban food distribution | caption: "...balanced localized and sustainable network." |
| 3b. | Backyard Farm Service: A Business Plan for Localizing Food Production | Research | 2001 | 11 and 12 | food distribution | map captions--"local network," "regional network" |

# APPENDIX D

*5. Is the project depicting an intangible characteristic = yes*

| | i. Project Title | Category | Year | I.D. | ii.what non-tangible aspect is the graphic depicting? | graphic use a standard model? | iv. If not to c, describe the strategy |
|---|---|---|---|---|---|---|---|
| 4a. | The New American City: The Noisette Community of North Charleston, SC | Analysis and Planning | 2005 | 13 | the planning and building process within the community | no | "spiderweb" diagram |
| 4b. | Lloyd Crossing Sustainable Urban Design Plan | Analysis and Planning | 2005 | 7 | environmental impact | line graph | |
| 4c. | The Growth Pattern of Taizhou City Based on Ecological Infrastructure | Analysis and Planning | 2005 | 8 | project strategy for generating urban development recommendations | flowchart | |
| 4d. | Brightwater Siting Project | Analysis and Planning | 2005 | 3 | siting decision process | flowchart/timeline | |
| 4e. | Brightwater Siting Project | Analysis and Planning | 2005 | 4 | site selection process | flowchart | |
| 4f. | The Grand Concourse Authority Walkway Maintenance Manual | Communications | 2005 | 9 | system maintenance plan | flowchart (very basic) | |
| 4g. | Chess Park | General | 2006 | 2, 3 | the story of the park [Caption: "Diagramming the story of the park"] | flowchart (iconographic) | |
| 4h. | Parque Amazonia | Analysis and Planning | 2006 | 1 | project design principles | no | "tree" diagram, but with one-to-one relationship in branching |
| 4i. | Intrinsic Landscape Aesthetic Resource Information System | Research | 2006 | 1 | project conceptual framework | flowchart | |
| 4j. | Intrinsic Landscape Aesthetic Resource Information System | Research | 2006 | 2 | GIS process model | flowchart | |
| 4k. | From Landscapes to Lots: Understanding and Managing Midwestern Landscape Change | Research | 2006 | 2 | "A process model for understanding landscape change" | flowchart | |

| | i. Project Title | Category | Year | I.D. | ii.what non-tangible aspect is the graphic depicting? | graphic use a standard model? | iv. If not to c, describe the strategy |
|---|---|---|---|---|---|---|---|
| 4l. | From Landscapes to Lots: Understanding and Managing Midwestern Landscape Change | Research | 2006 | 3 | Midwest and Twin Cities growth rates | line graph | |
| 4m. | From Landscapes to Lots: Understanding and Managing Midwestern Landscape Change | Research | 2006 | 7 | Perceived sprawl-related concerns | bar graph | |
| 4n. | From Landscapes to Lots: Understanding and Managing Midwestern Landscape Change | Research | 2006 | 8 | relationship between housing density and timber removal | scatter plot | |
| 4o. | Forgotten Rain: Rediscovering Rainwater Harvesting | Communications | 2006 | 6 | rainwater harvesting process | flowchart | |
| 4p. | Hunters Point Waterfront Park Project | Analysis and Planning | 2007 | 8 | activities desired by residents | bar graph | scaled circles, but without edges |
| 4q. | The Park and New Town upon the fishponds - The Planning of 2007 China International Garden Show Park Area in Xiamen | Analysis and Planning | 2007 | 14 | planning process and methodology | flowchart | |
| 4r. | Atlanta BeltLine Redevelopment Plan | Analysis and Planning | 2007 | 2 | how tax allocations districts work | flowchart/line graph | |
| 4s. | University of Balamand Campus Master Plan | Analysis and Planning | 2007 | 4 | climate (wind and solar aspect) | windrose/sun projection | |
| 4t. | The Growth Pattern of Taizhou City Based on Ecological Infrastructure | Analysis and Planning | 2005 | 2 | project objectives across scales | flowchart | |
| 4u. | Lower Howards's Creek Corridor Management Plan | Analysis and Planning | 2007 | 3 | planning process for management plan | flowchart | |
| 4v. | Orange County Great Park Comprehensive Master Plan "A Vision for the Great Park of the 21st Century | Analysis and Planning | 2008 | 4 | social, ecological, and environmental health, "sustainable oasis" | Venn diagram | Circle Diagrams |

| | i. Project Title | Category | Year | I.D. | ii.what non-tangible aspect is the graphic depicting? | graphic use a standard model? | iv. If not to c, describe the strategy |
|---|---|---|---|---|---|---|---|
| 4w. | New Terrain for the North Lake Region of Chongming Island | Analysis and Planning | 2008 | 12 | and development rights transfer process | flowchart (iconographic) | |
| 4x. | New Terrain for the North Lake Region of Chongming Island | Analysis and Planning | 2008 | 13 | land lease agreement partnerships | no | iconographic diagrams (arrows and annotation show relationships) |
| 4y. | Brooklyn Bridge Park | Analysis and Planning | 2009 | 9 | economic self-sufficiency/ and revenue | no | infographics, including stylized bar graph |
| 4z. | Brooklyn Bridge Park | Analysis and Planning | 2009 | 13 | microclimate | bar graph, wind rose, solar aspect | |
| 4za. | Brays Bayou Greenway Framework | Analysis and Planning | 2009 | 4 | financial magnitude of current and futuer projects | Venn diagram | |
| 4zb. | Roadside Cultural Resources Preservation: A Guide to Assessing the Effects of Roadside Safety Implementation Projects on the Blue Ridge Parkway | Analysis and Planning | 2009 | 8 | roadside cultural resources preservation evaluation process | flowchart | |
| 4zc. | Greensburg Sustainable Comprehensive Plan | Analysis and Planning | 2009 | 6 | average wind speed | bar graph | |
| 4zd. | Remodeling Paradise--Landscape Renovation Round West Lake Region in Hangzhou | Analysis and Planning | 2010 | 3 | conflicts between ecology, economy, and culture | no | modified Venn diagram |
| 4ze. | Remodeling Paradise--Landscape Renovation Round West Lake Region in Hangzhou | Analysis and Planning | 2010 | 16 | average income/economic aggreate | bar graph | |
| 4zf. | Resuscitating the Fez River | Analysis and Planning | 2010 | 15 | tannery production model and income generation model (flow chart); project completion (timeline) | flowchart and timeline | |

| | i. Project Title | Category | Year | I.D. | ii.what non-tangible aspect is the graphic depicting? | graphic use a standard model? | iv. If not to c, describe the strategy |
|---|---|---|---|---|---|---|---|
| 4zg. | PGHSNAP: Neighborhood Data and Map Resource | Analysis and Planning | 2010 | 9 | Action Planning Analysis components | | basic box and arrow diagram |
| 4zh. | PGHSNAP: Neighborhood Data and Map Resource | Analysis and Planning | 2010 | 10 | process for incorporating the blight indicators with the physical and social indicators to form a complete analysis | flowchart | |
| 4zi. | PGHSNAP: Neighborhood Data and Map Resource | Analysis and Planning | 2010 | 11 | Action Planning Strategy Matrix generation process | flowchart | |
| 4zj. | Park 20/20: A Cradle to Cradle Inspired Master Plan | Analysis and Planning | 2010 | 6 | solar exposure | solar path diagram | |
| 4zk. | Park 20/20: A Cradle to Cradle Inspired Master Plan | Analysis and Planning | 2010 | 8 | wind | wind rose diagram | |
| 4zl. | Access to Nature for Older Adults: Promoting Health Through Landscape Design | Research | 2010 | 14 | research dissemination | flowchart | |
| 4zm. | Getting to Minus 80: Defining the Contribution of Urban Form to Achieving Greenhouse Gas Emission Reduction Targets | Research | 2010 | 9 | energy consumption | pie chart | |
| 4zn. | An Emerging Natural Paradise-Aogu Wetland Forest Park Master Plan | Analysis and Planning | 2011 | 16 | management organizational structure and process | flowchart (iconographic) | |
| 4zo. | The Regeneration / Yongsan Park | Analysis and Planning | 2011 | 5 | design concept | no | illustrative imagery witih scaled text |
| 4zq. | South Grand Boulevard "Great Streets Initiative" | Analysis and Planning | 2011 | 4 | concerns and important aspects of design | bar graph | |
| 4zr. | South Grand Boulevard "Great Streets Initiative" | Analysis and Planning | 2011 | 12 | traffic accidents and associated finances | bar graphs and line graph | |

| | i. Project Title | Category | Year | I.D. | ii.what non-tangible aspect is the graphic depicting? | graphic use a standard model? | iv. If not to c, describe the strategy |
|---|---|---|---|---|---|---|---|
| 4zs. | Making a Wild Place in Milwaukee's Urban Menomonee Valley | Analysis and Planning | 2011 | 10 | solar exposure | solar path diagram | |
| 4zt. | Backyard Farm Service: A Business Plan for Localizing Food Production | Research | 2011 | 4 | distance traveled by produce | bar graph | |
| 4zu. | Backyard Farm Service: A Business Plan for Localizing Food Production | Research | 2011 | 9 | when to plant crops | timeline/matrix | |
| 4zw. | Backyard Farm Service: A Business Plan for Localizing Food Production | Research | 2011 | 13 | nutrition info compared to farm subsidies | bar graph | |
| 4zx. | Tudela-Culip (Club Med) Restoration Prject in 'Cap de Creus' Cape | General | 2012 | 2 | wind | wind rose | |
| 4zy. | Governors Island Park and Public Space Master Plan | Analysis and Planning | 2012 | 8 | experiential qualities of light and shade | | diagrammatic bars of color blended and scaled text (meaning of sclae unclear)*Also integrated with section line, disqualifying from strictest interpretation of methods |
| 4zz. | Governors Island Park and Public Space Master Plan | Analysis and Planning | 2012 | 14 | program and experience | | scaled text (meaning of scale unclear)*Also integrated with plan, disqualifying from strictest interpretation of methods |

| | i. Project Title | Category | Year | I.D. | ii.what non-tangible aspect is the graphic depicting? | graphic use a standard model? | iv. If not to c, describe the strategy |
|---|---|---|---|---|---|---|---|
| 4zza. | Core Area of Lotus Lake National Wetland Park Landscape Planning | Analysis and Planning | 2012 | 3 | planning process | flowchart | |
| 4zzb. | Core Area of Lotus Lake National Wetland Park Landscape Planning | Analysis and Planning | 2012 | 6 | project concept | | puzzle piece diagram of four major components |
| 4zzc | Nanhu: Farm Town in the Big City | Analysis and Planning | 2012 | 4 | agricultural inputs and outputs | bar graph | |
| 4zzd | Productive Neighborhoods: A Case Study Based Exploration of Seattle Urban Agriculture Projects | Research | 2012 | 4 | history of movements in urban agriculture | line graph (with integrated annotations) | |
| 4zze | Productive Neighborhoods: A Case Study Based Exploration of Seattle Urban Agriculture Projects | Research | 2013 | 15 | opportunties for productive land use | | cyclical (spiraled) annotated timeline |
| 4zzf | Museum of Freeway Art (MoFA) - The Atlanta 1/75 - I/85 Connector Transformation | Analysis and Planning | 2013 | 4 | program elements | | scaled text, but unclear what the scale indicates *Also integrated with plan, disqualifying from strictest interpretation of methods |
| 4zzg | Museum of Freeway Art (MoFA) - The Atlanta 1/75 - I/85 Connector Transformation | Analysis and Planning | 2013 | 9 | level of activity | line graph | |
| 4zzh | Museum of Freeway Art (MoFA) - The Atlanta 1/75 - I/85 Connector Transformation | Analysis and Planning | 2013 | 12 | phasing strategy | | thematic timeline (includes ambiguous integration with plan view) |

| | i. Project Title | Category | Year | I.D. | ii.what non-tangible aspect is the graphic depicting? | graphic use a standard model? | iv. If not to c, describe the strategy |
|---|---|---|---|---|---|---|---|
| 4zzi | Museum of Freeway Art (MoFA) - The Atlanta 1/75 - I/85 Connector Transformation | Analysis and Planning | 2013 | 14 | project timeline | | timeline with scaled text and color-coding |
| 4zzj | Green Infrastructure Master Plan | Research | 2013 | 2 | study approach for master plan development | flowchart | |
| 4zzk | Midtown Detroit Techtown District | Analysis and Planning | 2014 | 5 | temporal use | | infographic circle diagram/stylized timeline |
| 4zzl | Finding Connections to the Outdoors for Youth and Families in Larimer County, CO | Research | 2014 | 2 | study process | flowchart | |
| 4zzm | Finding Connections to the Outdoors for Youth and Families in Larimer County, CO | Research | 2014 | 3 | importance and relationship to experiences in nature | scatterplot | bull's eye diagram (integrated with map=spatial) |
| 4zzn | Finding Connections to the Outdoors for Youth and Families in Larimer County, CO | Research | 2014 | 4 | outdoor activity participation and access | bar graphs | |
| 4zzo | Finding Connections to the Outdoors for Youth and Families in Larimer County, CO | Research | 2014 | 6 | outdoor activity priorities and availability | bar graphs | |
| 4zzp | Finding Connections to the Outdoors for Youth and Families in Larimer County, CO | Research | 2014 | 9 | strategy for identifying priority lands | flowchart | |
| 4zzq | Yerba Buena Street Life Plan | Analysis and Planning | 2014 | 5 | relationship between projects, strategies, and values | | basic infographic (nested boxes) |
| 4zzr | The Phenology Project | Research | 2014 | 12 | "textural presence" | | non-standard graphic timeline |
| 4zzs | The Phenology Project | Research | 2014 | 13 | ecological interactions and presence between species | line graph (annotated) | |

| | i. Project Title | Category | Year | I.D. | ii.what non-tangible aspect is the graphic depicting? | graphic use a standard model? | iv. If not to c, describe the strategy |
|---|---|---|---|---|---|---|---|
| 4zzu | James Island | Analysis and Planning | 2015 | 3 | wind shadow effect | line graphs | |
| 4zzv | Collective Visions: Exploring the Design Potential of Landscape History | Research | 2015 | 1 | "narratives of nature, nurture, industry" | | non-standard circular timeline |
| 4zzw | Collective Visions: Exploring the Design Potential of Landscape History | Research | 2015 | 5 | history of the Jersey Shore | line graph, timeline | infographics, collage |
| 4zzx | Collective Visions: Exploring the Design Potential of Landscape History | Research | 2015 | 5 | history using Ben Shahn mural as inspiration | | graphic timeline |
| 4zzy | Collective Visions: Exploring the Design Potential of Landscape History | Research | 2016 | 11 | soundscape | decibel level diagrams | |

# APPENDIX E

*6. Answer the following questions about the graphic*

| | a. Project Title | Category | Year | I.D. | b.what is the graphic representing? | use a standard model? | d. if no to c, describe strategy |
|---|---|---|---|---|---|---|---|
| 5a. | Lloyd Crossing Sustainable Urban Design Plan | Analysis and Planning | 2005 | 7 | Potable water demand | Bar graph | |
| 5b. | Open Space Seattle 2100 Envisioning Seattle's Green Infrastructure for the Next Century | Analysis and Planning | 2007 | 13 | perviousness of different surfaces | Bar graph | |
| 5c. | The Green Build-out Model: Quantifying Stormwater Benefits of Trees and Greenroofs in Washington, DC | Research | 2007 | 2 | existing landcover | Pie chart | |
| 5d. | The Green Build-out Model: Quantifying Stormwater Benefits of Trees and Greenroofs in Washington, DC | Research | 2007 | 3 | building distribution | Line graph | |
| 5e. | Port Lands Estuary: Reinventing the Don River as an Agent of Urbanism | Analysis and Planning | 2008 | 6 | sediment particle size | Bar graph | |
| 5f. | Port Lands Estuary: Reinventing the Don River as an Agent of Urbanism | Analysis and Planning | 2008 | 15 | remediation | flowchart (iconographic) | |
| 5g. | Orange County Great Park Comprehensive Master Plan "A Vision for the Great Park of the 21st Century | Analysis and Planning | 2008 | 9 | plant community frequency and location | No | divided and inverted pyramid (showing reducing frequencies of plant communities) |
| 5h. | New Terrain for the North Lake Region of Chongming Island | Analysis and Planning | 2008 | 14 | land to water area ratio | Bar graph (integrated with unclear circle graph) | |
| 5i. | Bird-Safe Building Guidelines | Communications | 2008 | 7 | visible wavelengths to birds | No | iconographic diagram integrated with spectral diagram |
| 5j. | Michael Van Valkenburgh Associates: Reconstructing Urban Landscapes | Communications | 2009 | 3 | remediation | flowchart (iconographic) | |

| | a. Project Title | Category | Year | I.D. | b.what is the graphic representing? | use a standard model? | d. if no to c, describe strategy |
|---|---|---|---|---|---|---|---|
| 5k. | Restoration ecology preocesses to advance natural landscape design | Research | 2009 | 1 | comparative rooting depth | bar graph | |
| 5l. | Restoration ecology preocesses to advance natural landscape design | Research | 2009 | 5 | growth by seed source | Bar graph | |
| 5m. | Restoration ecology preocesses to advance natural landscape design | Research | 2009 | 8 | pollinator visitation/species presence | 3-axis bar graph | |
| 5n. | Restoration ecology preocesses to advance natural landscape design | Research | 2009 | 9 | non-native plants | bar graph | |
| 5o. | Restoration ecology preocesses to advance natural landscape design | Research | 2009 | 10 | plant community composition | bar graph | |
| 5p. | Restoration ecology preocesses to advance natural landscape design | Research | 2009 | 11 | sapling height under canopies | bar graph | |
| 5q. | Kigali Conceptual Master Plan | Analysis and Planning | 2010 | 12 | watershed infrastructure | flowchart | |
| 5r. | Remodeling Paradise--Landscape Renovation Round West Lake Region in Hangzhou | Analysis and Planning | 2010 | 6 | pollution sources | pie chart | |
| 5s. | Remodeling Paradise--Landscape Renovation Round West Lake Region in Hangzhou | Analysis and Planning | 2010 | 13 | water transparance | bar graph | |
| 5t. | Remodeling Paradise--Landscape Renovation Round West Lake Region in Hangzhou | Analysis and Planning | 2010 | 15 | greenspace, tourist attractions, tourists and tourism income | Bar graph | |
| 5u. | Resuscitating the Fez River | Analysis and Planning | 2010 | 3 | open space, pollution | bar graph | pictoral infographic |
| 5v. | Grid/Street/Place: Essential Elements of Sustainable Urban Districts | Communications | 2010 | 5 | land use | bar graph | |

| | a. Project Title | Category | Year | I.D. | b.what is the graphic representing? | use a standard model? | d. if no to c, describe strategy |
|---|---|---|---|---|---|---|---|
| 5w. | Grid/Street/Place: Essential Elements of Sustainable Urban Districts | Communications | 2010 | 7 , 9 | spatial enclosure (building height to open space ratio) | bar graph | |
| 5x. | Landscape Infrastructures | Communications | 2010 | 8 | flow volumes | line graph | |
| 5y. | Access to Nature for Older Adults: Promoting Health Through Landscape Design | Research | 2010 | 8 | landscape features that increased time spent outdoors | bar graph | |
| 5z. | Getting to Minus 80: Defining the Contribution of Urban Form to Achieving Greenhouse Gas Emission Reduction Targets | Research | 2010 | 8 | land use profile | pie chart | |
| 5za. | Getting to Minus 80: Defining the Contribution of Urban Form to Achieving Greenhouse Gas Emission Reduction Targets | Research | 2010 | 10 | greenhouse gas emissions | integrated sequential bar graphs (?) | |
| 5zb. | Getting to Minus 80: Defining the Contribution of Urban Form to Achieving Greenhouse Gas Emission Reduction Targets | Research | 2011 | 11 | greenhouse gas emissions | integrated sequential bar graphs (?) | |
| 5zc. | Getting to Minus 80: Defining the Contribution of Urban Form to Achieving Greenhouse Gas Emission Reduction Targets | Research | 2011 | 12 | greenhouse gas emissions | integrated sequential bar graphs (?) | |
| 5zd. | An Emerging Natural Paradise-Aogu Wetland Forest Park Master Plan | Analysis and Planning | 2011 | 4 | habitat composition | non-typical pie chart | |
| 5ze. | An Emerging Natural Paradise-Aogu Wetland Forest Park Master Plan | Analysis and Planning | 2011 | 9 | water level management | flowchart (cycle diagram) | |
| 5zf. | Low Impact Development: A Design Manual For Urban Areas | Communications | 2011 | 3 | soil structure | soil triangle | |
| 5zg. | Adding Green to Urban Design | Analysis and Planning | 2011 | 4 | land use | pie chart | |

| | a. Project Title | Category | Year | I.D. | b.what is the graphic representing? | use a standard model? | d. if no to c, describe strategy |
|---|---|---|---|---|---|---|---|
| 5zh. | Adding Green to Urban Design | Analysis and Planning | 2011 | 8 | public right of way area | pie chart | |
| 5zi. | Adding Green to Urban Design | Analysis and Planning | 2011 | 11 | public landscape area | pie chart | |
| 5zk. | The Regeneration / Yongsan Park | Analysis and Planning | 2011 | 10 | ecosystem services distribution | multiple pie charts, scaled and distributed | |
| 5zl. | Integration Habitats: "Growing Together" | Analysis and Planning | 2011 | 5 | regional structure of ecological and human systems | timeline (with graphics) | |
| 5zm. | Integration Habitats: "Growing Together" | Analysis and Planning | 2011 | 14 | land use intensity and diversity | bar graph | |
| 5zn. | South Grand Boulevard "Great Streets Initiative" | Analysis and Planning | 2011 | 5 | pervious surfaces, plantings, heat island effect, emissions | line graph, bar graphs | |
| 5zo. | South Grand Boulevard "Great Streets Initiative" | Analysis and Planning | 2011 | 13 | tree canopy, tree count, monetary benefits | bar graphs | |
| 5zp. | The Regeneration / Yongsan Park | Analysis and Planning | 2011 | 9 | ecosystem attributes (landform, plant species, birds, community structure, etc.) | no | infographic chart |
| 5zq. | Making a Wild Place in Milwaukee's Urban Menomonee Valley | Analysis and Planning | 2011 | 5 | precipitation | bar graphs, line graph | |
| 5zr. | Multi-Variate Study of Stormwater BMPs | Research | 2011 | 7 | water depth | bar graph (histogram) | |
| 5zs. | Governors Island Park and Public Space Master Plan | Analysis and Planning | 2012 | 10 | animal habitats, vertically stratified | | Pictographic "scatter plot" integrated with section line |
| 5zt. | Core Area of Lotus Lake National Wetland Park Landscape Planning | Analysis and Planning | 2012 | 2 | types of bird species present | bar graph | |

| | a. Project Title | Category | Year | I.D. | b.what is the graphic representing? | use a standard model? | d. if no to c, describe strategy |
|---|---|---|---|---|---|---|---|
| 5zu. | Core Area of Lotus Lake National Wetland Park Landscape Planning | Analysis and Planning | 2012 | 5 | habitat types and associated species | bar graph | |
| 5zv. | Core Area of Lotus Lake National Wetland Park Landscape Planning | Analysis and Planning | 2012 | 7 | water quality | line graph | |
| 5zw. | Core Area of Lotus Lake National Wetland Park Landscape Planning | Analysis and Planning | 2012 | 14 | habitat area | bar graph | |
| 5zx. | Wusong Riverfront: Landscape Infrastructure Pilot Project | Analysis and Planning | 2012 | 10 | water level | line graph | |
| 5zz. | Coastal Roulette: Planning Resilient Communities for Galveston Bay | Analysis and Planning | 2012 | 10 | NPS land area | bar graph | |
| 5zza. | Coastal Roulette: Planning Resilient Communities for Galveston Bay | Analysis and Planning | 2012 | 11 | Park land area, distance and budget; park visitation and population | bar graphs | scaled circles |
| 5zzb | A Strategic Masterplan for the Dead Sea | Analysis and Planning | 2012 | 3 | inflow to dead sea | no | iconographic ratio |
| 5zzc. | A Strategic Masterplan for the Dead Sea | Analysis and Planning | 2012 | 9 | water demand | pie chart (donut) | iconographic ratio |
| 5zzd | Landscape Infrastructure: Case Studies by SWA | Communications | 2013 | 13 | | | *see 4zzh--duplicate |
| 5zze | Productive Neighborhoods: A Case Study Based Exploration of Seattle Urban Agriculture Projects | Research | 2012 | 3 | food miles traveled | | infographic |
| 5zzf | Green Roof Innovation Testing Laboratory | Research | 2013 | 4 | percentage of seed mix | | very simple infographic (shaded portion of rectangle) |
| 5zzg | Green Roof Innovation Testing Laboratory | Research | 2013 | 5 | percentage of seed mix | pie chart | |

| | a. Project Title | Category | Year | I.D. | b.what is the graphic representing? | use a standard model? | d. if no to c, describe strategy |
|---|---|---|---|---|---|---|---|
| 5zzh | Green Roof Innovation Testing Laboratory | Research | 2013 | 7 | percentage of seed mix | | very simple infographic (shaded portion of rectangle) |
| 5zzi | Oriented Fabric: Farmington Arkansas | Analysis and Planning | 2013 | 5 | nutrient cycling | flowchart (cycle diagram) | |
| 5zzj | Petrochemical America | Communications | 2013 | 2 | atmospheric co2 | line graph (integrated with historical timeline | |
| 5zzk | Petrochemical America | Communications | 2013 | 3 | petrochemical products | | scaled text, but unclear what the scale indicates *Also integrated with plan |
| 5zzl | Petrochemical America | Communications | 2013 | 6 | petrochemical products | | scaled text, but unclear what the scale indicates |
| 5zzm | Petrochemical America | Communications | 2013 | 6 | toxics releasing and population | | infographic (population), scaled circles for toxics amount, spatially located as well |
| 5zzn | The Lawn is Dead - Long Live the Lawn | Research | 2013 | 1 | area of lawn and turf | | modified pie chart (nested circles) |
| 5zzo | The Lawn is Dead - Long Live the Lawn | Research | 2013 | 3 | above and belowground biomes | bar graph | |
| 5zzp | The Lawn is Dead - Long Live the Lawn | Research | 2013 | 4 | effects of mowing frequency | | infographic |
| 5zzq | The Lawn is Dead - Long Live the Lawn | Research | 2013 | 5 | weed vs. leaf density | bar graph | |
| 5zzr | Green Infrastructure Master Plan | Research | 2013 | 6 | bioinfiltration | line graph | |
| 5zzs | Zidell Yards District-Scale Green Infrastructure Scenarios | Analysis and Planning | 2014 | 4 | stormwater management conceptual appraoch | flowchart | |

| | a. Project Title | Category | Year | I.D. | b.what is the graphic representing? | use a standard model? | d. if no to c, describe strategy |
|---|---|---|---|---|---|---|---|
| 5zzt | Zidell Yards District-Scale Green Infrastructure Scenarios | Analysis and Planning | 2014 | 6 | overland discharge | (somewhat spatially explict) | |
| 5zzu | Zidell Yards District-Scale Green Infrastructure Scenarios | Analysis and Planning | 2014 | 9 | green infrastructure comparison | bar graph | |
| 5zzv | Zidell Yards District-Scale Green Infrastructure Scenarios | Analysis and Planning | 2014 | 11 | green infrastructure comparison | bar graph | |
| 5zzw | Zidell Yards District-Scale Green Infrastructure Scenarios | Analysis and Planning | 2014 | 13 | green infrastructure comparison | bar graph | |
| 5zzx | Monk's Garden: A Visual Record of Design Thinking and Landscape Making | Communications | 2014 | 11 | planting calendar and bloom time | coordinated thematic timeline | |
| 5zzy | A New Norris House Landscape | Research | 2014 | 6 | water supply quality | bar graphs (mini multiples) | |
| 5zzz | A New Norris House Landscape | Research | 2014 | 7 | water supply quantity | line and bar graphs | |
| 5zzza | A New Norris House Landscape | Research | 2014 | 8 | reduction in water consumption | | pictoral infographic |
| 5zzzb | A New Norris House Landscape | Research | 2014 | 9 | greywater quantity | line graphs | |
| 5zzzc | The Phenology Project | Research | 2014 | 11 | "ephemeral attributes" of plant seasonality--"presence" | | graphic circular timeline |
| 5zzzd | Dallas Connected Cities | Analysis and Planning | 2015 | 2 | population and water distribution | pie charts | infographic |
| 5zzze | Dallas Connected Cities | Analysis and Planning | 2015 | 4 | traffic | pie chart | |
| 5zzzf | Dallas Connected Cities | Analysis and Planning | 2015 | 4 | water storage | line graph/scatter plot | |
| 5zzzg | Dallas Connected Cities | Analysis and Planning | 2015 | 4 | water management by area | bar graph | diagramatic infographic |

| | a. Project Title | Category | Year | I.D. | b.what is the graphic representing? | use a standard model? | d. if no to c, describe strategy |
|---|---|---|---|---|---|---|---|
| 5zzzh | Design Potential of Landscape History | Research | 2015 | 3 | revenue | bar graphs (overlapped) | |
| 5zzzi | Collective  Visions: Exploring the Design Potential of Landscape History | Research | 2015 | 10 | "envisioning the future" (additional details not specified) | flowchart (iconographic) | |
| 5zzzj | Collective  Visions: Exploring the Design Potential of Landscape History | Research | 2015 | 12 | habitat aspects | | annotated infographic timeline |
| 5zzzk | Collective  Visions: Exploring the Design Potential of Landscape History | Research | 2015 | 13 | composting cycle | flowchart | |
| 5zzzl | Spontaneous Urban Plants | Research | 2015 | 11 | plant seasonality | timeline | |
| 5zzzm | Below the Surface: Evaluating Urban Soil Performance Over Time | Research | 2015 | 2 | soil types | | spiderweb diagram |
| 5zzzn | Below the Surface: Evaluating Urban Soil Performance Over Time | Research | 2015 | 7 | tree growth rate from tree core analysis | bar graph | |
| 5zzzo | Below the Surface: Evaluating Urban Soil Performance Over Time | Research | 2015 | 8 | tree growth rate | box and whisker plot | |
| 5zzzp | Below the Surface: Evaluating Urban Soil Performance Over Time | Research | 2015 | 9 | soil course material content | line graph | |
| 5zzzq | Below the Surface: Evaluating Urban Soil Performance Over Time | Research | 2015 | 10 | soil electrial conductivity | line graph | |
| 5zzzr | Below the Surface: Evaluating Urban Soil Performance Over Time | Research | 2015 | 11 | soil organic matter | scatter plot with trend line | |
| 5zzzs | Below the Surface: Evaluating Urban Soil Performance Over Time | Research | 2015 | 12 | organic matter content over time | decay curve, line graph | |
| 5zzzt | Below the Surface: Evaluating Urban Soil Performance Over Time | Research | 2015 | 13 | soil diameter growth over time | line graph | |
| 5zzzu | Below the Surface: Evaluating Urban Soil Performance Over Time | Research | 2015 | 14 | soil pH | scatter plot with trend line | |

| | a. Project Title | Category | Year | I.D. | b.what is the graphic representing? | use a standard model? | d. if no to c, describe strategy |
|---|---|---|---|---|---|---|---|
| 5zzzv | Restoration in Urban Parks: Long-term Tests of Forest Management to Advance Landscape Structure and Function | Research | 2015 | 6 | native ground layer cover | box and whisker plot | |
| 5zzzw | Restoration in Urban Parks: Long-term Tests of Forest Management to Advance Landscape Structure and Function | Research | 2015 | 8 | native trees | box and whisker plot | |
| 5zzzx | Restoration in Urban Parks: Long-term Tests of Forest Management to Advance Landscape Structure and Function | Research | 2015 | 9 | native ground layer, restored vs. unrestored | pie chart | |
| 5zzzy | Restoration in Urban Parks: Long-term Tests of Forest Management to Advance Landscape Structure and Function | Research | 2015 | 10 | average proportion of woody understory stems, restored vs. unrestored | Pie chart | |
| 5zzzz | Restoration in Urban Parks: Long-term Tests of Forest Management to Advance Landscape Structure and Function | Research | 2015 | 11 | total cover, restored vs. unrestored | stacked bar graph | |

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