The Path to Geodesign: The Family Car of Digital Landscape Architecture?

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Abstract

Decision-making about the environment is a fundamentally critical task – just like driving to work, collecting groceries and taking children to school. Very few drivers know much beyond the basic operating principles of their cars yet they are completely competent to use these technically sophisticated tools safely and efficiently. Ordinary people also make decisions about design and planning every day although they are not designers, programmers, ecologists or visualization experts. Are we confident that the geodesign systems we put in their hands will result in safe and efficient outcomes? Geodesign has emerged rapidly as a useful expression integrating the traditional core skills of the landscape designer and planner with the advanced tools that have been the focus of Digital Landscape Architecture. It promises to be a critical general-purpose decision-support tool for landscape architectural design and planning. It arrives at a time of great demands for stakeholder engagement in design and planning decisions, and for evidence-based design. I will use the analogy of the family car to explore the nature and promise of geodesign as a general-purpose design tool, how it might proceed and how it could be evaluated.

1 Introduction

Geodesign has rapidly emerged as a useful expression to encompass all the things we wish for the integration of the traditional core skills of the landscape designer and planner with the advanced tools that have been the focus of Digital Landscape Architecture meetings. It has the promise to be a critical general-purpose decision-support tool for landscape architectural design and planning. As such it arrives at a time when demands for stakeholder engagement in design and planning decisions, and the necessity for evidence-based design place new burdens on designers and their processes.

The central argument to this paper is that while the digital landscape architecture community has evolved ever better methods for technical analysis supported by increasingly clever visuals, e.g., Sheppard, 2005; Stock et al., 2009; Berry and Higgs, 2012; Pettit et al., 2012, we have not given the same attention to creating the means by which non-experts can participate other than as viewers (cf. Lange, 2008.) At the same time in allied fields we have excellent examples of engaged public participation, but without exploiting visualization tools to facilitate communication of landscape change. Voinov and Bousquet (2010) describe how they engage stakeholders in modelling future landscape scenarios. They highlight processes of shared visioning and discuss the challenges of dealing with surprise and disagreement, yet do not identify visualization as a means to achieving shared understanding. Palacios-Agundez and colleagues (2014) describe a process for visioning the future of a landscape in Spain where forestry is no longer profitable, relying on quantitative analyses yet expressing how lack of scientific insights limited stakeholder engagement. Forester and colleagues (2015) described a thoughtful Q-sort approach to understanding stakeholder perceptions of landscape adaptations and their impacts on water regimes in northern England, and point to the need for methods that are better at conveying the meaning of landscape change and "concise structured outputs rather than wordy reports." It is clearly necessary to integrate emerging engaged participatory processes and the sophisticated explanatory and exploratory tools developed as geodesign.

The family car is a general-purpose tool. It can be very simple or it can take on numerous specialized forms and perform extraordinary feats in expert hands. Once trained in the basics, drivers short and tall, poor and wealthy can get into any one and undertake complete tasks—they need no further instruction, much of what they do will be intuitive. The design of a successful car has two basic goals: A clear, consistent and equitable user interface, and a reliable foundation in science and technology. Geodesign has at its core the same two goals, but the design of the interface needs much work.

2 Background

Close participation with stakeholders can lead to engagement with the design process, perceived ownership of the outcomes and the promise of future involvement in ensuring that plans are implemented (Philipson et al., 2012; Voinov and Bousquet, 2010.) The closely related domain of public participatory GIS provides numerous examples in which stakeholder values are captured and mobilized in the planning process (Al-Khodmany, 1999; Elwood, 2006.) Evidence-based design, an expression borrowed from heath-care design, looks to bodies of environment-behavior research to advance the necessity to design deliberately to achieve beneficial outcomes identified by research (Verderber, 2014.)

Brown and Corry (2011) describe a process for the deliberate application of science-based evidence to the landscape design process and also argue that landscape architecture should avoid internal specialization but instead look to the best knowledge sources gleaned from academia, practitioners and the public. Beunen and Opdam, in the same special issue of *Landscape and Urban Planning* (2011) highlight the challenge of incorporating science in planning, specifically focusing on the distrust of experts and science in developing and implementing government policy. They point to the increasing complexity and ambiguity of science in describing the implications of the compelling phenomena of the age—climate change, renewable energy, aging populations—and remind us of the tendency for competing parties to only select the science findings that support their claims. They call for landscape design and planning to develop more insights into the means by which knowledge affects the societal processes of design and planning and suggest means to gather those insights. Rather than acknowledging and accepting the separation of scientific insights and community processes, this paper instead proposes that the geodesign framework (Steinitz, 2013) provides a mechanism and process by which ground-level participatory insight can be integrated with strategic-level scientific modelling, and in doing so provide a trusted vehicle for communication between citizen and scientist. The geodesign framework will, however, need some adjustment.

3 Modifying the Geodesign Framework

In the 100th volume of *Landscape and Urban Planning* Lange (2011) and Bishop (2011) focused attention on two key facets of evolving digital landscape architecture—the increasing sophistication of digital visualization in representing the nature of the landscape and the potential for game-like interfaces to engage users of various knowledge levels and providing insight into the systems underlying landscape change.

There is a rich history and literature regarding the contribution of visualization to the communication of landscape design and planning ideas—their value has been substantiated numerous times in practice and in research. Landscape visualization approaches commonly used by landscape architects have also been adopted in allied fields (Ferster and Coops, 2014; Llobera, 1996.) Nevertheless, the development of visualization tools has tended to be evolutionary rather than revolutionary—there is a clear path between early digitally edited images of landscape change and the most recent (Orland, 1986; Manyoky et al., 2014) and between early GIS maps and the most recent (Steinitz, 2014.) While the effectiveness of such images and maps in conveying change has been well substantiated, it is less clear if they are the best way to convey landscape change and authors have repeatedly pointed to the anticipated benefits of better immersive and multi-sensory display formats (Lange, 2011; Pettit et al., 2012; Sheppard, 2005.) As "Representation" is a key component of geodesign, design of its visual, perhaps multi-modal, interface should emerge from the widest possible survey of what it could be.

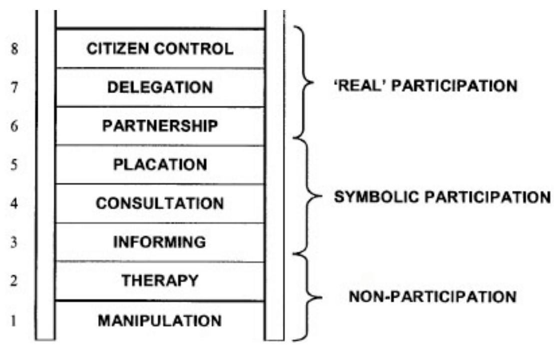

Fig. 1: Arnstein's Ladder of Citizen Participation (1969: 217)

Following Arnstein's (1969) Ladder of Citizen Participation (Fig 1), geodesign should be configured to support stakeholder partnership, delegated decisions and control of outcomes. Much has been written about public participation in technical planning, in many cases incorporating visualization as both a means for eliciting public values and as a way to convey those to others (Al-Khodomany, 1999; Forester et al., 2015; Palacios-Agundez et al., 2014; Phillipson et al., 2012.) However, in all cases choices have been made between using technically complete information that requires substantial training to interpret or simplified approaches that might be criticized as over-simplifying complex problems.

There is, however, guidance on resolving this apparent dichotomy. Vervoort et al. (2014) worked with mixed groups of media designers and complex system scientists to develop ways to communicate about climate change. The results fell into three categories: storytelling; system exploration games; and group interactions, each of which had an important and complementary role in communication. Storytelling relies on metaphor and narrative to make complex system interactions meaningful as well as conveying participants' roles in those systems. System exploration games convey complexity and interaction in engaging ways but fail to capture the individual perspectives and contributions of participants. Group interactions, which may include role-playing exercises, enable the expression and testing of individuals' values against one another but may not scale up to include large numbers or wide ranges of individuals.

Vervoort and colleagues' results offer guidance for the development of a participatory and communications window to geodesign. None of the three components mentioned above is new to environmental decision-making although there are few examples of all three coming together in a single setting. Each may suffer from being perceived as play-like, informal and not sufficiently serious for the important tasks at hand. Orland et al. (2014), observed the challenge of engaging scientists and managers in serious games enjoying broad adoption among other office workers.

Storytelling: The geography literature is rich with examples of storytelling as a means of discovering community values, of negotiating differences in values, and of envisioning the future (Cameron, 2012; Lorimer and Parr, 2014.) Stories connect the experience of the individual in the landscape to the circumstances and environments around them and convey meaning rather than simply location and physical composition. Cameron reviews the role of storytelling in expressing values and power relationships and leading to policy. Of particular use to landscape architecture is increased attention to small local stories. The stories of land occupation and the activities of daily life are the settings within which decision-making about landscape change should occur. Mikhailovich, (2009) and Paquet, (2013) describe community discourse in the context of wicked problems. For Mikhailovich the explicit embodiment of community, government and industry values to build trust in an ecosystem approach may have provided ways to address future water security needs.

System exploration games: Discovering how landscape systems work is essential to meaningful participation in landscape design and planning, and thus geodesign. Umphlett et al. (2009) and Brock and Deckert (2008) are among numerous authors who point to the value of games for exploring ecosystem dynamics. Daniel (2014) provides a number of examples used to teach engineering principles and Marlowe (2012) describes the pedagogical benefits of games as means to environmental design teaching. Although not described as a game, Metcalf et al. (2010) describe the development of an exploratory model of the Mississippi watershed based on STELLA (ISEE Systems, 2006) that has the characteristics of a game to educate stakeholders in ecosystem behaviour. The author and colleagues (Orland et al., 1997) exploited that connection for a museum game exploring the relationship between forest structure and wildlife populations. The connection to STELLA is additionally important in that numerous environmental system models are already available in that environment (e.g., Costanza, 1998; Costanza and Voinov, 2001.) System exploration games will be essential components of a "front end" to geodesign.

Group interactions: Role-playing games have been in use for many years for investigation of policy interventions in landscape planning—for managing and learning from the group interactions that occur as participants seek consensus among competing views and values (Duke, 2011.) Although some key computer-based tools emerged, e.g., METROPOLIS (Duke, 1966) and METRO-APEX (McGinty, 1985) there is a surprising dearth of such aids currently, although the communication processes may have replaced by the internet and tools such as GoogleDocs. MacIntyre (2003) used a board game to demonstrate landscape design principles in Australia; Pak and Castillo-Brieva (2010) used similar games to engage local peoples in understanding the factors driving landscape transformation in Colombia; and Speelman and colleagues (2014) used a similar approach for land-use planning in an agricultural landscape in Mexico. In our own work (Orland and Murtha, 2014) we have made extensive and effective use of a felt-board game [1]to educate citizens about the planning processes in natural gas development.

4 Design of a Complete System

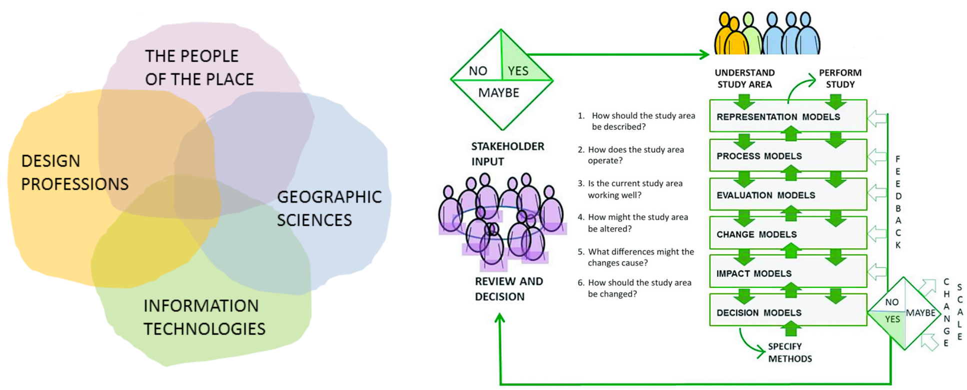

Fig. 2: The People of the Place in the Geodesign Framework (Steinitz, 2013)

Geodesign as described by Steinitz (2013) illustrates the critical role played by the "People of the Place" in reviewing and informing the design process, although stakeholder input is shown outside the core of the diagram of the design process (Figure 2.) This external location for stakeholder participation is reflective of common practice (See Figure 1) but does not represent an ideal means to assure that stakeholder input is both informed and used appropriately, and the location "outside" the design framework diverts attention from the need to integrate participation into the technical system. While the case studies described in "A Framework for Geodesign" (Steinitz, 2013) emphatically do include thoughtful and

[1] Created by Caitlin Smith, O2 Planning + Design Inc., Calgary. MLA, Penn State, 2012.

comprehensive stakeholder engagement, each instance was tailored to its circumstances and choreographed by Steinitz—they may not constitute repeatable and generalizable processes.

The fundamental geodesign framework is not dependent on computer technology but can be conducted equally well on sheets of paper or a chalkboard, but for most practitioners geodesign is thought of as a technical design approach. Digital GIS and BIM tools enable designers to consider more issues, with more precision and ability to interact and change the designs under consideration. In a similar manner, digital tools should be mobilized to introduce stakeholder participants to geodesign, teach them about its workings and enable them to frame their concerns in a manner to which technical design tools can respond.

What is the participatory design interface through which stakeholders from non-design backgrounds approach, comprehend and participate in geodesign? It is proposed here that system exploration story telling, exploratory game and group interaction elements as identified by Vervoort et al. (2014) will be key elements of the geodesign participatory design interface. The world of serious games (Bishop, 2011; Chang, 2011) offers a framework that lends itself to integration of these three elements in stakeholder engagement and participation, all in a richly visual interactive and engaging environment. A game-like approach also lends itself to deployment via mobile devices, e.g., Dogbey et al., 2014; Ferster and Coops, 2014, enabling participation to take place in place, *in situ,* and in real life, *in vivo*, in the environments at issue. The author, in a lightning talk at Geodesign 2014 (Orland, 2014) suggested a three-part interface to geodesign comprising a narrative story, an exploratory serious game and a browsing library of past geodesign projects as a means to engage and educate participants about system fundamentals and then convey the range of possible design questions participants might ask of a technical geodesign support system.

However, while technological advances can lead to increasingly capable systems, they also tend to put more burdens on users. In the case under discussion, the opposite is desired. The characteristics and performance needs of a geodesign interface supporting broad participation through incorporation of storytelling, system exploration, and group interaction will require careful design. While it is likely that an immersive, interactive game-like environment could be integrated within the framework of a GIS/BIM-based geodesign tool, it is not clear how much complexity and power is necessary to achieve its communication goals. The family car displays interface elements that have changed little over 100+ years, others that are less than a decade old. I use the family car as an analogy to investigate what the geodesign interface might be, how and for whom it should perform, and how its effectiveness should be evaluated.

5 The Family Car Analogy

The three system elements described above find a parallel in the design of the family car. The motivation behind the choice of vehicle reflects the story pursued by the owner—small and efficient for shopping, stylish to communicate prestige, spacious for family holidays. An essential first step to choosing a vehicle is to develop the narrative of what it needs to accomplish for the users, and how fast, safely and efficiently it needs to do that. Because most users are constrained by the potential expense as well as concerns as diverse as green-ness and conveying their personal image they will choose a vehicle that is sufficient to achieve their purposes. They will eventually evaluate its effectiveness on the basis of how well it performs the required functions. Flexibility and adaptability will be valued in as much as the car is able to fill functions and needs beyond the initial intention.

Operating the vehicle requires an initial understanding of the underlying systems and practical knowledge of how they interact. Once beyond the minor confusion arising from left- and right-hand driving, most drivers and passengers know how and where to access the car. In general a forward-hinged door with an opening handle gains access. Inside it is clear that the main driving support tool is the forward-facing windshield/screen. Subsidiary tools are arranged below it and close enough for a quick monitoring glance. The biggest is the speedometer providing vital safety information that is not easily assessed by looking through the windshield. Its prominence indicates its importance—there is less consistency in placing the remaining displays. The steering wheel always rotates in the direction of the intended turn. The two or three critical pedal controls below the dashboard are always arranged in the same order, and the way they operate is consistent across all motor vehicles. More "expert" users can add tachometers, oil and water gauges, but mostly their monitoring functions operate via warning lights and automation. Increasingly users can select to monitor their distance travelled and fuel use, assistance with GPS way-finding, track local radio stations and park in awkward spaces. A successful vehicle system will be consistent with these conventions, including some redundancy where experts may desire more information than a simple warning of an impending threshold. The controls will enable safe, economical and consistent operation of the vehicle.

Decisions about where to take the family car are borne out of group interactions. To be effective they rely on the goodwill of the family participants, their knowledge of each other's values and an ability to collaborate in decision-making (subject to intra-familial power dynamics.) To inform the decision, the family will require knowledge of the range of possibilities, of destination as well as means of getting there. They will rely on their memories of past journeys to inform the new decision, and they will provide each other on feedback about the likely implications of alternate choices. The controls of the car will enable the family to reach its destination without the vehicle's controls or systems getting in the way of that goal. The residual effect of the travel experience will be satisfaction with the outcome with the knowledge that everyone's values were considered, weighed and acted upon along the way.

5 Conclusion

The geodesign interface, like the driver's position in the car, must be consistent and equitable—like the car seat, font sizes and colours should be individually adjustable. The two main goals of the interface are to represent the landscape and to support interactive participation. The first is supported by a large and clear windshield in the car, although the photo-realism of day-time driving may not be necessary for effective use—after all, the night-time scene is by comparison highly abstract, less colour-rich and more symbolic in the way space is represented. Dahlstrom et al., (2009) indicate that high fidelity and realism in flight simulators is not necessary to pilot training and that lower fidelity displays may be more effective in supporting the development of generic decision-making skills. The same thinking should be tested for geodesign displays. Temporal and spatial navigation are accomplished in almost identical form in all automobiles. Geodesign interactivity should be equally familiar and consistent. Use and depletion of resources in response to user inputs must be available immediately, but might be accomplished by warning lights as limits are reached, rather than analogue or digital gauge feedback.

Family cars, as much as Formula 1 racing cars, have a reliable foundation in science and technology. The latter are some of the most heavily instrumented objects in the world (Waldo, 2009) and the driver of the family car would be overwhelmed by that data, even though it is reporting on the same underlying automobile architecture. Our current conception of geodesign tends to the Formula One model—perhaps with some justification since earth's systems are fragile and deserving of careful monitoring—but even racing team engineers, drivers and managers select the information they need for their specific functions. They do not seek to monitor all systems and trade-off much monitoring to closed-loop automated systems. In the family car even more data management is trusted to automated controls. The effects in recent years have been huge reductions in energy use and environmental emissions in individual vehicles. Geodesign should seek the same ends for its users. Key indicators—water availability and use; carbon sequestration; and climate effects—are monitored for all actions and thresholds are set to monitor performance. Users select the systems they wish to monitor most closely but are still alerted to the implications of their actions in other systems—higher speeds will reduce travel time but increase fuel consumption. The choices available to the family car buyer have been tailored by years of observation and direct feedback—they express their preferences through the marketplace. While geodesign lacks the longevity and scale of market of the family car we must systematically apply the same kind of thinking. While we may not like the proliferation of the family car, by understanding how people use and interact with these popular but complex systems we may find the means by which geodesign will become equally central to making daily good and supportable environmental decisions.

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