Six Key Conditions for Successfully Implementing a Responsive Landscape Planning Approach

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Abstract: A responsive landscape planning approach is characterized by feedback loops between sensing the environment and the designing and planning process. Advancements in this approach come along with technological developments and the generation of vast amount of data providing many new opportunities but also important challenges. While landscape planning and design requires a thorough understanding of the complex interactions between natural and socio-cultural factors, it is unclear how these new workflows and these data can successfully be implemented to shape landscapes that provide societally valued and needed qualities. We suggest six conditions for a successful implementation of such an approach and illustrate them with various examples. We discuss to what extent this new approach can create a knowledge-driven rather than a data-driven design and planning process and conclude with discussing the potential of the approach to foster social learning enabling shaping and transforming our landscapes.

Keywords: GIS, design, decision-support systems, participatory, Geodesign

1 Introduction

Landscapes are being continuously shaped by dynamic and complex interactions between natural and socio-cultural factors (COUNCIL OF EUROPE 2000). The resulting landscape character is a key determinant for the tie between people and place, and ultimately people's place attachment and place identity (JORGENSEN 2001). Neglecting these interactions can influence people's stewardship for their landscape and cause a loss in people's motivation to participate in the landscape-shaping process (BUCHECKER et al. 2003, HUNZIKER et al. 2008). Landscape planning and design methods, as both collective and creative processes and products of shaping the landscape, thus need to provide insight into the systems' feedback relations in order to identify designs and plans that can provide societally valued and needed qualities within the environmental and the social constraints of the landscape systems (STEINITZ 2012, GRÊT-REGAMEY et al. 2014, WISSEN HAYEK et al. 2016).

Technological achievements in data acquisition and processing, as well as simulating and visualizing landscapes invite new ways to plan and design landscapes. They foster iterative feedback loops between data obtained from the environment and the process of designing and planning. Such an iterative process between capturing, analysing and visualizing data of the environment and designing and planning landscapes provides the basis for a responsive landscape planning approach – a landscape planning approach capable to respond to changes in the environment. CANTRELL & HOLZMAN (2016) present a large number of cross-disciplinary projects, giving a sense of the immersive and participatory human experiences such landscape response outputs can produce. The development of workflows linking outputs from natural and physical scientists or engineers with designers is however not new. Linking design and ecology has already been promoted under the concept of "experimental design" at the beginning of the century to help test the ecological effects of different strategies using adaptive experimentation (PALMER et al. 2005, FELSON & PICKET 2005), and as a means for landscape change a few years later (NASSAUER & OPDAM 2008). In recent years, the approach entered the urban ecological community with AHREN et al. (2014) suggesting a planning framework for supporting adaptive urban planning, in which experimental design principles are integrated and operationalized with professional practice. CHILDERS et al. (2015) presented and illustrated the effectiveness of a transformative model that iteratively links urban design and ecology to foster an inclusive, creative, knowledge-to-action process. And PICKET et al. (2016) expanded on the conceptual, empirical, and methodological contents of an "ecology for city", which involves science in civic discourse, and engagement with the processes of shaping urban systems and their components. Such transdisciplinary processes have been facilitated by Geodesign approaches introduced by STEINITZ (2012), which provide on-demand simulations and impact analyses to provide more effective and more responsible integration of scientific knowledge and societal values into the design of alternative futures (ERVIN 2014).

With the world increasingly generating vast datasets of our environment, landscape planning and design call for advice on developing effective workflows for such responsive processes. Building on a set of principles for managing the landscape (called the landscape approach[1]) suggested by SAYER et al. (2013), this contribution presents six key conditions for successfully implementing a *responsive* landscape planning approach. We focus on the added challenges of implementing a landscape approach when sensed technologies are used to inform designs and plans about changes and impacts on the environment. While the bottom-up landscape approach implies a process-oriented opposed to a project-oriented planning approach, a *responsive* landscape approach additionally involves a thorough understanding of the risk and opportunities involved in capturing, processing, and visualization the new large datasets gathered by information-sensing devices. The six conditions presented in the following section thus provide a first set of recommendations to develop best landscape planning practices when using emerging technologies for sensing and responding to real-world conditions, and might ultimately have traction in guiding the shaping of responsive landscapes.

2 Six Key Conditions of a Responsive Landscape Planning Approach

Condition 1: Securing Space for Development

In order to allow landscapes to respond to sensed data, there needs to be enough space for landscapes to change. As environmental responses to humans are often nonlinear and uncontrollable (FOLKE et al. 2002), this space must allow unexpected disturbance. Potential flooding areas, for example, allow buffering climate-induced extreme rain events. Simultaneously, such areas can provide other important potential ecosystem services such as recreational services for future urban dwellers and habitats for endangered species (Fig. 1). Planning and designing space allowing the landscape to respond to unexpected environmental changes, and provide ecosystem services needed by future generations, thus requires understanding of how the landscape functions and which basic functional processes are needed to maintain the

1 SAYER'S et al. (2013) landscape approach suggests good practices to managing landscapes by emphasizing the need of negotiations among stakeholders in land use and land management decisions.

capacity of the system to renew itself in a dynamic environment. A responsive landscape planning approach needs to focus on supporting the long-term functioning of landscapes across scales as well as their functional biodiversity and protects the system from the failure of management actions that are taken based upon incomplete understanding. It also eventually allows planners and designers to learn and change (GUNDERSON 2000).

Fig. 1: Interactive assessment of urban patterns with green corridors based on ecosystem services trade-offs. Shape grammars based on design specifications and landscape ecological pattern-process relations for quantifying ecosystem services were embedded in a procedural modelling workflow to allow real-time response of the landscape to user preferences (GRÊT-REGAMEY et al. 2013).

Condition 2: Cross-scale Planning

Solutions at large scale do not necessarily inform about solutions at smaller scale, and improving the quality on one scale might affect the quality of another scale. Urban densification, providing desired living space for people, can for example influence habitat connectivity at the regional scale, the quality of open space at the district scale, and the social mix of the population at the local neighbourhood scale. OSTROM (2007) illustrates through various case studies, how difficult it is to manage complex socio-ecological systems due to the manifold interactions of factors across scales. Considering that, a responsive landscape approach empowers the planners and designers to manipulate and respond to environmental processes at various scales, it is highly important that they understand these cross-scale dynamics to develop robust urban development patterns facing the multi-scalar inputs from the environments (WISSEN HAYEK et al. 2015, Fig. 2).

Condition 3: Iterative Interdisciplinary Process

Understanding and responding to the environment allows planners and designers to create place specific responses expressing particular values. New sensing technologies, such as LIDAR technologies, can support bringing scientific knowledge into decision-making. A mutual understanding among the disciplines not only makes the landscape changes more salient and legitimate, but also fosters a negotiated process of change. In an iterative process between science and design, quantitative information about processes and patterns of the environment can become part of the deliberative process over future development that take place within a value-driven process and design. Particularly, computational parametric design has been shown to be highly suitable for such a process, e. g., for coupling landscape designs with hydrodynamic models for rapid design feedback (GRÊT-REGAMEY et al. 2016, Fig. 3).

Fig. 2: Real-time responses of recreational potential of various urban patterns can inform on an optimal design at multiple scales. At the local plan level, a smart city leads to a loss of recreational opportunities (bright areas), which however can be faced at the design level with a different urban design pattern (WISSEN HAYEK et al. 2015).

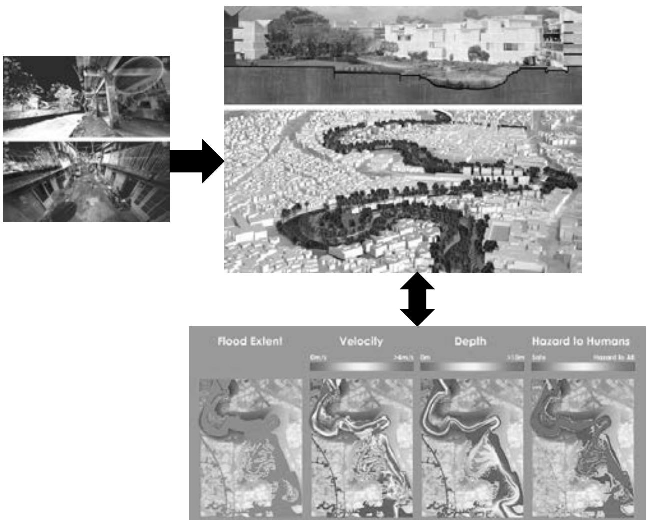

Fig. 3: Point-cloud modifications by landscape architects are reported back and forth to hydrodynamic models of engineers to assess the capability of channel widening to contain floodwaters and the impact on the existing urban fabric in Jakarta (GRÊT-REGAMEY et al. 2014). The interdisciplinary iterative process allowed designing a channel securing the ecosystem services demanded by local dwellers, which was used as a basis for further engineering consideration for restoring the Ciliwung river in Jakarta.

Condition 4: Participatory Process

Most stakeholders have their own interests in defining how to best manage landscapes in order to obtain desired ecosystem goods and services provided by these landscapes. Engaging stakeholders in the planning and design process allows integrating their concerns and aspirations, thus fostering deliberation and negotiation about landscape changes. New tools that allow the integration of participatory processes into landscape planning can make the design process truly interactive and responsive, and new workflows of integrating Geodesign into local collaborative design processes have been elaborated (WISSEN HAYEK et al. 2015; KLEIN et al. 2016, Fig. 4). Besides the development of digital tools, the process of design and planning is key to enable new forms of collaboration and responsive spatial solutions (RAMETSTEINER et al. 2011, STEINITZ 2014. WISSEN HAYEK et al. 2015).

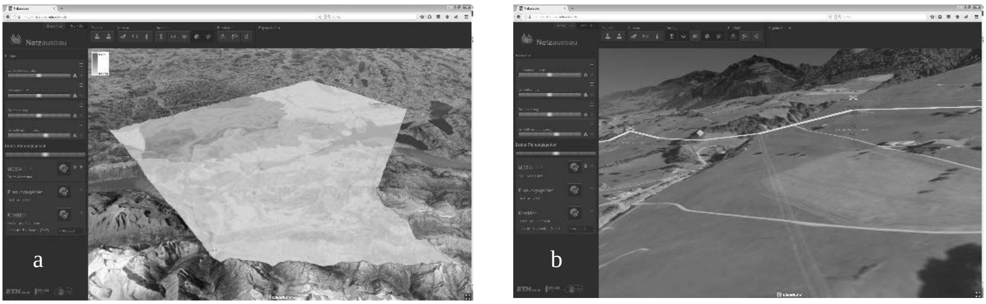

Fig. 4: Online platform for supporting power line planning. Stakeholders can define the weighting of different factors concerning environmental protection, spatial planning, and technical requirements and receive a spatial map showing the spatial resistance (yellow = low, purple = high) against power lines according to their weighting (a). Stakeholders can view the power line from a local perspective and interactively move individual pylons (b).

Condition 5: Access to and Usability of Data

Existing and new sensing technologies (e. g. remote sensing, thermographic cameras, acoustic sensors) provide enormous, dynamic and varied datasets. Limited access to the sensed data can however create inequalities, excluding some of the important stakeholders to the landscape shaping process. Ethical issues of big data in public health, for example, are not new (VAYENA et al. 2015). Attention needs to be paid to secure the access to data and enhance the ability of the public to understand not only what is presented to them, but also how and with what assumptions the new technologies generate information and choices. In addition, as many of the new emerging datasets are generated with no specific questions in mind, planners and designers need to be mindful with respect to the use of the data (e. g. geotagged Twitter was never produced to provide answers with respect to the spatial distribution of people, and neither the drivers of such processes). The data is reflective of the technique used to generate it and holds certain characteristics (KITCHIN 2014).

Condition 6: Need for User-friendly Information and Communication Tools

Massive data and numbers do not speak for themselves. Communication of the sensed data needs a mutual understanding of information between data provider and stakeholder: stakeholders expect to understand information while bringing in their opinions, experience, and expertise when assessing landscape changes. Translating the sensed data into understandable information requires comprehensive consideration of various aspects that make information communicable (KLEIN et al. 2016, Fig. 5). However, it often also requires a real-time modelling approach, which might be difficult depending on the complexity of the socio-ecological system at stake. While visualizations rule the digital interfaces, multi-sensory and material interactions integrated in digital devices can expand the interactions between human sensory capabilities and external environments to consider.

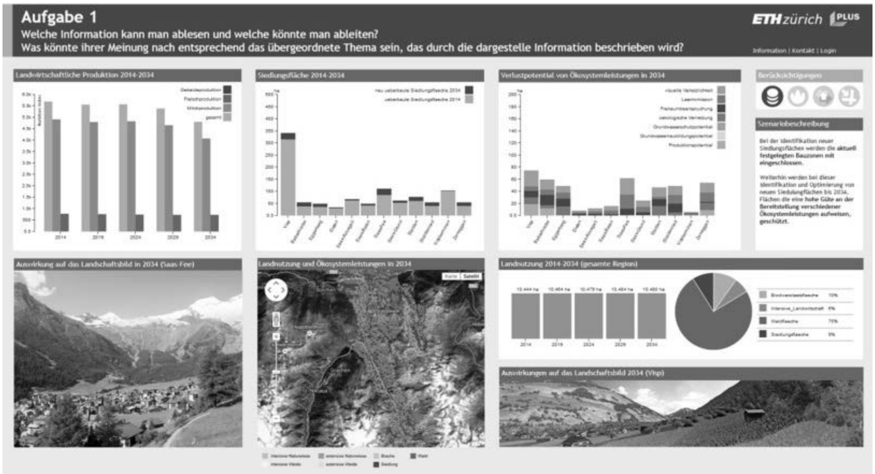

Fig. 5: Interface with various types of representation of information (KLEIN et al. 2016). Users' demands for various types of representation were investigated with eye-tracking experiments.

3 Discussion

A responsive landscape planning approach opens new ways of collaborating across disciplinary boundaries to generate informed landscape designs. Responding to environmental phenomena fosters understanding, interpreting, experiencing and interacting with the landscape (CANTRELL & HOLZMAN 2016). A successful implementation of such an approach can, however, only be reached under some conditions which we present herewith. As people with their values and beliefs are the basis for the approach, we believe that these conditions will evolve with time and be complemented by questions of epistemologies and paradigm shifts across multiple disciplines. These conditions are thus not a final list to be secured when using a responsive landscape planning approach, but can be consulted to help address the challenge of using the new workflows from sensing to processing, visualizing and feedback.

4 Conclusion and Outlook

New sensed technologies are responses to increasing societal concerns about environmental issues. The six conditions presented here to successfully implement a responsive landscape planning approach emphasize inter- and transdisciplinarity. While the opportunities of such approaches are tremendous, particularly to foster novel ways of deliberative decision-making and governance, and ultimately support humans to intentionally transform landscapes, the question remains on how this new approach will change the way we understand and design landscapes and how we will interact with them. In particular, we will need to better understand how the workflow can enable social learning, leading to collective action and institutional changes.

References

AHERN, J., CILLIERS, S. & NIEMELA, J. (2014), The concept of ecosystem services in adaptive urban planning and design: A framework for supporting innovation. Landscape and Urban Planning, 125, 254-259.

BUCHECKER, M., HUNZIKER, M. & KIENAST, F. (2003), Participatory landscape development: overcoming social barriers to public involvement. Landscape and Urban Planning, 64 (1-2), 29-46.

CANTRELL, B. & HOLZMAN, J. (2016), Responsive Landscapes, Strategies for responsive technologies in landscape architecture. Routledge, London & New York, USA.

CELIO, E. & GRÊT-REGAMEY, A. (2016), Understanding farmers' influence on land-use change using a participatory Bayesian network approach in a pre-Alpine region in Switzerland. Journal of Environmental Planning and Management, 59/11, 2079-2101.

CHILDERS, D. L., CADENASSO, M. L., GROVE, J. M., MARSHALL, V., MCGRATH, B. & PICKETT, S. T. (2015), An ecology for cities: A transformational nexus of design and ecology to advance climate change resilience and urban sustainability. Sustainability, 7, 3774-3791.

COUNCIL OF EUROPE (2016), The European Landscape Convention. Strasbourg.

ERVIN, S. (2014), BioComplexity, Systems Thinking, and Multi-Scale Dynamic Simulation: Foundations of Geodesign. In: WISSEN HAYEK, U., FRICKER P. & BUHMANN, E. (Eds.), Peer Reviewed Proceedings of Digital Landscape Architecture 2014 at ETH Zurich. Wichmann, Berlin/Offenbach.

FELSON, A. J. & PICKETT, S. T. (2005), Designed experiments: new approaches to studying urban ecosystems. Frontiers in Ecology and the Environment, 3, 549-556.

FOLKE, C., CARPENTER, S., ELMQVIST, T., GUNDRSON, L., HOLLING, C. S. & WALKER, B. (2002), Resilience and sustainable development: building adaptive capacity in a world of transformations. AMBIO: A Journal of the Human Environment, 31, 437-440.

GRÊT-REGAMEY, A., CELIO, E., KLEIN, T. M. & WISSEN HAYEK, U. (2013), Understanding ecosystem services trade-offs with interactive procedural modeling for sustainable urban planning. Landscape and Urban Planning, 109, 107-116.

GRÊT-REGAMEY, A., BURLANDO, P., GRIOT, C., LIN, E. S., SHAAD, K. & VOLLMER, D. (2014), Digital methods and collaborative platforms for informing design values with science. In: WISSEN HAYEK, U., FRICKER, P. & BUHMANN, E. (Eds.), Peer Reviewed Proceedings of Digital Landscape Architecture 2014 at ETH Zurich, Wichmann, Berlin/Offenbach, 46-56.

GRÊT-REGAMEY, A., WEIBEL, B., VOLLMER, D., BURLANDO, P. & GIROT, C. (2016), River rehabilitation as an opportunity for ecological landscape design. Sustainable Cities and Society, 20, 142-146.

GUNDERSON, L. H. (2000), Ecological resilience – in theory and application. Annual review of Ecology and Systematics, 31, 425-439.

HUNZIKER, M., FELBER, P., GEHRING, K., BUCHECKER, M., BAUER, N. & KIENAST, F. (2008), Evaluation of landscape change by different social groups: results of two empirical studies in Switzerland. Mountain Research and Development, 28 (2), 140-147.

JORGENSEN, B. S. & STEDMAN, R. C. (2001), Sense of place as an attitude: Lakeshore owners attitudes toward their properties. Journal of environmental psychology, 21 (3), 233-248.

KITCHIN, R. (2014), The data revolution: Big data, open data, data infrastructures and their consequences, Sage.

KLEIN, T. M., DROBNIK, T. & GRÊT-REGAMEY, A. (2016), Shedding light on the usability of ecosystem services-based decision support systems: An eye-tracking study linked to the cognitive probing approach. Ecosystem Services, 19, 65-86.

NASSAUER, J. I. (2012), Landscape as medium and method for synthesis in urban ecological design. Landscape and Urban Planning, 106, 221-229.

NASSAUER, J & OPDAM, P. (2008), Design in science: extending the landscape ecology paradigm. Landscape Ecology, 23, 633-644.

OSTROM, E. (2007), A diagnostic approach for going beyond panaceas. Proceedings of the National Academy of Sciences, 104, 15181-15187.

PALMER, M. A., BERNHARDT, E. S., ALLAN, J. D., LAKE, P. S., ALEXANDER, G. et al. (2005), Standards for ecologically successful river restoration. Journal of Applied Ecology, 42, 208-217.

PICKETT, S. T. A., CADENASSO, M. L., CHILDERS, D. L., MCDONNELL, M. J. & ZHOU, W. (2016), Evolution and future of urban ecological science: ecology in, of, and for the city. Ecosystem Health and Sustainability, 2, 7: e01229. doi:10.1002/ehs2.1229.

RAMETSTEINER, E., PÜLZL, H., ALKAN-OLSSON, J. & FREDERIKSEN, P. (2011), Sustainability indicator development – Science or political negotiation? Ecological Indicators, 11, 61-70.

SAYER, J., SUNDERLAND, T., GHAZOUL, J., PFUND, J-L., SHEIL, D., MEIJAARD, E., VENTER, M., BOEDHIHARTONO, A. K., DAY, M., GARCIA, C., VAN OOSTEN, C. & BUCK, L. E. (2012), Ten principles for a landscape approach to reconciling agriculture, conservation, and other competing land uses. PNAS, 110, 21: 8349-8356. doi:10.1073/pnas.1210595110.

SPIELHOFER, R., REBSAMEN, J., VOLLMER, M., FABRIKANT, S., GRÊT-REGAMEY, A. & WISSEN HAYEK, U. (2017), 3D Point Clouds for Representing Landscape Change. Journal of Digital Landscape Architecture, 2-2017. doi:10.14627/537629021.

STEINITZ, C. (2012), A Framework for Geodesign: Changing Geography by Design. Esri Press, Redlands, CA.

STEINITZ, C. (2014), On teaching ecological principles to designers. The Ecological Design and Planning Reader. Springer.

VAYENA, E, SALATHÉ, M, MADOFF, L. C. & BROWNSTEIN, J. S. (2015), Ethical Challenges of Big Data in Public Health. PLoS Comput Biol, 11 (2), e1003904. doi:10.1371/journal.pcbi.1003904.

WISSEN HAYEK, U., VON WIRTH, T., NEUENSCHWANDER, N. & GRÊT-REGAMEY, A. (2016), Organizing and facilitating Geodesign processes: Integrating tools into collaborative design processes for urban transformation. Landscape and Urban Planning, 156, 59-70.

WISSEN HAYEK, U., EFTHYMIOU, D., FAROOQ, B., VON WIRTH, T., TEICH, M., NEUENSCHWANDER, N. & GRÊT-RÊGAMEY, A. (2015), Quality of urban patterns: Spatially explicit evidence for multiple scales. Landscape and Urban Planning, 142, 47-62.