Chapter 21
Geodesign in Practice: What About the Urban Designers?

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21.1 Introduction

> He [the architect-urbanist] is a participant just like the others (…) More important and better than what you are proposing is to stimulate the imagination of the participants in the team. (Cornelis van Eesteren in a letter to Jaap Bakema 1957, translated from Van Rossem 1993, p. 9).
> Design is a discipline and process where people deliberately create. Design is about purpose and intentions; it's about seeing in our mind's eye what could be, then creating it. (Dangermond 2010, p. 507).

It is often remarked that the burgeoning concept of Geodesign has great potential for all disciplines engaged in changing the future of places (e.g. Flaxman 2010; McElvaney 2012). Through better visualizations, simulations and impact analysis, the planning of cities and regions could be improved, both in terms of process (e.g. increased participation) and outcomes (e.g. more sustainable solutions). What makes the concept of Geodesign unique is that it explicitly attempts to combine design and analytic disciplines. As Zwick (2010, p. 20) remarks about Geodesign: 'it must integrate the design professions with other disciplines—ecology, geography and other earth sciences, real estate and the social sciences'. As a working definition, we conceive Geodesign in this paper as: an approach to visioning, planning or policymaking in which insights and ways of working from a design and analytical perspective are integrated, often supported by dedicated geo-information tool.

This integration is far from an easy task, since some fundamental differences exist between these disciplines. Typically, design disciplines—in this regard urban design and landscape architecture in particular—focus on 'intent or purpose, the

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creation of something better, beautiful, or both' (McElvaney 2012). For analytical disciplines, like environmental science, geography, real estate, transport planning, etc., the core aim is to understand and describe how a certain object (in this case spatial phenomena) works. This could refer to the situation at a certain moment in time, the future situation, or the situation after an intervention—the impact (Steinitz 1990; cf. Rydin 2007).

Hence, it is not surprising that differences exist between the professional conduct of the design and analytical disciplines. Moreover, the usage of tools is quite different; whereas for a transport analyst a traffic model is critical in assessing obstacles and identifying solutions, urban designers rely much more on paper, pens and visualization software like AutoCad. Geodesign holds the potential to integrate these two worlds by offering a common professional language, since it allows the iterative combination of sketching and drawing with, often quantitative, analysis.

However, similar to the implementation of Decision Support Systems (DSS) and Planning Support Systems (PSS), usage of new tools in practice tends to be problematic and several barriers and bottlenecks have to be overcome (Vonk et al. 2005). In this contribution we try to improve our understanding of the barriers for urban designers to apply Geodesign in practice. Since 'understanding a problem is only halfway to solving it' (Van Aken 2004, p. 20), we propose a set of solutions to overcome the identified barriers. The paper is structured as follows. First, we give some more insight into the difference between design and analytical disciplines. Second, we describe the results our empirical material to study this issue: an experiment with students and interviews with practitioners. We identify four main barriers for urban designers. Subsequently, we provide tentative solutions for these barriers. The paper closes with some conclusions, reflections and suggestions about the direction of future research.

21.2 Barriers for Urban Designers

21.2.1 Analytical and Design Frames

There is no straightforward definition of urban design. As Rowley (1994, p. 179) notes: 'having a name for something does not necessarily mean that we understand what it is! (…) Urban design is, surely, a case in point'. Nonetheless, some relevant differences between urban designers and more analytically inclined stakeholders can be observed. Carton (2007) studied the framing of maps by different stakeholders in planning processes. Frames are 'schemata of interpretation' (Goffman 1974) steering the way in which planning actors perceive problems and solutions, and fulfill their tasks. Carton finds that, typically, there are actors with a design frame for whom a map is a design tool, perhaps comparable to the brush and canvas of a painter. On the other hand, there are actors with an analytical frame, for whom a map is a research device. Geodesign aims to support actors with both a design and an analytical frame through GIS-based tools.

Whereas the development of tools to support Geodesign has taken off and its conceptual basis is quite sound, empirical research into its application in practice is still limited. This paper aims to fill this lacuna by making use of two types of research: a structured experiment and semi-structured interviews. The experiment is *control rich*, allowing us to make relatively robust claims about the usage of a GIS-based tool in Geodesign applications, because we can control for variation not related to the tool usage (e.g. a different set-up of the workshop). Since these experiments are conducted with students, they provide little insight in the planning context. Therefore we also conducted complementary semi-structured interviews. These are *context rich*, which make it difficult to measure mechanisms and claims systematically, but provides a way to get in-depth understanding of the praxis of urban design in relation to GIS-based tools and to allow us to understand the barriers and potentials for Geodesign in practice. Whereas the experiment and the semi-structured interviews deal with different tools, what they have in common is that a GIS-based tool is applied in situations where urban design plays a critical role.

21.2.2 An Experiment

We set up an experiment with 55 students (more detailed description in te Brömmelstroet 2013a). The students were selected from three different undergraduate studies; spatial planning, environmental engineering (both second year, Saxion University of Applied Science) and transport engineering (first year, Windesheim University of Applied Science). They were invited to take part in a design competition, organized by TNO, Utrecht University and the University of Amsterdam. Beforehand, we randomly divided them into six groups. In each group there were three to four transport planners, two to three environmental engineers and six spatial planners. To avoid the risk that the six spatial planners would dominate the groups, they were (randomly) divided into urban designers and project economists.

Two weeks before the design competition, each student received a set of information that contained:

- A predefined plan for an urban infill area in the Rotterdam harbor (Fig. 21.1). A map showed the initial planned locations of housing, offices and leisure activities in the area and the accompanying text explaining what ambitions Rotterdam has with this area to become attractive for creative companies and urban families.
- Depending on their role, a text and maps explaining the problems of the existing plan. The environmental engineers received maps of air pollution, external safety and noise nuisance; the transport engineers received maps of capacity problems on the internal and surrounding car network; the urban designers became aware of the notion that the current plan was not attractive and the project economists that the plan was not financially viable.
- The set-up and rules of the competition: 1 hour in which a new plan needs to be developed on paper and with accompanying text.
- Depending on their role, a specific target and possible interventions that can support this.

Fig. 21.1 Infill area in the old harbors of Rotterdam (*left*) and original design (*right*); *blue* = offices, *orange* = housing

Fig. 21.2 Physical set-up for groups: Table with maps and whiteboard to develop ideas (*left*) and interaction with the calculated effects through a surface table with a chauffeur (*right*)

The resulting plans would be reviewed by experts and for each distinct role a price would be rewarded for the best plan.

On May twenty-first 2013, the groups developed their plans. The six groups worked in turn, enabling us to observe every group. Each group received a short opening statement on the goal and set-up of the competition. Then, one of the authors served as mediator to guide the group through a number of design and analysis loops, which were meant to help them to understand the problem and develop solutions. The groups were first encouraged to develop concrete planning interventions. Hereby, they were supported by a large paper map of the plan area and a whiteboard (see Fig. 21.2). The solutions they developed were translated into the Urban Strategy tool (www.tno.nl/urbanstrategy). This state-of-the-art *Planning Support Tool* links fast computer modeling on a variety of urban dimensions to intuitive visualization of effects of a planning intervention on for instance traffic flows and noise pollution (Dias et al. 2013). It uses a surface table to communicate between the users and the models (see Fig. 21.2 right). By seeing the effects of their interventions, the groups could get a feeling about what works and what does not. Subsequently, they could discuss further improvements. Ten minutes before the end, the groups were urged to draft their final plan and write their accompanying text.

After the session the students had to fill out an extensive survey. Among other things, they were asked to give their opinion on statements that addressed multiple characteristics of Urban Strategy (based on te Brömmelstroet 2010). The participants were asked to respond to each statement on a seven point Likert scale (1 = strongly disagree; 7 = strongly agree). Table 21.1 presents the average outcomes for each of the four roles and their standard deviations.

Looking at the outcomes in Table 21.1, four statements show significant differences between urban designers and the other roles (see also Fig. 21.3). For all other statements, no significant differences were recorded. The project economists score relatively low on all four significant statements. The urban designers seem content with the clarity of the output presented but seem much less satisfied with the fit of the tool with their role and the idea that the tool separates sense from nonsense. The transport engineers are positive about both this fit and the function of Urban Strategy to separate sense from non-sense.

It is an interesting finding that on all other statements, no significant differences could be found. This indicates that there seems to be an agreement across the roles about the general positive perception of usability of Urban Strategy. It also points to the limitations of our experimental setup. Increasing the sample by repeating the experiment could help us to assess if this agreement is indeed present or if it is an artifact of this sample. Also, it shows that although the control-rich environment and possible repetition of an experiment is powerful in terms of internal validity, it is severely limited in understanding the rich context of real world characteristics. The students have not yet been specializing in their roles and have not made a career in their own silo (with their own instruments). Moreover, the students with the role urban designer did not have a background in urban design, but spatial planning. Therefore, we cannot expect to replicate such important real world conditions in the experiment. To increase this external (or ecological) validity, it is necessary to triangulate an experiment with context rich methods. This is what we will discuss in the next section.

21.2.3 Interviews with Practitioners

In addition to the survey, 15 semi-structured interviews were conducted with people involved in spatial planning in the Netherlands. The purpose of the interviews was to further explore the issues designers face while using GIS-based tools. The interviewees had experience with GIS-based tools in a planning or design process and/or were active in practice as an urban designer. The quotes below are all translated from Dutch, whereby inevitably some of the nuances are lost[1]. Most of the interviewees emphasize that usage of (interactive) GIS by urban designers is problematic. As one interviewee noted:

> I had expected that urban designers would endorse it because they are designers and visually focused, but this has disappointed me. (…) whereas they could use geo-information really well to make designs more realistic and better. (Project Manager and GIS Specialist)

[1] A full list of quotes from the interviewees is available upon request.

Table 21.1 Results on the evaluation survey of urban strategy

Statements	Environmental engineers (N = 11)		Transport engineers (N = 20)		Urban designers (N = 12)		Project economist (N = 12)	
	Average	St. dev	Average	St. dev	Average	St. dev	Average	St. dev
Urban strategy is transparent	5.18	*0.751*	4.65	*0.813*	5.09	*0.831*	4.42	*1.24*
The communicative value of the output is high*	5.73	*0.467*	5.00	*0.918*	5.08	*0.900*	4.58	*1.084*
The output is clearly presented*	5.82	*0.603*	4.95	*1.191*	5.92	*0.793*	4.67	*0.888*
Urban strategy is user friendly	5.64	*0.924*	4.80	*1.005*	5.18	*0.603*	4.92	*0.900*
The output is credible	5.73	*0.905*	5.20	*0.834*	5.33	*1.303*	5.00	*0.739*
Urban strategy is comprehensive enough	4.36	*0.809*	4.85	*1.461*	4.75	*1.545*	4.92	*0.793*
The focus of urban strategy is good	4.90	*1.101*	5.35	*0.933*	5.25	*1.215*	4.67	*0.651*
The level of detail in the maps is sufficient	5.09	*1.578*	5.25	*1.682*	5.92	*0.996*	4.58	*1.881*
Urban strategy is easy to understand	5.64	*1.362*	5.65	*0.745*	5.83	*0.835*	4.92	*1.084*
The tool facilitated evaluating alternatives	5.64	*0.809*	5.35	*0.933*	5.33	*0.888*	4.83	*1.403*
The tool facilitated creating ideas	5.36	*1.027*	5.25	*0.967*	5.17	*1.115*	5.42	*0.515*
The tool facilitated sketching ideas	5.73	*0.786*	5.4	*0.754*	5.08	*1.311*	5.25	*0.866*
Urban strategy fits well in my role*	5.18	*0.751*	5.80	*0.894*	4.92	*1.443*	4.00	*1.595*
Urban strategy separated sense from nonsense*	4.36	*0.924*	5.37	*0.895*	4.75	*0.965*	4.58	*0.996*
Urban strategy limited our creativity	2.64	*1.433*	3.25	*1.773*	4.25	*1.603*	3.75	*1.485*
I understand what is (not) represented by the indicators	4.00	*1.414*	4.65	*1.089*	4.50	*0.972*	4.27	*1.104*
Urban strategy allowed us to do more in less time	5.91	*0.831*	5.45	*0.826*	5.58	*0.515*	5.08	*1.165*

*Dimensions marked with (*) reveal significant differences at a 0.05 level between the average from the role urban designer and one of the analytical roles

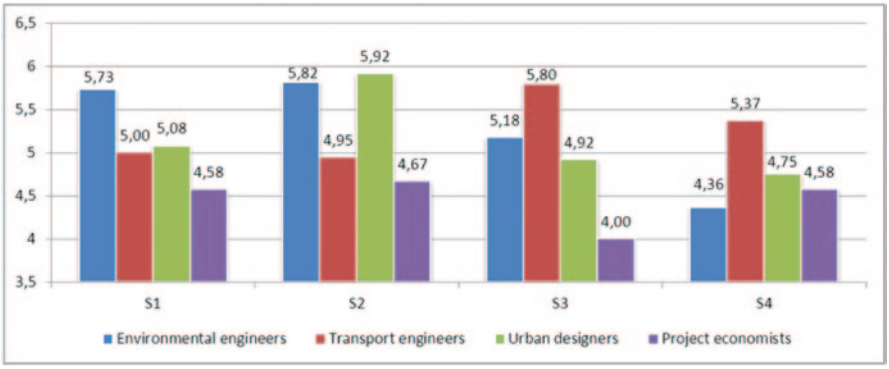

Fig. 21.3 Response to the four significant statements by student by role. The scores are the means per role (for the respective N's see Table 21.1). *Statement 1 (S1):* The communicative value of the output is high. *Statement 2 (S2):* The output is clearly presented. *Statement 3 (S3):* Urban Strategy fits well in my role. Statement 4 (S4): Urban Strategy separated sense from nonsense

The next section discusses four main barriers that came out in the interviews.

Not Everything that Counts can be Measured, and Not Everything that can be Measured Counts

An issue frequently mentioned is that geo-information tools have a bias towards specific themes. Environmental aspects—noise pollution, water quality, etc.—are much easier to model than an abstract and subjective concept like 'spatial quality'. The latter could involve the 'look and feel' of an area. As one urban designer remarks: 'For most urban designers feeling is critical—the atmosphere. How do I live somewhere? Images play a crucial role during the process.' These are aspects that are currently insufficiently covered when GIS is applied in design sessions. Hence, the first barrier:

→*Barrier 1: Unquantifiable aspects that are important for urban designers are currently insufficiently included in the application of GIS-based tools.*

Creativity Versus Analysis

A second barrier is that GIS-based tools are perceived to restrict creativity and freedom for urban designers[2]. This was indicated by the experiment results and supported in the interviews. An urban designer remarks:

[2] We are not providing a judgment as to whether or not this notion is true, since the famous Thomas-theorem states: 'If men define situations as real, they are real in their consequences'.

> From a design side, we're on a very abstract level, making sketches in which a meter does not matter so much. I do it roughly and find out later what the exact contours will be. But then [when using an interactive geo-information tool] there is a number that is very precise, with three decimal places. And that does not fit the idea that I have in my head. (…) I would prefer a rough sketch on the table. (Urban Designer with experience of using an interactive GIS-based tool).

He continues to remark about the dynamics of the design process:

> The role of the urban designer in the design process is to keep the flow. It works really well to fix specific points and leave others open. Later on, you can find a solution for these fixed points. You should not solve everything the moment you do something. It stops, it stands still. One wants to work from large to small, from principles to detail. (GIS Specialist)

Another interviewee, who had a fair bit of experience with applying map-based touch tables in planning situations, also emphasized the point of restricting creativity: 'I notice they [urban designers] find it much too realistic, I think they're afraid of it. They think it will restrict their creativity or it is too systematic' (Project Manager and GIS-specialist). The critical question is, of course, to what extent does a GIS-based tool *actually* restrict creativity, or is this only the perception? It is clear, however, that we need to better understand this notion.

→*Barrier 2: A GIS-based tool is perceived to restrict creativity.*

Fuzziness Versus Explicitness

Applying a GIS-based tool leads to an explicit representation of spatial phenomena. For instance, an area either has a leisure or a residential function; within models and tools, boundaries between functions tend to be hard–think of lines and polygons. Fuzziness, such as the blending of land uses, is more difficult to handle in a GIS. In the interviews, however, fuzziness was mentioned as an important aspect of urban design. Integral and explicit evaluation of the problems at hand is sometimes difficult to handle for an urban designer, particularly in the early stages:

> That's the risk of such a table [map-based touch table combined with an interactive GIS] – that one continuously sees everything. It becomes too integrative; it is no longer possible to arrive at one abstract system. One is forced to solve everything at once. (Urban Designer with experience with an interactive GIS-based tool).

A GIS specialist observes something similar:

> Urban designers are used to drawing and sketching rough lines on paper. And that is something that is difficult in a MapTable. One can draw a polygon but in the end you have to click with a mouse and indicate vertices. And then, after a short period of time, they [urban designers] tend to say: "I don't like this". (GIS Specialist)

In summary, the third barrier can be formulated as follows.

→*Barrier 3: Fuzziness is a virtue for urban design that is often not supported by GIS-based tools.*

Innovation Versus Habits

The fourth and final barrier has already been observed earlier in the GIS and PSS debate. New technologies are not easily accepted, since existing habits and perceptions are difficult to change (e.g. Vonk et al. 2005, 2007). This barrier is particularly relevant for the adoption of GIS-based tools by urban designers because it involves quite a radical shift in the way of working. A GIS specialist describes the struggle he has to get urban designers on board:

> We have a touch table, which we attempt to get urban designers to use, because one can use it with the fingers. But that is too much for them. They want to draw with a pen on the table. Although it is easier to draw with their fingers, they prefer a pen because that is what they are used to. I'm always struggling with the question: should I facilitate what they are used to? Or is it better to say: it's a whole new world, we're going to try something different now? Often I start with what they are used to and then say: "we're doing it like this now, but let's try something different". It is easier to get them on board when you give them a handhold. And for them [urban designers] that handhold is, literally, a pen. (GIS-specialist)

Hence, the fourth barrier can be formulated as:

→*Barrier 4: It is difficult to break with old habits.*

21.3 Solutions to Overcome the Barriers

Based on insights from existing literature, our experiment, the interviews and hands-on involvement with applications of GIS-based tools in practice, we have developed some tentative directions for finding a solution. There are two distinct directions for finding improvement: one is by adapting the *tool* and one is by adapting the *process*.

21.3.1 →Barrier 1: Not All Dimensions that are Important for Urban Designers are Currently Included in GIS-based Tools

In terms of improving tools, this is arguably one of the most challenging issues. Some spatial phenomena (e.g. 'spatial quality') are hard to capture in a GIS or a quantitative model. It is likely that the solution lies in clever combinations with other types of visualizations, such as images and 3D visualizations or quotes from inhabitants. Some interesting examples of this can be found in Geertman and Stillwell (2009) (in particular: the mapping of landscape values by Carver et al. 2009; gathering localized knowledge through 'Soft GIS' by Kahila and Kyttä 2009; and making use of a 'Virtual Landscape Theater' by Miller et al. 2009).

The process approach to overcome this barrier lies in ensuring that there is sufficient time, resources and attention for aspects that cannot be included in a GIS-based tool. What should be prevented is that GIS becomes 'performative' and

that stakeholders start to be dependent on the tool instead of vice versa (Smith et al. 2013). Just as a model specialist or a GIS specialist should be trusted with preparing the tool, urban designers should be trusted as being intuitive and creative experts. In sum, applying a GIS-based tool successfully in Geodesign requires the very careful organization of workshops, dealing with different types of knowledge forms, for instance experiential and systematized knowledge (Healey 2007). The importance of careful knowledge management has also been emphasized by earlier work in the field of PSS (e.g. te Brömmelstroet 2010).

21.3.2 →Barrier 2: A Geo-information Tool Restricts Creativity

The rising use of map-based touch tables in combination with GIS makes it easier to support sessions in which creativity and analysis are combined. However, even when using user-friendly software like SketchUp and Sketchbook Pro, the freedom of a paper and pens is unrivaled. Two solutions could work. First: combining paper maps with a GIS-based tool—something we did in the experiment. Hereby, the intuitive process of drawing with pens and paper is still possible. The problem however is combining the paper drawings quickly and efficiently with a GIS. This is almost impossible in a workshop and could lead to a loss of momentum and a loss of detail in the translation process. The second solution is something to be done much later in time: in the future software and hardware will more than likely become even more user friendly and intuitive.

One of the strengths of urban designers is that they are able to ignite a creative process in which a plan is developed. This virtue should be captured by Geodesign. Key to this is to continuously emphasize that tools are *supporting* the process; they are a part of it, but they do not *steer* it. It's the people that analyze, develop ideas and sketch, not the tool!

21.3.3 →Barrier 3: Fuzziness is a Virtue for Urban Design

Related to overcoming the barrier of creativity is the barrier of too much precision and systematized information. An urban designer has an idea for a tool that fits their demands:

> What if we were to have a table [a map-based touch table] with lines that are thick and flexible? Lines that one could dent and stretch. More like rubber than the 'hard' GIS. Because it takes so much time and consultation to draw lines. Because there is this little blue line in the soil and then it has to be next to that line otherwise it is in the water, etc. Whereas, actually, you would just need to 'go-go-go-go' to have a rough sketch and later on you put it in an AutoCad. I would not know how this should work exactly, but this is more from our [urban designers'] perspective. (Urban Designer with experience with an interactive GIS-based tool)

This idea relates to the more intuitive geo-design tools identified for the previous barrier. The idea of 'rubber' lines is interesting and innovative and deserves further attention in the future.

As important as a tool that appreciates fuzziness, is a process which is open to it. One of the key elements is not to start too early with complicated and integral calculations. Whereas these are necessary in developing a plan—and inevitably have to be conducted somewhere in the process—it should be very carefully decided *when* in the process these are conducted. To an important extent this depends on the urban designer (To what extent is he/she able to deal with complicated calculations?) and the planning issue (Are there strict financial or environmental restrictions for the urban designer?). Also, when detailed calculations are needed later on in the planning process, this should be acknowledged from the start (Mouter and Pelzer 2013).

21.3.4 →Barrier 4: It is Difficult to Break with Old Habits

The fourth and final barrier is arguably the most persistent but it has one big ally: time. The future generation of urban designers is now using tablets, smartphones and Google maps. The step towards GIS-based tools will in the future arguably be much smaller. However, to enhance the integration of Geodesign and urban designers, it would be relevant to pay attention to the framing of a tool. GIS-based tools are often perceived to belong to GIS specialists or environmental analysts. A concrete intervention to overcome this is to use map-based touch tables to discuss sketches and images (for instance scans of drawings on paper or 3D visualizations). In the next stage, this table could be used for more advanced applications of Geodesign (see Pelzer et al. 2013, for an example) (Fig. 21.4).

From a process perspective, it is important to see a Geodesign application as a collective learning experience. The technology, models, indicators, topics, and other disciplines are being interactively explored and by actively linking them, new and shared knowledge is created. This takes time and some of the benefits are likely to be more visible in the long run. It is very important for all actors, including urban designers, to acknowledge this. A spatial planner looks back on the sessions with a GIS-based tool in which he was involved.

> For me it was a very instructive experience because I was forced into seeing a very different approach. What I found very funny about the sessions we had around the table (map-based touch table) with urban designers was that we had to get used to each other.

Truly fundamental shifts in the ways of working and using tools could only occur, however, if urban designers endorse *and* communicate the potential of Geodesign.

21.4 Conclusion

This paper addressed a critical issue for the future of Geodesign: the persistent disconnection between the potential of Geodesign and the usage of GIS-based tools in practice. Although this will in part be solved by time and technological developments, we also observed some fundamental dilemmas. Our tentative solutions

Fig. 21.4 Application of a map-based touch table in the Province of Utrecht, the Netherlands

for the identified barriers are not written in stone. We identified them to ignite the discussion about the implementation of Geodesign. As in the strongly related field of PSS, it is critical for the future of Geodesign to pay attention to user perspectives (for relevant discussions on PSS see Geertman 2008; te Brömmelstroet 2013b). 'Users' should be defined broadly, including GIS specialists and model developers, but also urban designers and policy advisors. More research into this aspect would also enhance our understanding of the relation between urban designers and Geodesign. The findings from this paper should be tested in more detail and in other contexts. Particularly the quantitative findings from the experiments are indicative, and require more empirical research. Hereby, it would be very relevant to test the extent to which recently developed and more intuitive GIS-based tools overcome the barriers outlined above (for a relevant early attempt see Dias et al. 2013; cf. te Brömmelstroet 2014).

Moreover, another factor that deserves further scrutiny is a holistic perspective of the users involved in Geodesign. In this paper we primarily focused on disciplinary background. The psychological background of the users is, however, also very relevant. Several interviewees indicated that to get people to be willing to use GIS-based tools, character (personality, emotions, etc.) is pivotal. People that are open, assertive and able and willing to think out-of-the-box are more likely to adopt new technology. Moreover, age also seems to be a factor. Younger people tend to have more experience with digital tools and are less used to old ways of working. Further research could provide more in-depth insight into this issue.

We will end this paper with the two persons from the introduction. Cornelis van Eesteren is arguably the most famous urbanist in Dutch history. His 'General Extension Plan for Amsterdam' from 1934 is still being used in 2013 by the Municipality of Amsterdam. Jack Dangermond founded ESRI and is now one of the strongest proponents of Geodesign. What do these two have in common? They both realize that developing a plan for the future requires creativity and collaborative imagination *combined with* analysis.

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