Geodesign Meets Its Institutional Design in the Cybernetic Loop

Tijana Dabović
University of Belgrade, Faculty of Geography, Belgrade/Serbia · tdabovic@gef.bg.ac.rs

Abstract: The paper offers a general overview of the possibilities and challenges of geodesign institutionalisation, i. e. its embedment into concomitant planning systems. The aim is to explore and suggest new areas of research regarding the institutional dimension of geodesign which could complement and enhance the rapidly developing research in its procedural dimension. Perceived as complementary to geodesign's purpose, the cybernetic loop is used as a conceptual framework for the study. It implies organisation, interaction and co-evolution between the system with a set goal and its environment. The context of the study, the main terms and their interrelation are explained based on a literature review. geodesign institutionalisation in the cybernetic loop is sketched and used for identifying the elements of institutional design required for better informed and more collaborative process, but also more feasible geodesign studies. STEINITZ'S (2012) Geodesign Framework and BOOHER & INES'S (2002) network power model are interrelated and proposed for securing a more systematic approach to this endeavour. Due to the complexity and novelty of geodesign's institutional dimension, along with conclusions, the lines of further research are proposed as well.

Keywords: Geodesign, cybernetic loop, planning system, institutional design, computing.

1 Introduction

Geodesign can be defined as a human activity of designing geographic space by assessing and changing its existing conditions so that it can accommodate an improved human life. In turn, geographic conditions changed by humans or nature change human lives and are subsequently assessed and changed. Perceived as such, geodesign implies a continuous interaction and co-evolution between humans, their needs and goals, as well as their environment. It is an inherent part of human existence and its development. As a discipline which combines design and planning, environmental and social sciences with geographic information systems, geodesign can be traced back to the first decade of the 21st century (BATTY 2013, [1]). It is usually associated with integrated land use planning, where science, system thinking and value-based spatio-temporal contexts can be interrelated. As a mechanism, geodesign performs as a collaborative platform for integrated spatial guidance and expression of policy areas and disciplines (e. g. agriculture, infrastructure, industry, commerce and residence) crucial in meeting community's goals, which may include the mitigation of environmental hazards or population influx, resource management, CO_2 emission reduction, and sequestration management etc. (STEINITZ 2012, [2]).

Due to recognised benefits, coupled with many reliable, openly available and/or affordable didactic resources, the number of its advocates in academic and professional circles is increasing. As a consequence, geodesign is used as an educational, research and technical tool (STEINITZ 2012, GOODCHILD 2010, PARADIS et al. 2013, [3]). The fundamental regard and intertwining of the Sustainable Development Goals with geodesign studies as the main aspiration of the 2020 International geodesign Collaboration [4] will most probably enhance its global outreach.

Journal of Digital Landscape Architecture, 5-2020, pp. 486-496. © Wichmann Verlag, VDE VERLAG GMBH · Berlin · Offenbach. ISBN 978-3-87907-690-1, ISSN 2367-4253, e-ISSN 2511-624X, doi:10.14627/537690050.

So far, the research efforts of geodesign as a discipline have mostly been invested in "supporting 'human in the loop' design" (FLAXMAN 2010, 29). This is its procedural dimension. However, both planning and design are institutionalised goal-, decision- and action-oriented activities (HEALEY et al. 1982, ALEXANDER 2007). Prerequisites for the geodesign process, as a collaborative and integrated land use planning towards achieving some community goals, are an improved organisation, operation, performance and interaction among many institutions and stakeholders. The paper focuses on supporting geodesign's institutional dimension by using the cybernetic loop as a conceptual framework for the research.

Namely, the cybernetic loop implies circular causal and feedback processes between a system and its environment. The system with set goals acquires and assesses the information about the environmental conditions and reacts towards the accomplishment of the goal ([5]). In this regard, geodesign's main purpose and the main principles of the cybernetic loop are compatible. In this paper, the cybernetic loop is used as a conceptual framework for exploring the potential of organising a better informed and more collaborative geodesign process, as well as more practicable geodesign studies. To this end, a literature review was performed and the cybernetic loop was applied and analyzed in the conceptual institutionalisation of geodesign. The results contribute to and promote the expansion of the field of research in geodesign to include pro-active approaches to the institutional dimension of collaborative planning. The paper also promotes the need for constant co-evolution of the institutional and procedural dimensions of geodesign. The language and the logic used are mostly derived from the author's previous research in planning theory and systems of land use planning in Europe (ДАБОВИЋ 2017, DABOVIĆ et al. 2020).

2 Literature Review

Literature review was guided by the conceptual framework of the cybernetic loop and its application to geodesign's institutionalisation. It was used to set the contextual background and explain and interrelate the main terms and contributions. The initial selection of publications was made by searching for the combination of the following keywords: cybernetics, cybernetic loop, planning, design, geodesign, planning system, institutional design, collaborative planning in the Web of Science and Google Scholar. The results were refined by reading the abstracts of identified publications to assess their relevance for the research and by analysing the number and relevance of quotations. Subsequently, a quality and eligibility evaluation was conducted by analysing the full texts. Lists of references in the retrieved publications were also analysed and new sources were identified, evaluated and selected. The literature covered cybernetics, planning, design, geodesign, social and political sciences domains. In addition, similar method was used to identify, select and review relevant internet sources.

2.1 Cybernetic Loop

As an integral part of systems science, cybernetics implies the science of efficient governing.[1] It is focused on control and communication in artificial, engineered, as well as evolving sys-

[1] Greek word κυβερνητική means "governance" and is associated to kybernáō i. e. "to steer, navigate, govern" (https://en.wikipedia.org/wiki/Cybernetics).

tems (e. g. nervous, psychological, biological and social systems). Basically, it explores the abstract principles, but also concrete ways in which information, models, and actions are used to steer the system towards goals, while counteracting various disturbances from its environment (WIENER 1948, HEYLIGHEN & JOSLYN 2001, DUBBERLY & PANGARO 2007, [5]). Consequently, it has been mostly cultivated in engineering, neuroscience, psychology, biology and sociology. The famous cybernetician VON FOERSTER (2003) believed that computation is one of the essential principles of cybernetics. Computation as a mechanism or an ordering "algorithm" implies the way in which systems interact with their environment. These interactions mean that systems can develop languages which "fit" their environment better; they may change their environment until it "fits" their constitution or the desired state; and, they may do both (VON FOERSTER 2003, 197). VON FOERSTER (2003, 303) also made a distinction between first-order cybernetics (the cybernetics of observed systems) and second-order cybernetics (the cybernetics of observing systems).

The cybernetic loop in particular implies circular causal and feedback interaction between a system and its environment (Figure 1). The system consists of three elements: sensor, comparator and actuator and has a goal or desired state of its environment. The action by the system is generated when the sensor detects a change in the environment and sends it as information to the comparator. In case the comparator computes this input as an error, i. e. the deviation from the desired state, the action is computed and sent to the actuator. The actuator acts towards correcting the "error" in the environment. Apart from the system, the environment can be changed by disturbances. All changes in the environment are reflected in the sensor, starting a new loop and triggering the system to change. The ability to adapt to environmental change, therefore, secures the system's resilience (WIENER 1948, VON FOERSTER 2003, DUBBERLY & PANGARO 2007, HEYLIGHEN & JOSLYN 2001, [5]).

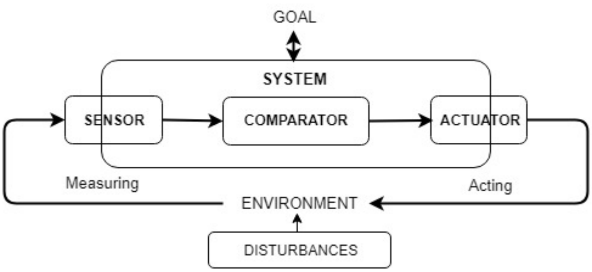

Fig. 1: Cybernetic Loop

2.2 Geodesign

Geodesign is "a design and planning method which tightly couples the creation of design proposals with impact simulations informed by geographic context" (FLAXMAN 2010, 29). The portion of geography involved in the geodesign process is usually, or will be, culturally produced by a community, i. e. it is differently perceived (mental and lately also digital), conceived and constructed (social) and lived (physical) space. As such, it entails different knowledge, perspectives and values pertaining to community's goals and needs (MILLER 2012, DAVOUDI & STRANGE 2009). In this regard, geodesign offers an adaptive framework and workflow for better informed and more collaborative decision-making seeking to "change geography by design" (FLAXMAN 2010, STEINITZ 2012). In particular, STEINITZ'S geodesign Framework (GDF) (2012) relies on three iterations along six models (representation, process, evaluation, change, impact and the decision model) and along three types of questions: why we are doing the study; how the study will be performed; and what, where and when the actions in "geography" should occur towards "its change" (STEINITZ 2012). When these questions are answered and decisions taken, geodesign as a verb will become geodesign as a noun and a process of changing the geography will start. As already mentioned, these changes in turn have a subsequent impact and change the community itself, initiating a new (loop of) geodesign process.

Based on the literature and a review of internet resources (LEE et al. 2014, GU et al. 2018, CAMPAGNA et al. 2018, PETTIT et al. 2019, [2], [3], [6], [7]), geodesign is gaining prominence in academic and professional circles worldwide. Research and networking are mostly based on the efforts to improve its procedural dimension, although few significant contributions related to its institutional dimension have been presented recently (see CAMPAGNA et al. 2018, PETTIT et al. 2019).

2.3 Institutionalisation within Planning Systems

Compared to its procedural dimension, the institutional dimension, i. e. the planning system and its institutions, is a still generally neglected field of research in planning theory. The knowledge base of institutional design in particular is eclectic and largely preliminary due to situation-specific problems and the lack of systematic research (ALEXANDER 2007, VERMA 2007, JANIN RIVOLIN 2012).[2] As already noted, similar circumstances exist in geodesign as a discipline.

Planning system is an inherent part of governance (VERMA 2007, SERVILLO & VAN DEN BROECK 2012, REIMER et al. 2014). Both can be placed within "geography" as their environment if "geography" is defined as a dynamic, complex, networked system that supports or inhibits life. It is differently perceived and lived by individuals and groups, yet it should be also socially conceived, i. e. the basic understanding and shared assumptions about it are jointly constructed (MILLER 2012, DAVOUDI & STRANGE 2009, PETTIT et al. 2019, LEEDS-HURWITZ 2009).

Governance implies a networked system of governing processes which should make it possible to assess, respond to, anticipate and undertake changes in geography. These processes can be performed by stakeholders such as government, market, or groups through policies, laws, norms, power or language (BEVIR 2012, JESSOP 2016, PETERS 2012). The latter present established and prevalent social rules of interactions between stakeholders. These interactions should make expectations more reliable and the system more resilient (VERMA 2007). Under a cybernetic lens, the term "institutions" cannot be reduced merely to formal agencies. Instead, institutions are computing apparatuses and they include both formal and informal stakeholders and rules of interactions they are engaged in.

Within governance, planning systems are responsible for assigning rights to land use and spatial development so that the general societal (e. g. sustainable development) or particular

[2] Scholarly contributions on planning systems can mostly be found in Europe as a result of the EU integration process (REIMER et al. 2014, JANNIN RIVOLIN 2017). In the USA, some authors explain that the lack of efforts and contributions are the consequence of the general notion that the existence of a planning system is impossible (CULLINGWORTH 1994).

community's goals (e. g. resource management) are accommodated in a concomitant spatio-temporal context. Relevant stakeholders in planning mostly include government agencies, political, professional, disciplinary, non-governmental groups, as well as those related to spatial issues, private actors and citizens. They are engaged in internal (among them) as well as in external interactions (towards governance and geography). These interactions imply policies, laws, norms, regulations, practices, communication, monitoring, spatial interventions, organisational structures. They should ensure coordination, conflict resolution and assigning of responsibilities and tasks among stakeholders (HODGSON 2006, VERMA 2007, ALEXANDER 2007, JANIN RIVOLIN 2017).

Although decelerated by path-dependency, cultural embeddedness and inertia (REIMER et al. 2014), planning systems change. These changes are determined by diverse and interconnected technical, cognitive, socio-political and discursive capacities and the competition of relevant stakeholders. Changes in relevant stakeholders, their positions and practices can raise the prominence of the new ways of solving problems and creating new possibilities in governance and geography. These can result from the practices of influential groups, the maintenance or reform of a planning system, generational shifts or the rise of a critical mass of counter-hegemonic groups etc. (SERVILLO & VAN DEN BROECK 2012 based on JESSOP 2001, BUITELAAR et al. 2007). If considered socially successful, new practices usually result in institutionalisation. Institutionalisation refers to the process of embedding something (e. g. a concept or workflow) within an organization, social system, or society as a whole (SERVILLO & VAN DEN BROECK 2012).

The institutionalisation of geodesign requires an institutional approach to collaborative planning, such as the network power model proposed by BOOHER & INNES (2002). Network power emerges when diverse stakeholders focus on mutual and common goals and develop shared meanings and common heuristics to guide their particular, contained actions. These are self-organizing collaborative networks which have a substantial collective intelligence and power of action and transaction (BOOHER & INNES 2002).

According to BOOHER & INNES (2002), three conditions govern the interactions among stakeholders: diversity, interdependence and authentic dialogue. The *diversity* of stakeholders enables a more encompassing insight into information, interests and capacities relevant to the issues at hand. It fosters innovative thinking and co-evolution of stakeholders, but it also makes the devising of the inter-organisation rules more difficult. *Interdependence* exists when stakeholders realise that their ability to fulfil their interests depends on each other's actions, when they have something to offer that others want and something they want from the others. It becomes especially important when there are actions which are too complex for one stakeholder to complete on its own. Authentic dialogue means that the information and communication transmissions through the network are both accurate and trusted by stakeholders so they can come to understand, cultivate and create their interdependence. Stakeholders are open to jointly construct a way of seeing the problem instead of speaking in different languages within different frames of reference. They can agree on the problem's characteristics and dimensions and assess the implications for them individually and as a network. In this way, they socially conceive an understand problems relying on a common system of shared perspectives, norms and heuristics (BOOHER & INNES 2002, ALEXANDER 2007).

2.4 Cybernetic Loops in Governance, Planning, Design and Geodesign

Although interactions between a system and its environment have been considered previously, the solid positioning of cybernetics in academic circles happened during the 1950s. Works of WIENER (1948), ASHBY (1956) and VON FOERSTER (1952), as well as cross-disciplinary debates organised at MACY Conferences have significantly contributed to this. Following the subsequent evolution of cybernetics and the system theory, their explanatory potential has been fertilised in governance, planning and design. At first, it was used in developing system approaches to government, urban and regional planning in the 1960s and early 1970s (e. g. CHADWICK 1971). In the following decades, some of its principles were used in the planning literature to explain the strategic approach, the context of "information age" and "network society" and for fertilising communicative and complexity theory in planning (e. g. FRIEND & HICKLING 1987, BRYSON & CROSBY 1993, ALBRECHTS & MANDELBAUM 2007, DE ROO & HILLIER 2016).

In some individual contributions, the "cybernetic loop" was directly recognised as an appropriate explanatory principle for different conceptual and practical aspects of planning and design (FALUDI 1973, SCHÖNWANDT 2008, ERVIN 2016, GLANVILLE 2007, DUBBERLY & PANGARO 2009). Most of these efforts highlighted the aspects of guidance, control and communication. The loop also served to emphasize the structure – think, decide, act, evaluate and think again/learn – in order to converge on a goal by creating prototypes of increasing reliability (GLANVILLE 2007). Also, the importance of communication flows and use of system language for conveying, understanding instructions and converging on agreement in order to act was stressed (DUBBERLY & PANGARO 2009).

Based on the literature review conducted in this research, the cybernetic loop was not used as a conceptual framework for geodesign's institutionalisation before, although it seems appropriate.

3 Cybernetic Loop of Geodesign's Institutionalisation

The standard conceptual translation of the geodesign study into the cybernetic loop would imply the following process. The geodesign team, together with other stakeholders, uses the collected data and information to detect any discrepancy between the current and desired state. If there is a discrepancy, six models related to those types of land use upon which achieving the desired state significantly depends (e. g. agriculture, different types of infrastructure, industry and distribution, residential, institutional uses etc) will be collaboratively computed. In the first two iterations, models are a "language" that fits the geography better. In the third iteration, proposals on how to change it to better "fit" the desired state are collaboratively defined. Hence, geodesign as a system has responded in an attempt to guide and control the geography.

The scheme of geodesign institutionalisation in the cybernetic loop based on previous findings indicates more complex issues that should be addressed. First of all, Figure 2 shows that geodesign's environment is not only "geography", but also the planning system and consequently governance. In this case, the goal is to secure better informed, more collaborative and feasible geodesign studies. Hence, the missing geodesign institutionalisation can be identified in three important partially overlapping external and internal interactions of relevant stakeholders, i. e. external and internal institutional design. The first implies interactions among stakeholders that collect information about the environment (external 1). Namely, by perceiving, collecting and sharing data and information, these institutions influence the computation of models that are more fitting for the environment. The second involves institutional design towards better internal interactions among the geodesign team and relevant stakeholders during the geodesign process. These interactions should facilitate the computation of language, i. e. models, and the computation of actions required for its desired change. The third institutional design should make it possible to converge on an agreement and manage the interventions of stakeholders that imply guidance and control in the environment (external 2).

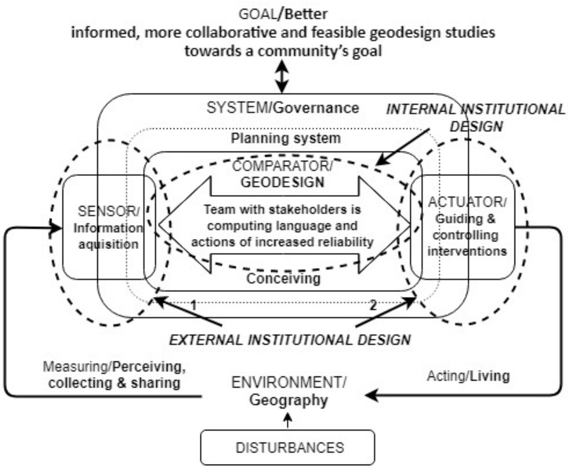

Fig 2:
The Cybernetic Loop of Geodesign's Institutionalisation

Even more so, the presented iterations and models of STEINITZ'S (2012) Geodesign Framework could be used for securing a more systematic approach to this endeavour. The first iteration would explain the context of the possible institutional settings for geodesign. The second iteration would identify the methods of modelling the institutional design. The third iteration would define what, where, when and by whom the interventions should occur. In each loop, they should compute language and actions of increased reliability as a consequence of constant learning and adaptation to geographical changes. All the models should be continuously intertwined with the geodesign process. Even more so, understanding the purpose of a particular geodesign study, i. e. certain community's goal (e. g. resource management or sustainable development), will not only enable defining the "portion of geography", but also the "portion of governance and planning system" which should be explored and improved by the geodesign's institutional design.

In this regard, in the representation model, the diversity of stakeholders (government agencies, private actors, political, professional, disciplinary, non-governmental networks, as well as those related to spatial issues) related to the types of land uses relevant for the community's goal and their capacities and interests would be explained. The process model would be used to explain their interdependence and interactions in relation to the models given in the geodesign study. The evaluation models of technical, cognitive, socio-political, and discursive capacities and main interests would be elaborated to identify which interactions are working well and which need to be changed. The change model would identify the required capacity development and possible creation of new or amendments of old stakeholders, rules, procedures, responsibilities, practices, discourses etc., which improve inter-organisation networks. The impact model would describe which resources (financial, temporal, educational, legal etc.) would be allocated and used for the proposed changes and which links would be weakened as a result. The decision model would enable a comparison between different scenarios of institutional design. Scenarios could be edited towards a jointly conceived solution. It would contain concrete instructions on how, where, when and by whom to improve geodesign institutional capacities, organisation and heuristics. This, in turn, would bring significant new insights to a particular geodesign process.

Conducting this kind of process depends on securing a more solid systematic knowledge base of institutional dimension in planning and geodesign. This is especially relevant in terms of developing concrete parameters of stakeholders' capacities and interests, indicators related to network power model as well as visual technology that would enable collaborative decision-making about institutional design. Moreover, some experimentation would require situation-specific analysis of path-dependencies, current performance and dynamics of planning system. As a result, the main factors of geodesign institutionalisation should be identified.

4 Concluding Remarks

Both planning and design are institutionalised goal-, decision- and action-oriented activities. The literature review had shown that in both disciplines the institutional dimension is insufficiently explored. Very complex social, political, economic and situation-specific institutional aspects have probably acted as a knowledge barrier. However, the growing importance and number of geodesign studies worldwide increases the significance of this type of research. This paper aims at expanding the research on geodesign institutionalisation by using the cybernetic loop as a conceptual framework. This has proved to be a satisfactory choice. The cybernetic loop has explained the system – environment interaction, purpose, operation, performance and organisation of institutions in the planning and governance system. It highlights the necessity of change and control, learning and adaptation in the system – environment interaction. The use of cybernetic loop on a general scale helps identify the nested position of the planning system in the governance system within geography as its environment. It also implies wider definitions of each of these terms. On this scale, geography includes everything that enables or inhibits life. Governance, the planning system and their institutions are not reduced to formal government and agencies. Instead, they include many different stakeholders, their mutual and interactions towards environment, capacities and interests.

Geodesign's institutionalisation implies its embedment in the planning system. The goal is to secure a better informed and more collaborative and feasible geodesign studies towards certain community's goals. Hence, it should be continuously consulting geodesign processes. Furthermore, STEINITZ'S Geodesign Framework (2012) and network power model by BOOHER & INES (2002) could enable a more systematic approach to creating new and/or amending old stakeholders and their interactions. Institutional design should develop inter-organisational networks of diverse, interdependent stakeholders that are engaged in an authentic dialogue. It should secure more accurate and trusted information production, communication flows, shared heuristics, agreements, accountability and management of actions and transactions. Institutions involved in geodesign should co-evolve and adapt to the environment in order to compute language and actions of increased reliability.

Finally, geodesign studies are expected to facilitate the process of assigning rights to land use towards better living conditions of a community. Towards this end, the geodesign process is dependent on improved organisation, operation and performance of many institutions. So far, institutional dimension is a missing part of geodesign's first-order cybernetics. Creating knowledge on how to fill this void could also be collaboratively designed and conceptualised as a networked research. Developing parameters of stakeholders' capacities and interests, indicators related to inter-organisational networks as well as visual technology that would enable collaborative decision-making about institutional design are crucial in this regard. Solid ground for further elaboration of the cybernetic approach to geodesign's institutionalisation can be found in the recognised importance of good organisation, collaboration, linguistics, learning and adaptation in the growing geodesign community.

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