Towards a Tighter Coupling of Visualization and Public Policy Making

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Abstract

The purpose of this ongoing work is to motivate public policy making as an application area for information visualization and visual analytics. Through our expertise gathered in several policy making-related projects, we identified parallels between the benefits of visualization and the needs of evidence-based public policy making. In the following, we will share our previous work consisting of the conceptual introduction of information visualization and visual analytics into the application field of public policy making. Moreover, we will show two real-world cases applying this concept. Finally, we will share identified challenges to be addressed by the information visualization and visual analytics domains in the future.

1 Motivation

Decision making in the field of public policy making is a complex task. To solve problems on the political agenda *policy makers* formulate, adopt and implement public policies (cf. the standard policy cycle in Figure 1). The impacts of a policy are evaluated after its implementation. Before policy makers put policies into practice, different influencing aspects based on economic, environmental and social determinants need to be considered. Due to this vast space of influencing factors policy makers need to estimate the impacts of several alternative solutions, called *policy options* during the policy formulation phase. The generation and evaluation of these policy options is conducted by *policy analysts*. They have to investigate policy options from an evidence-based, in-depth perspective. This policy analysis process can be supported by profound knowledge from experts in respective areas. In many cases they contribute computational models in order to estimate the impacts of policy options. For example, if a climate policy needs to be implemented, climate researchers should be consulted to make profound decisions. Policy analysts use the condensed analysis results of the *modeling experts* to generate policy options and communicate them to the policy maker. Finally, the policy maker puts a single policy into practice. The individual expertises of the three described stakeholders (policy maker, policy analyst and modeling experts) support evidence-based public policy making. However, the interaction between the different stakeholders plays a key role in the effectiveness and the efficiency of the decision making process. We identify information visualization and visual analytics technology as a beneficial means for the representation and communication of knowledge, possibly being based on different levels of abstraction. Moreover, these technologies may improve the development of so called science-policy interfaces.

First ideas for introducing visualization to the public policy making domain have been presented by Kohlhammer et al. [4]. Similarly, a variety of design studies showed that visual analytics can support domain experts in performing complex analysis tasks, and may also support policy analysts in decision making. In the research agenda of geovisual analytics for space-related decision making concepts and challenges similar to the ones stated in this ongoing work are discussed [1]. However, only few approaches where information visualization and visual analytics techniques were applied in the general policy making domain have been presented so far. The 'Vismon' approach serves as an inspiring example [2].

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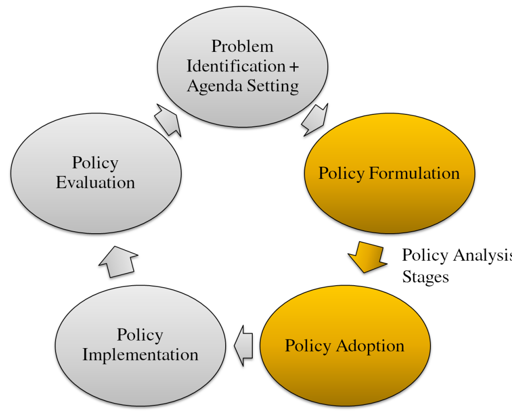

Figure 1: Standard Policy Cycle consisting of 5 steps. Policy analysis is mainly conducted in two stages: policy formulation (generating alternative solutions to given problem) and policy adoption (choosing one of the option to be implemented).

2 Previous Work

In this section, we will summarize our previous work that lead to the idea of this publication. It underlines the suitability of our long term approach and leads to the identification of future challenges.

2.1 Concept

The long term goal of our work is to present a concept for applying information visualization and visual analytics to the field of public policy making. In an initial version of this concept [6], we adapted the standard policy cycle (cf. Figure 1), and showed that information visualization and visual analytics can be applied to policy analysis taking place in the policy formulation stage of the cycle. We characterized three main stakeholders in the policy cycle: policy makers, policy analysts, and modeling experts, and identified knowledge gaps between these stakeholders, Finally, we motivated the introduction of information visualization and visual analytics into the process in order to bridge these gaps.

2.2 Case 1: Visual Access to Strategic Environmental Assessment

The introduced concept was instantiated in a real-world case in the field of regional energy planning [7]. In collaboration with modeling experts from the optimization field, we designed a system that allows policy makers to compute an optimal energy plan based on

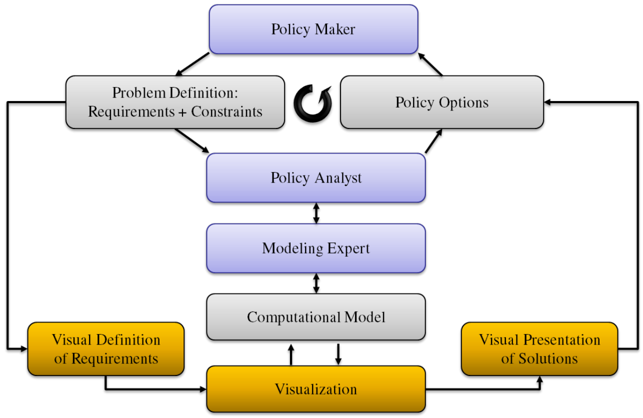

Figure 2: Visual support model for policy analysis. The upper part denotes the policy analysis process with its goal to generate alternative solutions (policy options) to a problem on the political agenda, and the selection of the most appropriate option. Visualization is introduced into the process in order to simplify and support the generation and analysis of policy options. Moreover, the transparency of the whole process is increased, if all stakeholders can access the same information

a specified target (e.g. minimize costs) and additional constraints (e.g. energy target). Besides the energy sources and the costs environmental impacts generated by the computed energy plan where considered. The visual interface enabled non-experts in optimization to a) visually define the optimization problem, b) compute and analyze the optimal solution to it, and c) compare multiple solutions with varying constraints and target functions. An evaluation of the system demonstrated its real-world usefulness and usability.

2.3 Case 2: Visual Access to Social Simulation

In a second real-world case, we showed the applicability of our concept in a collaboration with social scientists [8]. We introduced a visual interface to an agent-based simulation model. The goal of the approach was to evaluate the impact of different subsidy strategies on the public adoption of photovoltaic panels. Again through the visual interface a non-expert in simulation was enabled to a) visually define a simulation scenario, b) start a simulation and analyze the simulated public behavior, and c) compare multiple simulation runs originating from different policy scenarios.

3 Future Challenges

Adaptation of Design Study Methodology. In existing design study methodologies concrete guidelines for the design and implementation of visual analytics expert systems are provided, e.g. [9]. However, in contrast to these methodologies in the field of public policy making several stakeholders with different levels of expertise need to be included into the process. Moreover, public policy making is a very time-critical process, which provokes fast development cycles with short requirement analysis and evaluation stages. Hence, we identify a need for an adapted design study methodology for implementing visual analytics systems in order to support public policy making processes.

Acceleration of Evaluation Processes. As described above public policy making processes are time-critical. Hence, evaluation conducted with real users seems to be unrealistic. In order to provide useful and usable visual analytics solutions the current evaluation processes need to be accelerated. As an option, current usability heuristics may be adapted to the public policy making domain. Moreover, evaluation through user interaction logs should be supported. Additionally, we recommend the evaluation of generic visualization techniques with different user groups, including non-expert users, in order to provide guidelines for the design of easy-to-use visual analytics systems. (For example, we experienced that policy makers where already overwhelmed by simple scatter plots.)

Advancing Collaborative Visual Analytics. A further challenge regards collaborative visual analytics research. We highlighted the varying expertises of stakeholders in the public policy making process. This adds a third dimension to the characterization of collaborative visualization by Isenberg et al. [3]. Besides time (asynchronous vs. synchronous) and space (co-located vs. distributed) the level of expertise (expert vs. non-expert) should be added to the model in order to support the communication between scientists and policy makers.

Visual Analytics for Presentation. Besides exploration and analysis, presentation is an important stage of visualization research [5]. We support this view, especially for applications in the field of public policy making. Analytics process capturing methods can support policy analysts in the presentation of results to decision makers. Furthermore, research in visual analytics story telling can contribute to the dissemination of information and improve the transparency of the policy analysis process.

Device-Adaptive Interfaces. Finally, mobility plays in important role for policy makers. Access to information and analysis functionalities needs to be granted from different locations and devices. This poses challenges to visual analytics, since solutions need to be provided as web applications, and on mobiles with small screens. A possible solution for this would be to reduce analysis results to the most relevant information and provide simple infographics as output of the visual analytics process.

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See http://www.epolicy-project.eu/ for more details.

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